POWERFLEX 2200 C/F/S/D Handbook

Guided Radar (TDR) Level Transmitter for the nuclear industry

KROHNE

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1.1 Software history

"Firmware revision" agrees with NAMUR NE 53. It is a series of numbers used to record the revision status of embedded software (firmware) in electronic equipment assemblies. It gives data on the type of changes made and the effect that changes have on compatibility.

Data about software revisions is shown in menu 1.1.0 IDENT.. For more data, refer to *Function description* on page 70. If it is not possible to refer to the device menu, record the serial number of the device (given on the device nameplate) and speak to the supplier.

Release date	Printed circuit assembly	Firmware revision	Hardware revision	Changes and compatibility	Documentation
2016-05-30	Converter	1.08.04	4000342401	—	MA POWERFLEX 2200 R01 + R02 + R03
	Sensor	1.22.03	4000357001		
	HMI (LCD display option)	1.10.05	4000487601		

1.2 Intended use

CAUTION!
Responsibility for the use of the measuring devices with regard to suitability, intended use and corrosion resistance of the used materials against the measured fluid lies solely with the operator.

INFORMATION!
The manufacturer is not liable for any damage resulting from improper use or use for other than the intended purpose.

This TDR level transmitter measures distance, level, mass and volume of liquids.

It is for use in the nuclear industry and can be installed in spent fuel pools.

1.3 Certification

CE

In accordance with the commitment to customer service and safety, the device described in this document meets the following safety requirements:

- Electromagnetic Compatibility (EMC) Directive 2014/30/EU in conjunction with EN 61326-1 (2013).

All devices are based on the CE marking and meet the requirements of NAMUR Guideline NE 21, NE 43, NE 53 and NE 107.

1.4 Electromagnetic compatibility

The device design agrees with the Electromagnetic Compatibility (EMC) Directive and the related European Standard when installed in metallic tanks.

The device design agrees with tests done according to performance criteria "A" of International Standards IEC 61000 (Parts 4-2, 4-4, 4-5, 4-6, 4-8, 4-9, 4-10, 4-12, and 4-16), and CISPR 11.

You can install the device on open-air tanks and tanks that are not made of metal. Refer also to the note that follows.

CAUTION!
If you install a device with a rod or cable probe in a non-metallic tank or open-air pit, a strong electromagnetic field near to the device can have an unwanted effect on the accuracy. Use a device with a coaxial probe for this type of installation.

INFORMATION!
Device operation agrees with residential-class (class B) and industrial-class (class A) emissions. The device fulfils immunity requirements when it is installed in industrial areas.

The device agrees with these conditions if:

- *the device has a single or double probe (rod or cable probe) and is used in a closed tank made of metal or*
- *the device has a coaxial probe.*

1.5 Safety instructions from the manufacturer

1.5.1 Copyright and data protection

The contents of this document have been created with great care. Nevertheless, we provide no guarantee that the contents are correct, complete or up-to-date.

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1.5.2 Disclaimer

The manufacturer will not be liable for any damage of any kind by using its product, including, but not limited to direct, indirect or incidental and consequential damages.

This disclaimer does not apply in case the manufacturer has acted on purpose or with gross negligence. In the event any applicable law does not allow such limitations on implied warranties or the exclusion of limitation of certain damages, you may, if such law applies to you, not be subject to some or all of the above disclaimer, exclusions or limitations.

Any product purchased from the manufacturer is warranted in accordance with the relevant product documentation and our Terms and Conditions of Sale.

The manufacturer reserves the right to alter the content of its documents, including this disclaimer in any way, at any time, for any reason, without prior notification, and will not be liable in any way for possible consequences of such changes.

1.5.3 Product liability and warranty

The operator shall bear responsibility for the suitability of the device for the specific purpose. The manufacturer accepts no liability for the consequences of misuse by the operator. Improper installation or operation of the devices (systems) will cause the warranty to be void. The respective "Standard Terms and Conditions" which form the basis for the sales contract shall also apply.

1.5.4 Information concerning the documentation

To prevent any injury to the user or damage to the device it is essential that you read the information in this document and observe applicable national standards, safety requirements and accident prevention regulations.

If this document is not in your native language and if you have any problems understanding the text, we advise you to contact your local office for assistance. The manufacturer can not accept responsibility for any damage or injury caused by misunderstanding of the information in this document.

This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device. Special considerations and precautions are also described in the document, which appear in the form of icons as shown below.

1.5.5 Warnings and symbols used

Safety warnings are indicated by the following symbols.

DANGER!
This warning refers to the immediate danger when working with electricity.

DANGER!
This warning refers to the immediate danger of burns caused by heat or hot surfaces.

DANGER!
This warning refers to the immediate danger when using this device in a hazardous atmosphere.

DANGER!
These warnings must be observed without fail. Even partial disregard of this warning can lead to serious health problems and even death. There is also the risk of seriously damaging the device or parts of the operator's plant.

WARNING!
Disregarding this safety warning, even if only in part, poses the risk of serious health problems. There is also the risk of damaging the device or parts of the operator's plant.

CAUTION!
Disregarding these instructions can result in damage to the device or to parts of the operator's plant.

INFORMATION!
These instructions contain important information for the handling of the device.

LEGAL NOTICE!
This note contains information on statutory directives and standards.

- HANDLING
  This symbol designates all instructions for actions to be carried out by the operator in the specified sequence.

➲ RESULT
This symbol refers to all important consequences of the previous actions.

1.6 Safety instructions for the operator

WARNING!
In general, devices from the manufacturer may only be installed, commissioned, operated and maintained by properly trained and authorized personnel.
This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device.

2.1 Scope of delivery

INFORMATION!
Do a check of the packing list to make sure that you have all the elements given in the order.

POWERFLEX 2200 C – Compact version

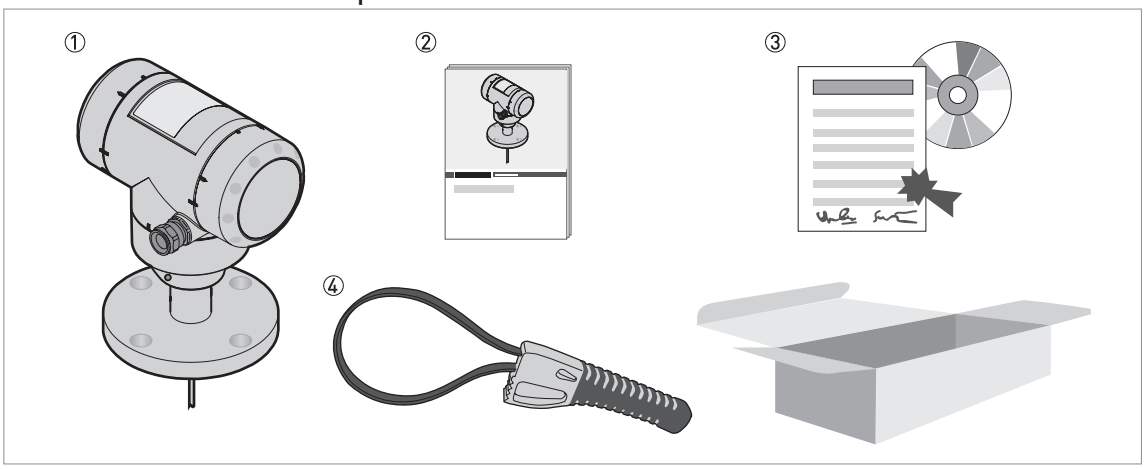


Figure 2-1: Scope of delivery (POWERFLEX 2200 C – Compact version)

① Device (compact version: signal converter and probe)
② Quick Start
③ DVD-ROM. This contains the handbook, the quick start, the technical data sheet and related software.
④ Strap wrench

POWERFLEX 2200 S – Compact version with sensor extension

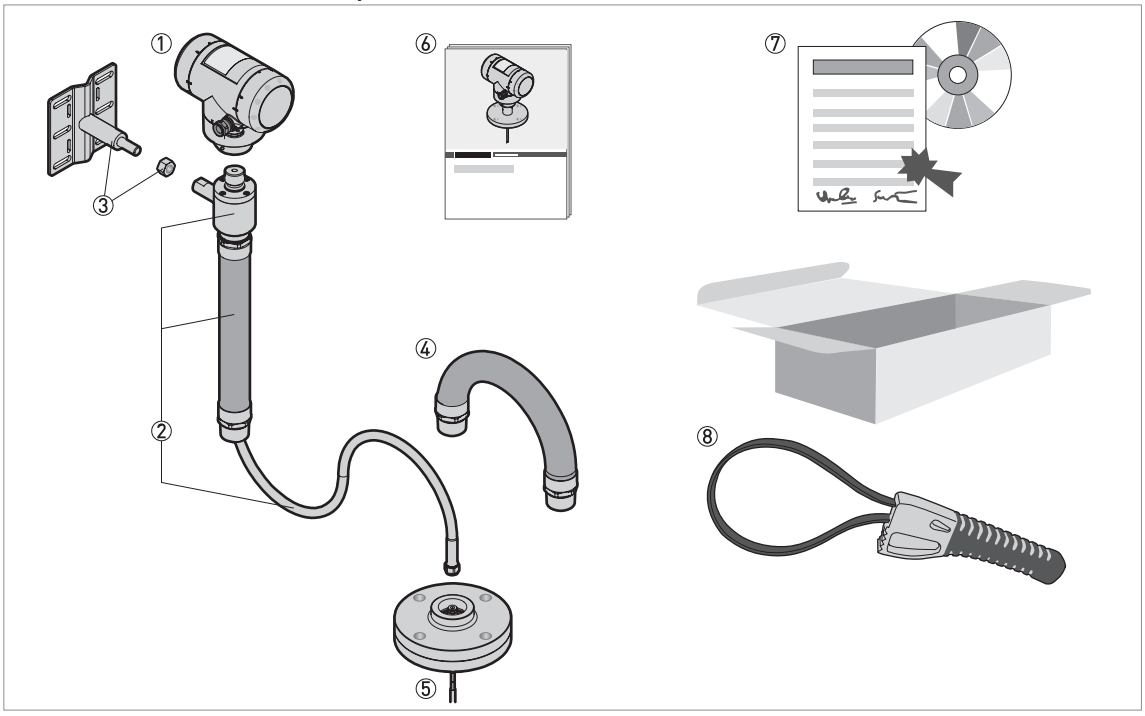


Figure 2-2: Scope of delivery (POWERFLEX 2200 S – Compact version with sensor extension)

① Signal converter
② Sensor extension: Coaxial cable and support with one attached length of flexible stainless steel jacket
③ Sensor extension: Wall bracket and lock nut
④ Sensor extension: One length of flexible stainless steel jacket
⑤ Process connection and probe
⑥ Quick Start
⑦ DVD-ROM. This contains the handbook, the quick start, the technical data sheet and related software.
⑧ Strap wrench

POWERFLEX 2200 F – Remote version

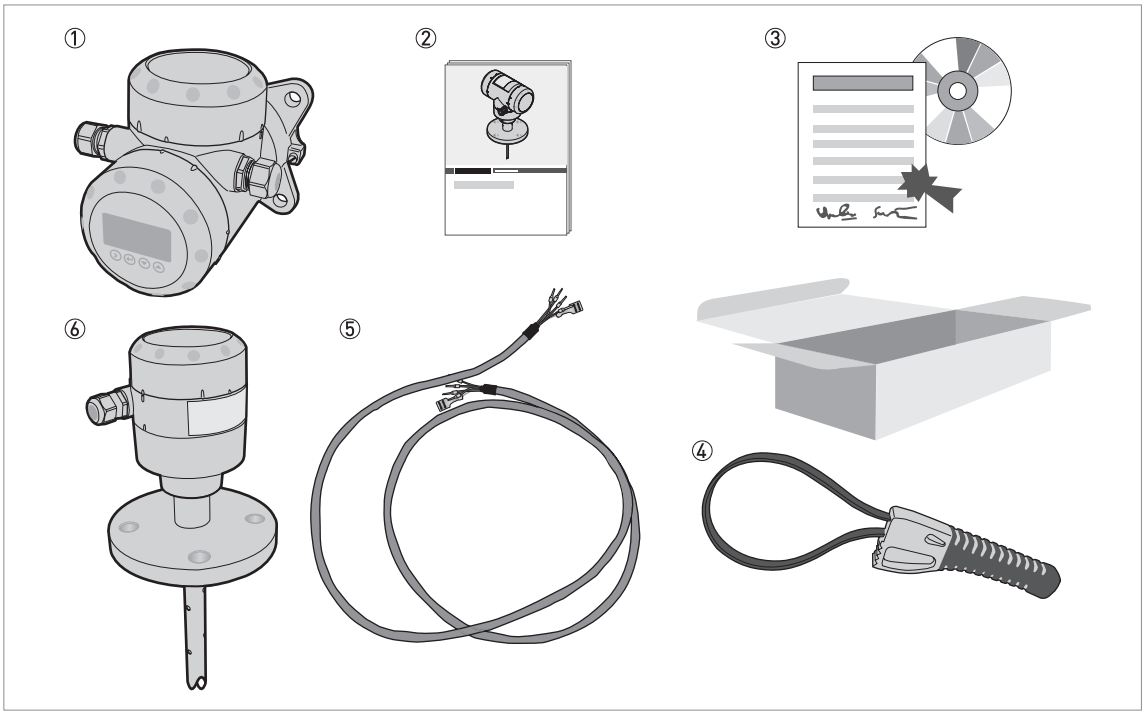


Figure 2-3: Scope of delivery (POWERFLEX 2200 F – Remote version)

① Signal converter
② Quick Start
③ DVD-ROM. This contains the handbook, the quick start, the technical data sheet and related software.
④ Strap wrench
⑤ RS-485 cable. A signal cable connects the signal converter to the probe housing. This signal cable is supplied on request. For more data about the signal cable, refer to *Remote device data* on page 49.
⑥ Probe housing, process connection and probe

POWERFLEX 2200 D – Remote version with sensor extension

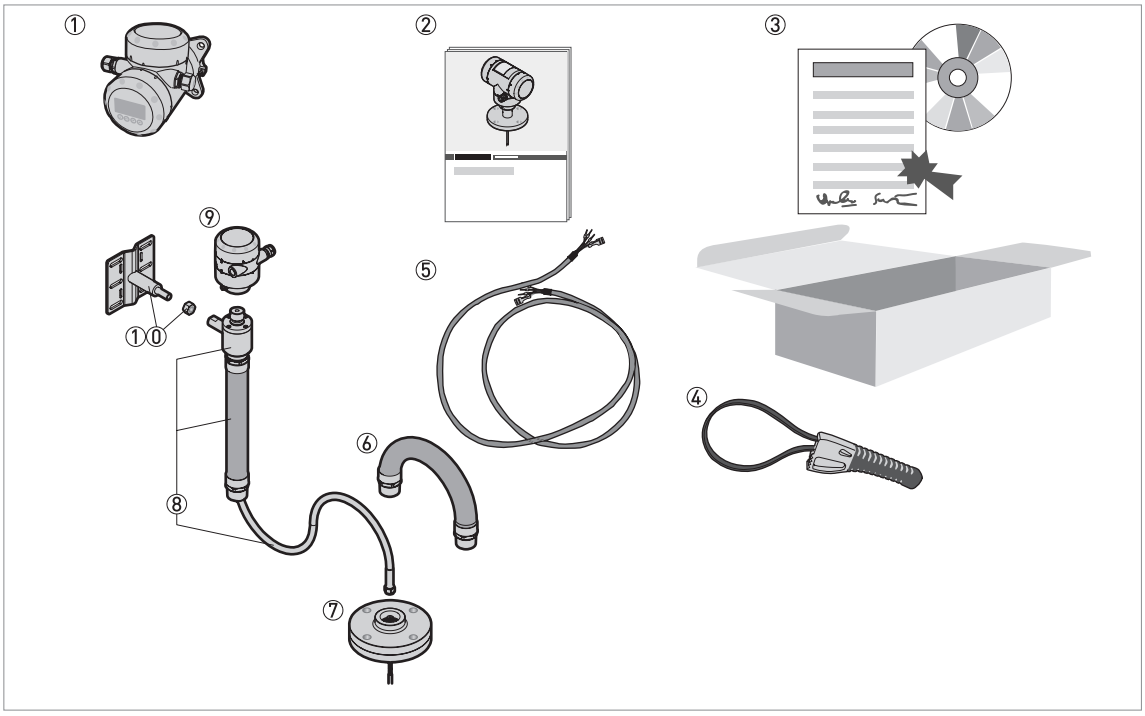


Figure 2-4: Scope of delivery (POWERFLEX 2200 D – Remote version with sensor extension)

① Signal converter
② Quick Start
③ DVD-ROM. This contains the handbook, the quick start, the technical data sheet and related software.
④ Strap wrench
⑤ RS-485 cable. A signal cable connects the signal converter to the probe housing. This signal cable is supplied on request. For more data about the signal cable, refer to *Remote device data* on page 49.
⑥ Sensor extension: One length of flexible stainless steel jacket
⑦ Process connection and probe
⑧ Sensor extension: Coaxial cable and support with one attached length of flexible stainless steel jacket
⑨ Probe housing
①⓪ Sensor extension: Wall bracket and lock nut

2.2 Device description

The TDR level transmitter is designed to measure the distance, level and volume of liquids.

TDR level transmitters use a probe to guide a signal to the surface of the measured product. The device has a large choice of probes. Thus, it can measure most products in difficult conditions. For more data, refer to *Technical data* on page 103.

The signal converter of the device has 6 versions: Compact (C), Compact with sensor extension (S), Compact with LOCA sensor extension (S LOCA), Remote (F), Remote with sensor extension (D) and Remote with LOCA sensor extension (D LOCA). The converter can also be ordered with horizontal or vertical housing options for easy access to the device terminals and the optional display. If the device has a LOCA sensor extension, then it can operate and transmit measurement data after a loss of coolant accident (LOCA) occurs.

Compact version
The signal converter is attached directly to the process connection and the antenna (vertical housing option shown).

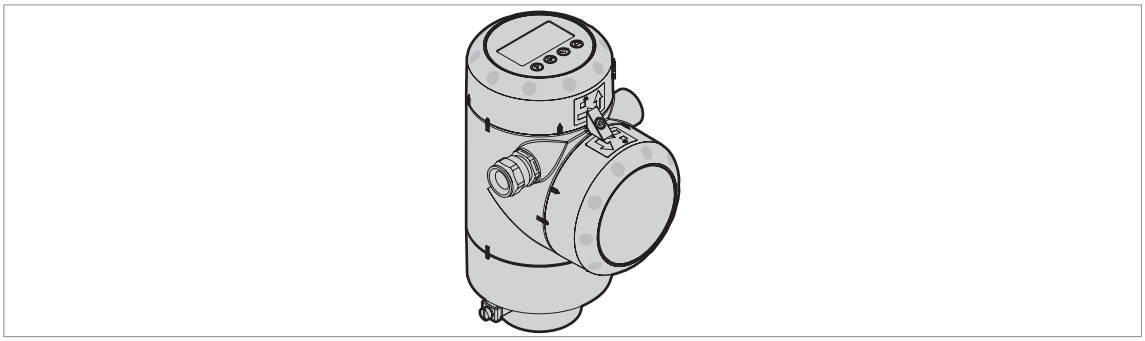


Figure 2-5: Compact version

Remote (Field) version
The signal converter is installed away from the process connection and the antenna (for example: at the bottom of a tank). The RS-485 signal cable between the signal converter and the antenna has a maximum length of 300 m / 984 ft.

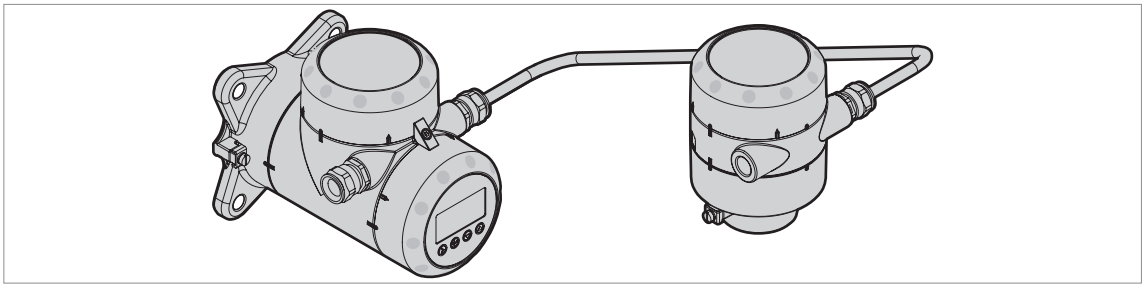


Figure 2-6: Remote (Field) version with an RS485 signal cable

Sensor extension (with flexible stainless steel jackets)
A sensor extension option is available for the compact or remote version of the device. This option is recommended if the ambient conditions around the process connection are not in the approved limits. A coaxial cable (maximum length 150 m / 492 ft) is connected between the wall bracket for the probe housing and the process connection. The coaxial cable has a flexible stainless steel jacket that has a maximum length of 150 m / 492 ft. This stainless steel jacket can be in one or more pieces to prevent damage to the coaxial cable.

INFORMATION!
The length of the coaxial cable and the stainless steel jacket depends on the data given in the customer order.

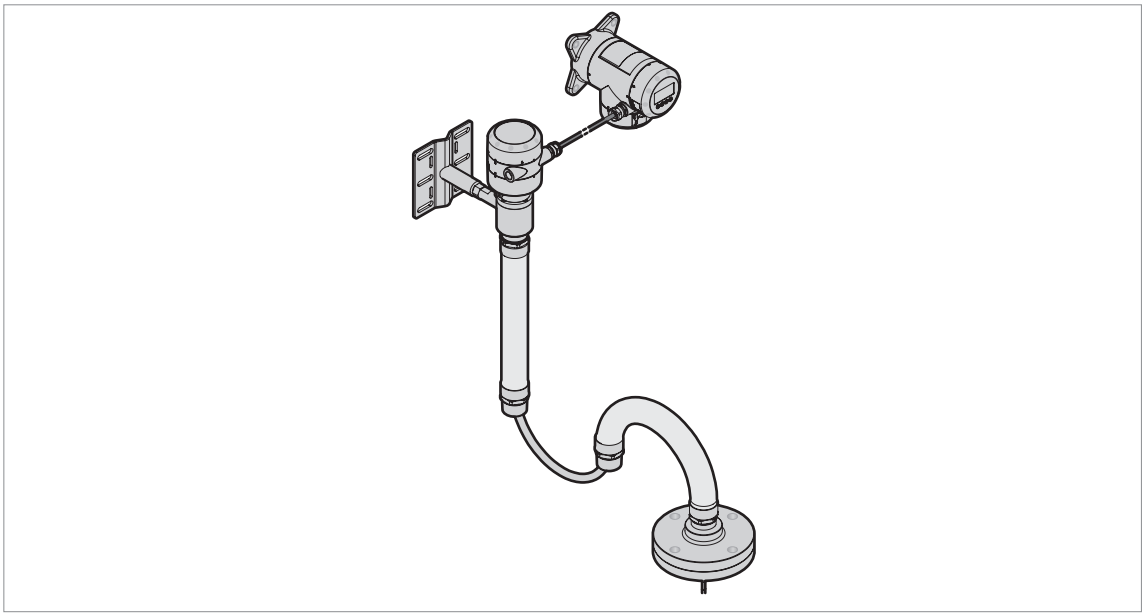


Figure 2-7: Sensor extension option

2.3 Visual Check

INFORMATION!

Inspect the packaging carefully for damages or signs of rough handling. Report damage to the carrier and to the local office of the manufacturer.

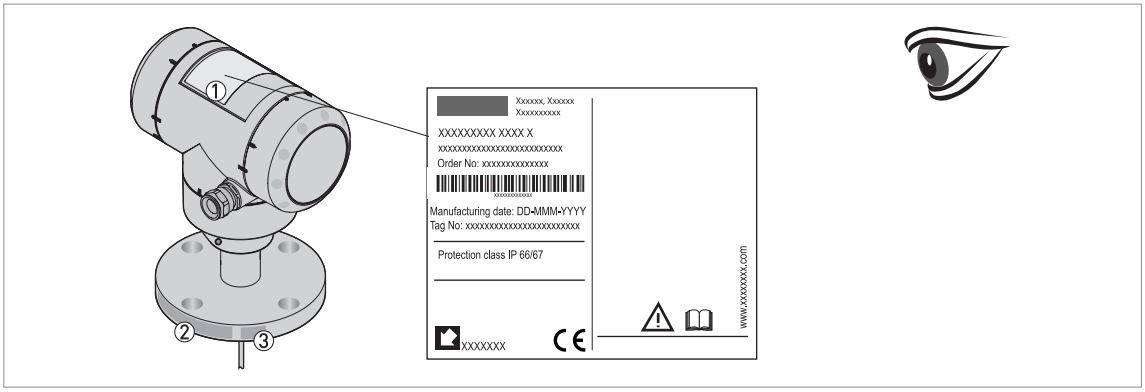


Figure 2-8: Visual check

① Device nameplate (for more data, refer to *Nameplate* on page 19)
② Process connection data (size and pressure rating, material reference and heat number)
③ Gasket material data – refer to the illustration that follows

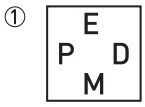


Figure 2-9: Symbol for the supplied gasket material (on the side of the process connection)

① EPDM

2.4 Nameplates

INFORMATION!
Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

2.4.1 Nameplate

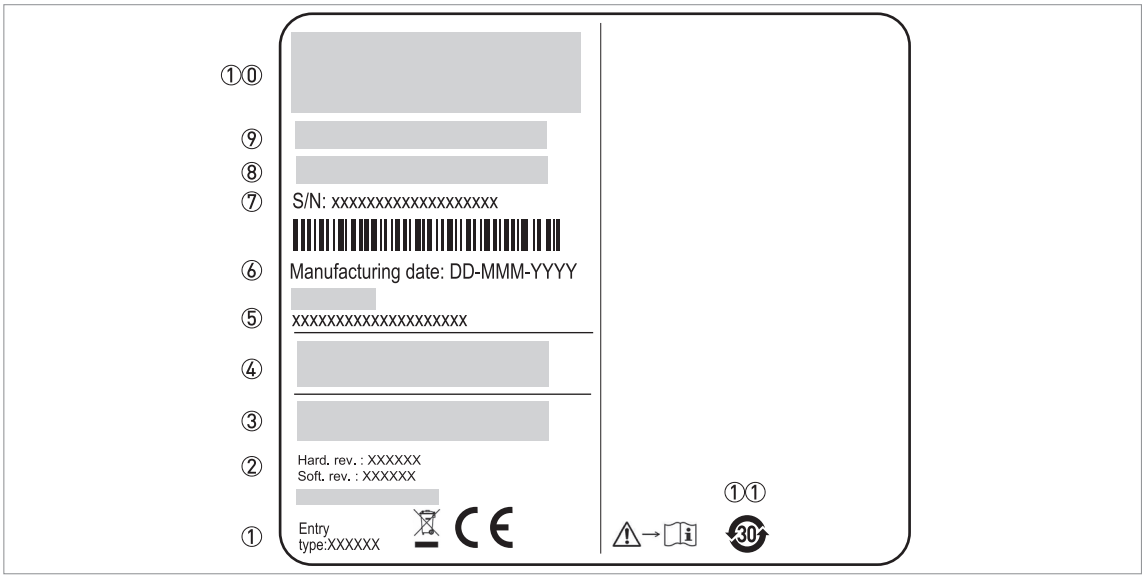


Figure 2-10: Compact version (C), compact version with sensor extension (S), remote version (F) and remote version with sensor extension (D): Nameplate attached to the housing

① Cable entry size
② Hardware revision / Software revision (according to NAMUR NE 53)
③ Output signal (analog, digital etc.), input voltage and maximum current
④ Degree of ingress protection (according to EN 60529 / IEC 60529)
⑤ Customer tag number
⑥ Date of manufacture
⑦ Serial number
⑧ Type code (defined in order)
⑨ Model name and number. The last letter "X" is either:
C = compact version,
S = compact version with sensor extension,
F = remote (field) version or
D = remote version with (double) sensor extension.
⑩ Company name and address
⑪ Symbol to show that the device agrees with China RoHS (Chinese Government regulation to prevent contamination of the environment from materials used in the manufacture of electronic devices). The value given on the symbol is the time in years that the device is guaranteed to be environmentally safe.

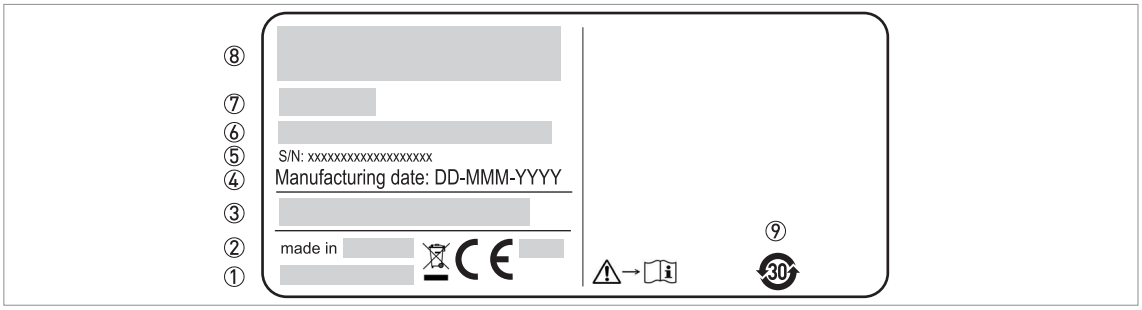


Figure 2-11: Remote version or remote version with sensor extension: Nameplate attached to the probe assembly

① Company web address
② Country of manufacture
③ Degree of ingress protection (according to EN 60529 / IEC 60529)
④ Date of manufacture
⑤ Serial number
⑥ Type code (defined in order)
⑦ Model name and number. X = "F" remote (field) version or "D" remote version with (double) sensor extension.
⑧ Company logo, name and postal address
⑨ Symbol to show that the device agrees with China RoHS (Chinese Government regulation to prevent contamination of the environment from materials used in the manufacture of electronic devices). The value given on the symbol is the time in years that the device is guaranteed to be environmentally safe.

3.1 General notes on installation

INFORMATION!
Inspect the packaging carefully for damages or signs of rough handling. Report damage to the carrier and to the local office of the manufacturer.

INFORMATION!
Do a check of the packing list to make sure that you have all the elements given in the order.

INFORMATION!
Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

3.2 Storage

WARNING!
Store the device in its original packing.

WARNING!
Do not keep the device in a vertical position. This will damage the probe and the device will not measure correctly.

- Store the device in a dry and dust-free location.
- Storage temperature range: -50...+85°C / -60...+185°F (min. -40°C / -40°F for devices with the integrated LCD display option)

3.3 Transport

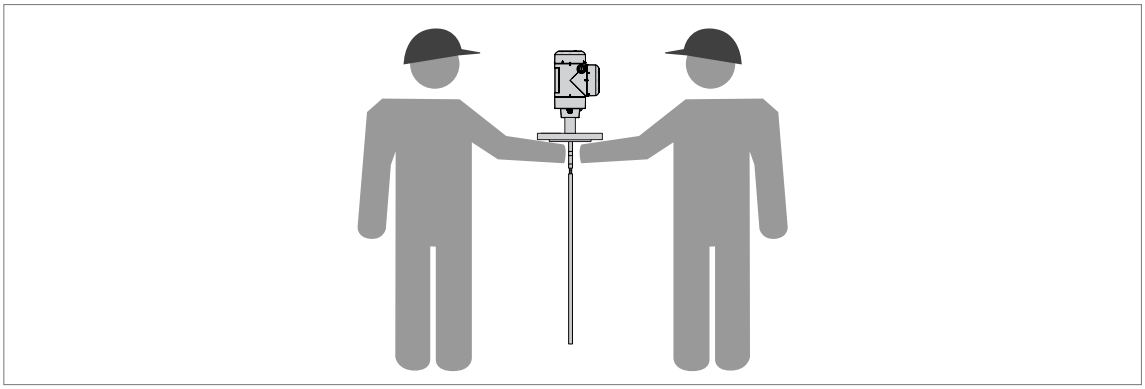


Figure 3-1: How to hold the device: general data

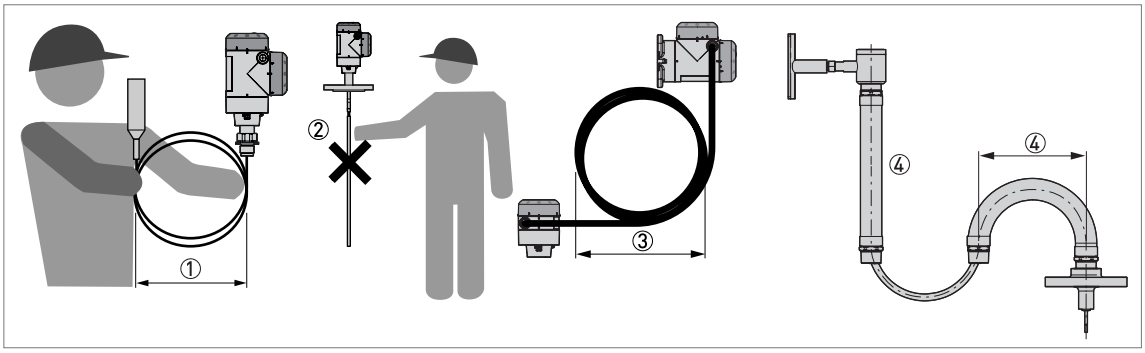


Figure 3-2: How to hold the device: cable data

① Do not wind the cable probes less than 400 mm / 16¨ in diameter.
② Do not hold the probe when you lift the device.
③ Remote versions (F or D): Do not wind the RS-485 electrical cable less than 330 mm / 13¨ in diameter.
④ Do not bend the flexible jacket less than 500 mm / 20¨ in diameter.

WARNING!
If you do not lift the device carefully, you can cause damage to the probe.

3.4 Pre-installation requirements

INFORMATION!
Obey the precautions that follow to make sure that the device is correctly installed.

- Make sure that there is sufficient space on all sides.
- Protect the signal converter from direct sunlight. If necessary, install the weather protection accessory.
- Do not subject the signal converter to heavy vibrations.

3.5 How to prepare the tank before you install the device

CAUTION!
To avoid measuring errors and device malfunction, obey these precautions.

3.5.1 Pressure and temperature ranges

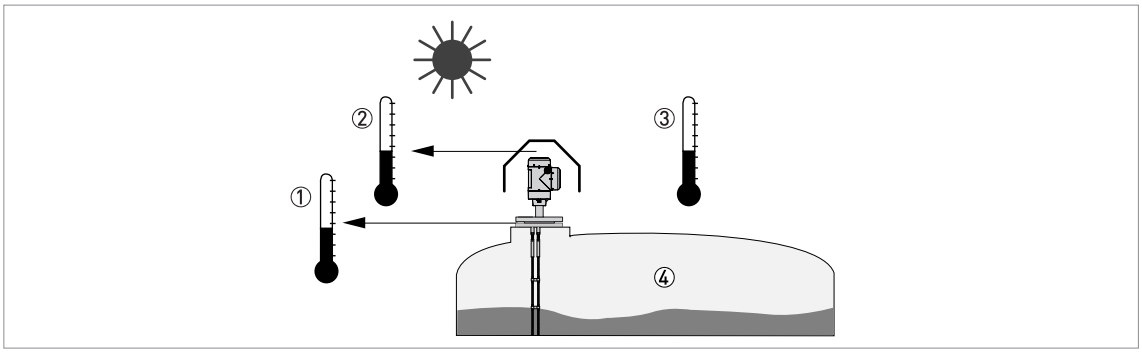


Figure 3-3: Pressure and temperature ranges

① Ambient temperature for operation of the display
-20...+60°C / -4...+140°F
If the ambient temperature is not between these limits, the display screen switches off automatically
② Ambient temperature
-40...+80°C / -40...+176°F
Process connection and probe of devices with the sensor extension option (versions S and D): -40...+85°C / -40...+185°F
③ Process pressure
-1...40 barg / -14.5...580 psig

WARNING!
The process connection temperature range must agree with the temperature limits of the gasket material.

Permitted temperature ranges for gaskets

Gasket material	Permitted temperature ranges for gaskets	
	[°C]	[°F]
EPDM	-50…+150	-58…+302

Ambient temperature / flange temperature, flange and threaded connection, in °C

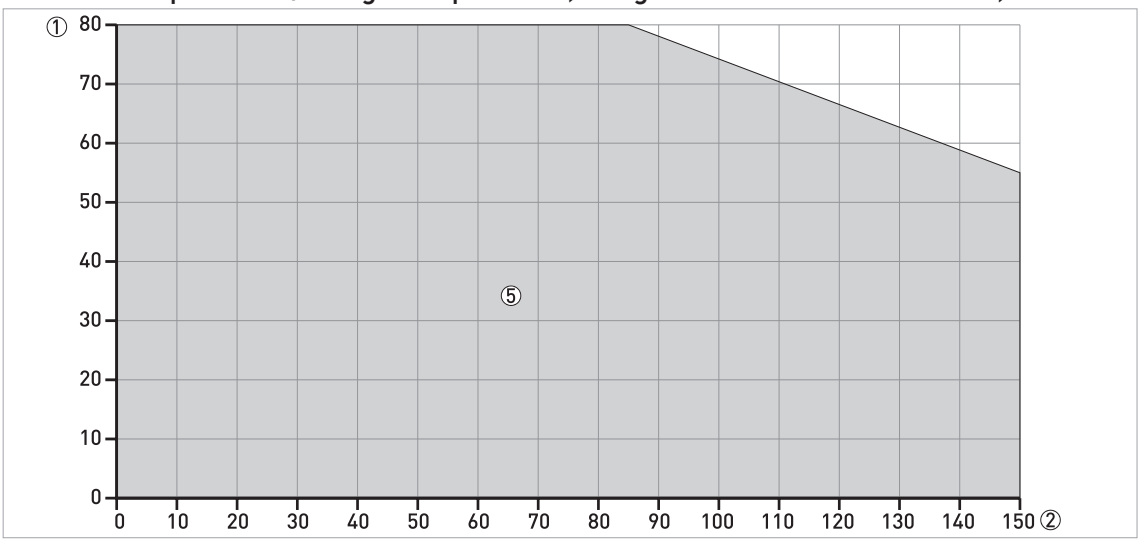


Figure 3-4: Ambient temperature / flange temperature, flange and threaded connection, in °C

Ambient temperature / flange temperature, flange and threaded connection, in °F

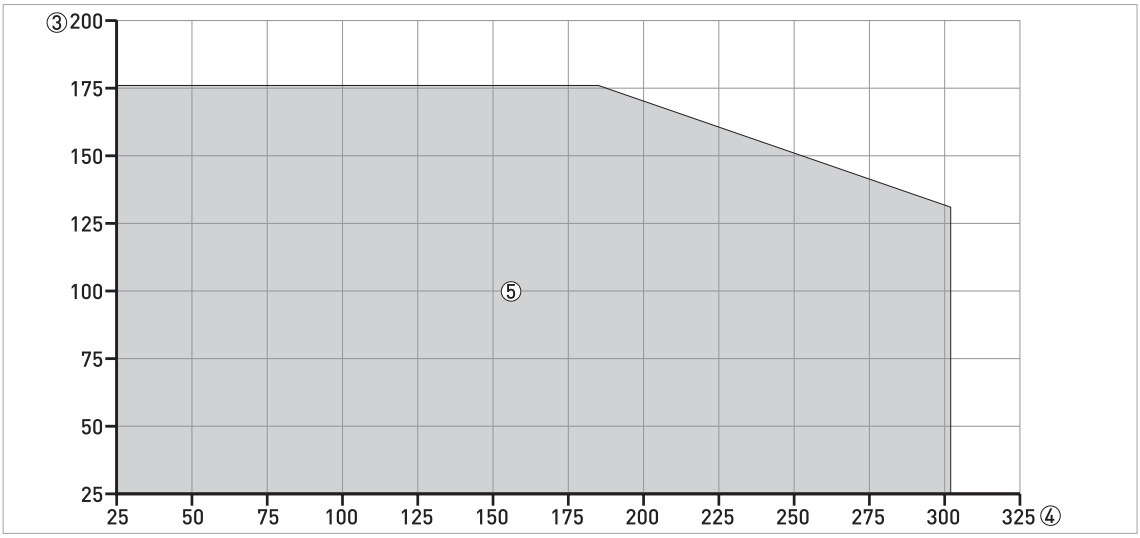


Figure 3-5: Ambient temperature / flange temperature, flange and threaded connection, in °F

① Maximum ambient temperature, °C
② Maximum flange temperature, °C
③ Maximum ambient temperature, °F
④ Maximum flange temperature, °F
⑤ All probes

INFORMATION!
Min. ambient temperature: -40°C / -40°F

3.5.2 General information for nozzles

CAUTION!
Follow these recommendations to make sure that the device measures correctly. They have an effect on the performance of the device.

CAUTION!
Do not put the process connection near to the product inlet. If the product that enters the tank touches the probe, the device will measure incorrectly.

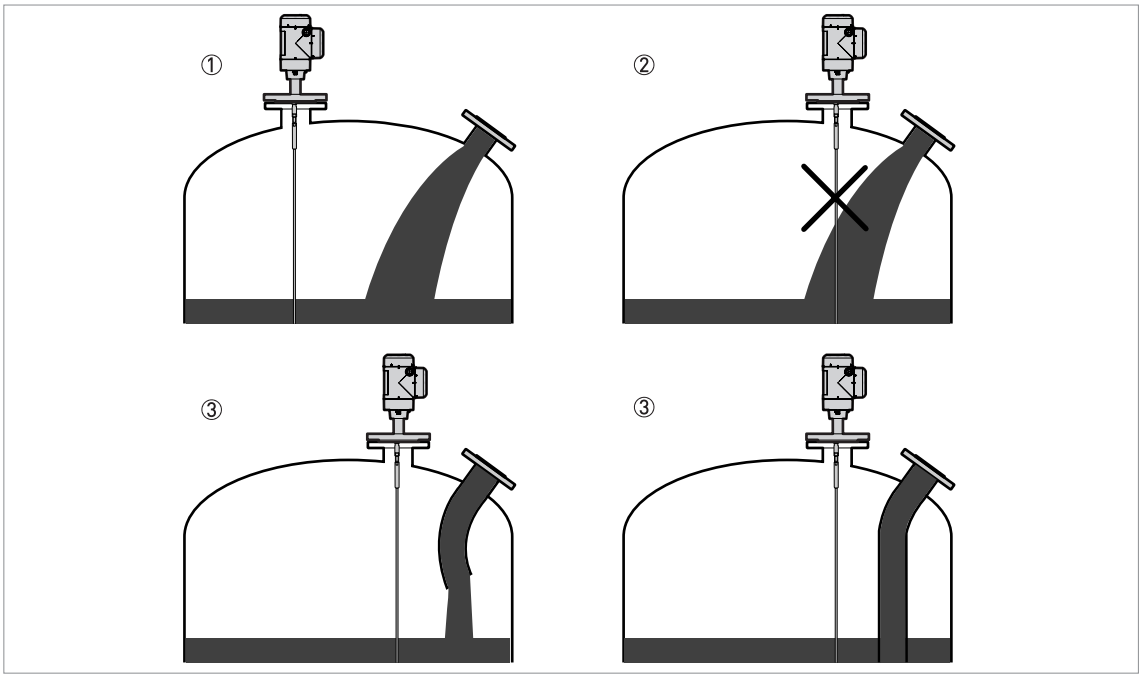


Figure 3-6: Do not put the device near to a product inlet

① The device is in the correct position.
② The device is too near to the product inlet.
③ If it is not possible to put the device in the recommended position, install a deflector pipe.

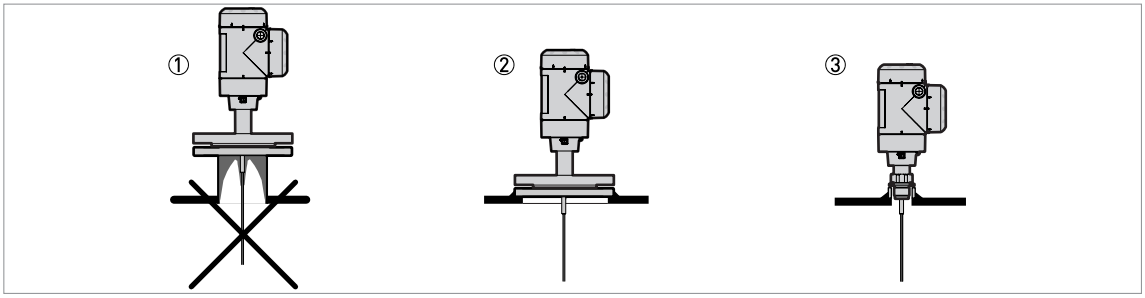


Figure 3-7: How to prevent build-up of product around the process connection

① If product particles are likely to collect in holes, a nozzle is not recommended.
② Attach the flange directly to the tank.
③ Use a threaded connection to attach the device directly to the tank.

For single cable and single rod probes:

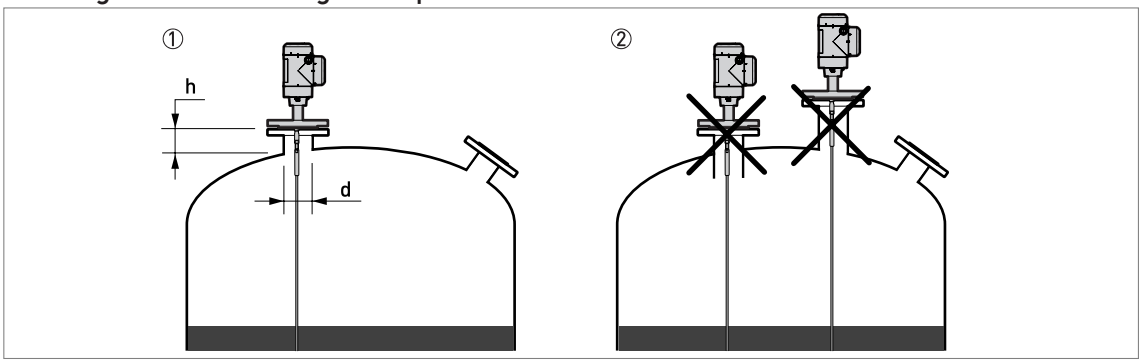


Figure 3-8: Recommended nozzle dimensions for single rod and single cable probes

① Recommended conditions: h ≤ d, where h is the height of the tank nozzle and d is the diameter of the tank nozzle.
② The end of the nozzle must not have an extension into the tank. Do not install the device on a high nozzle.

CAUTION!
If the device is installed on a high nozzle, make sure that the probe does not touch the side of the nozzle (attach the probe end etc.).

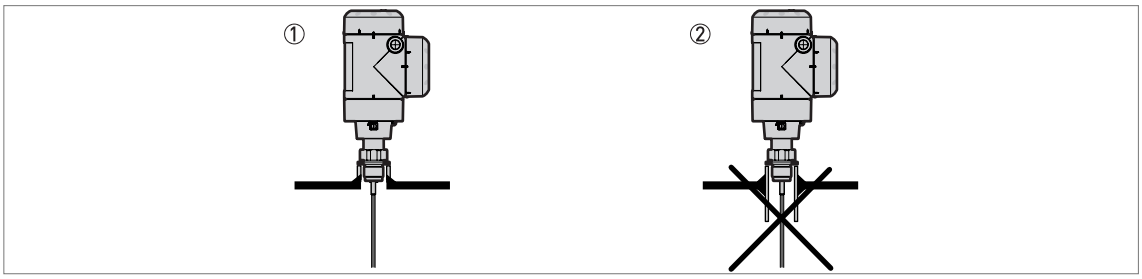


Figure 3-9: Sockets for threaded process connections

① Recommended installation
② The end of the socket must not have an extension into the tank

For double cable and double rod probes:

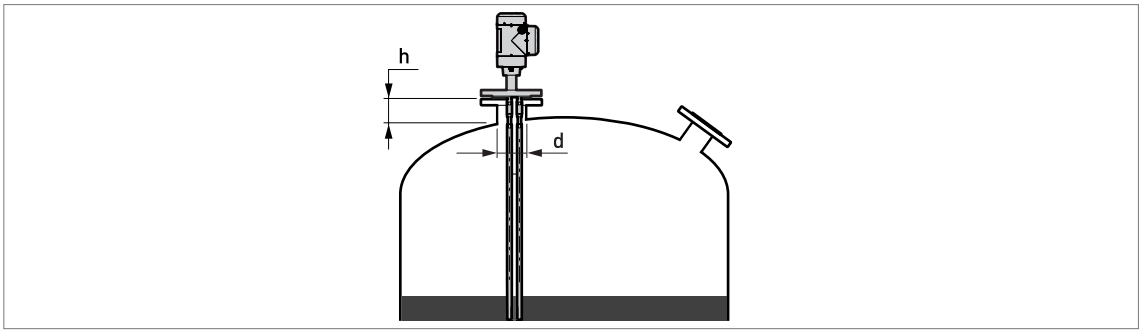


Figure 3-10: Recommended nozzle dimensions for double rod and double cable probes

d ≥ 50 mm / 2", where d is the diameter of the tank nozzle

For coaxial probes:

If your device has a coaxial probe, you can ignore these installation recommendations.

CAUTION!
Install coaxial probes in clean liquids that are not too viscous.

3.5.3 Installation requirements for concrete roofs

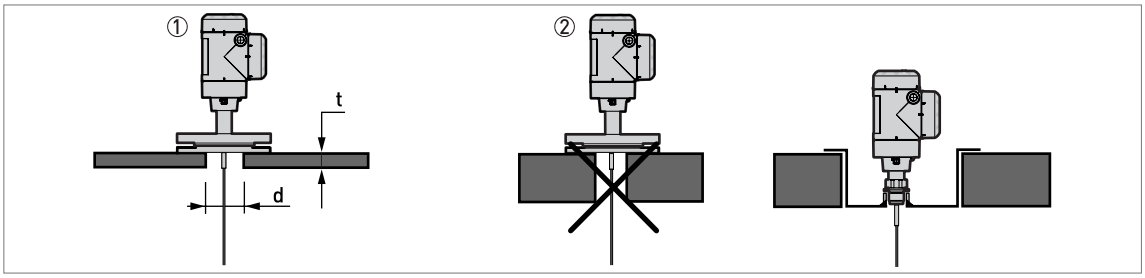


Figure 3-11: Installation on a concrete roof

① The diameter, d, of the hole must be greater than the thickness, t, of the concrete.
② If the thickness, t, of the concrete is greater than the diameter, d, of the hole, install the device in a recess.

3.6 Installation recommendations for liquids

3.6.1 General requirements

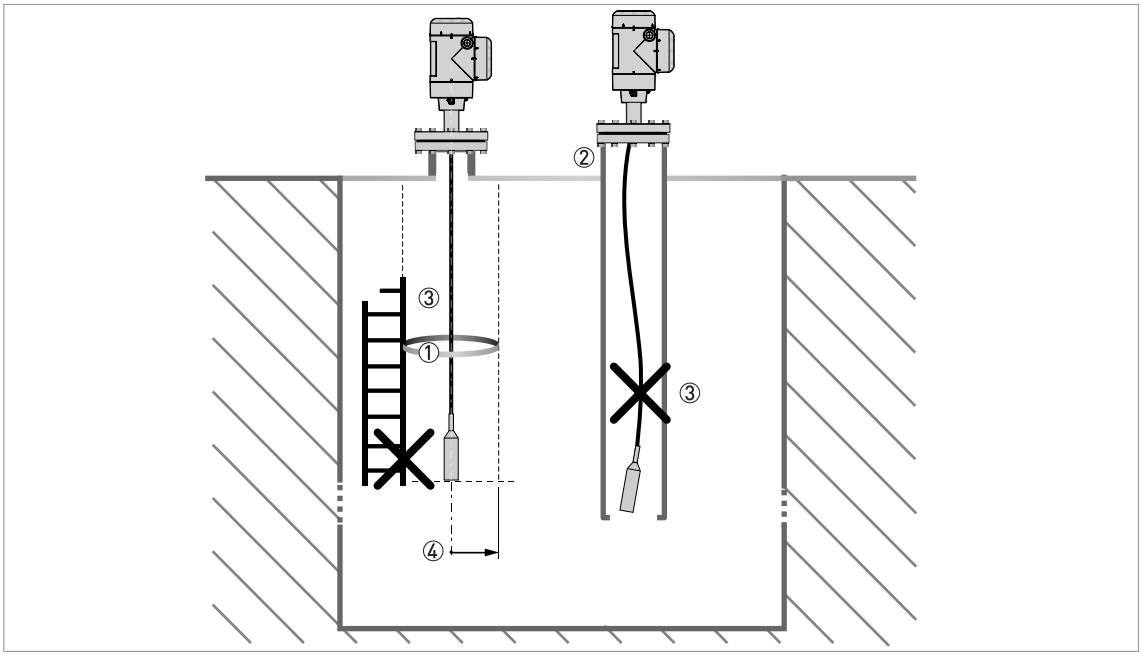


Figure 3-12: Installation recommendations for liquids

① The electromagnetic (EM) field generated by the device. It has a radius of R_{min}. Make sure that the EM field is clear of objects and product flow. Refer to the table that follows.
② If there are too many objects in the pool, install a stilling well
③ Keep the probe straight. If the probe is too long, shorten the probe length. Make sure that the device is configured with the new probe length. For more data on the procedure, refer to *How to decrease the length of probes* on page 90.
Keep the probe straight
④ Empty space. Refer to the table that follows.

Clearance between the probe and other objects in the tank

Probe type	Empty space (radius, R_{min}), around the probe	
	[mm]	[inches]
Coaxial	0	0
Double rod / cable	100	4
Single rod / cable	300	12

3.6.2 How to attach probes to the bottom of the tank

If the liquid is agitated or turbulent, you can attach the probe to the bottom of the tank. The procedure to attach the probe depends on the type of probe used.

CAUTION!
Keep the probe straight.

Double rod Ø8 mm / 0.32¨

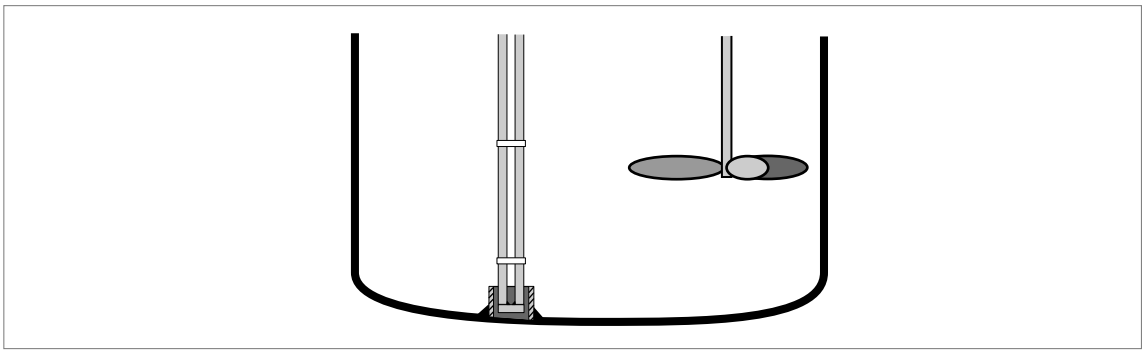


Figure 3-13: How to attach a double rod probe to keep it straight

- Weld a tube with an internal diameter of 28...30 mm / 1.1...1.2¨ to the bottom of the tank.

➲ Make sure the tube aligns with the process connection at the top of the tank.

- Lower the probe into the tank.
- Put the end of the probe into the tube.

Double cable Ø4 mm / 0.16¨

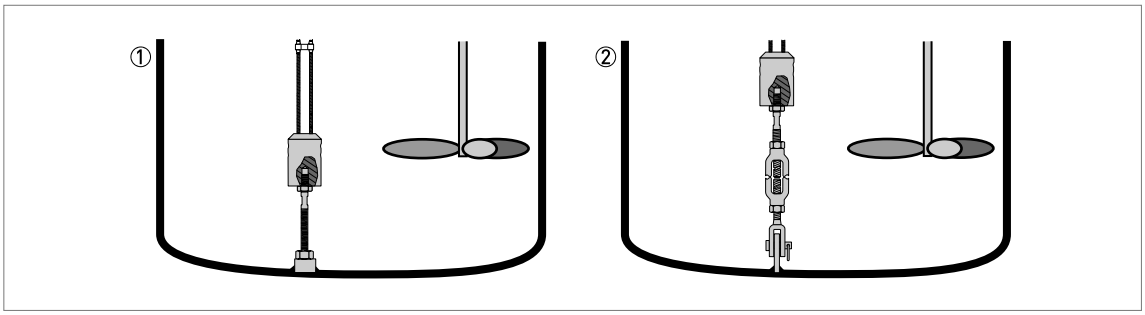


Figure 3-14: How to attach a double cable probe to keep it straight

The probe counterweight has a hole with an M8 internal thread. You can also select the appropriate options and attach:

① An anchoring rod
② A turnbuckle

For more data, speak or write to your supplier.

Single rod Ø8 mm / 0.32¨

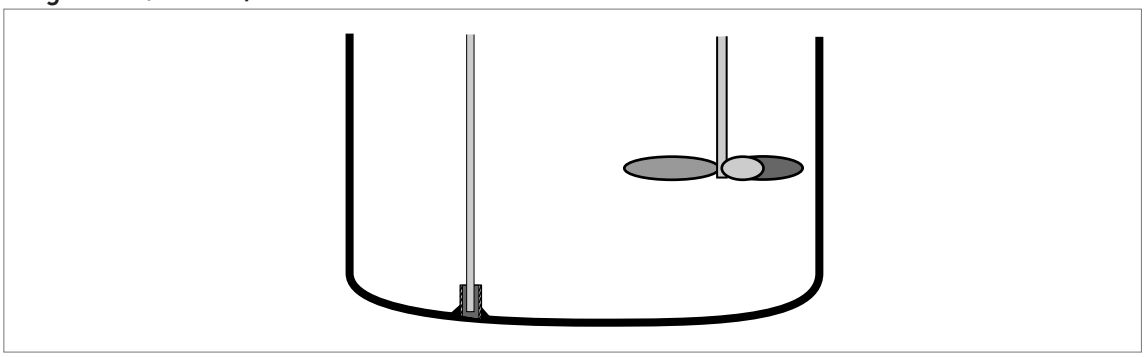


Figure 3-15: How to attach a single rod probe to keep it straight

- Weld a tube with an internal diameter of 12 mm / 0.5¨ to the bottom of the tank.

➲ Make sure the tube aligns with the process connection at the top of the tank.

- Lower the probe into the tank.
- Put the end of the probe into the tube.

Single cable Ø4 mm / 0.16¨

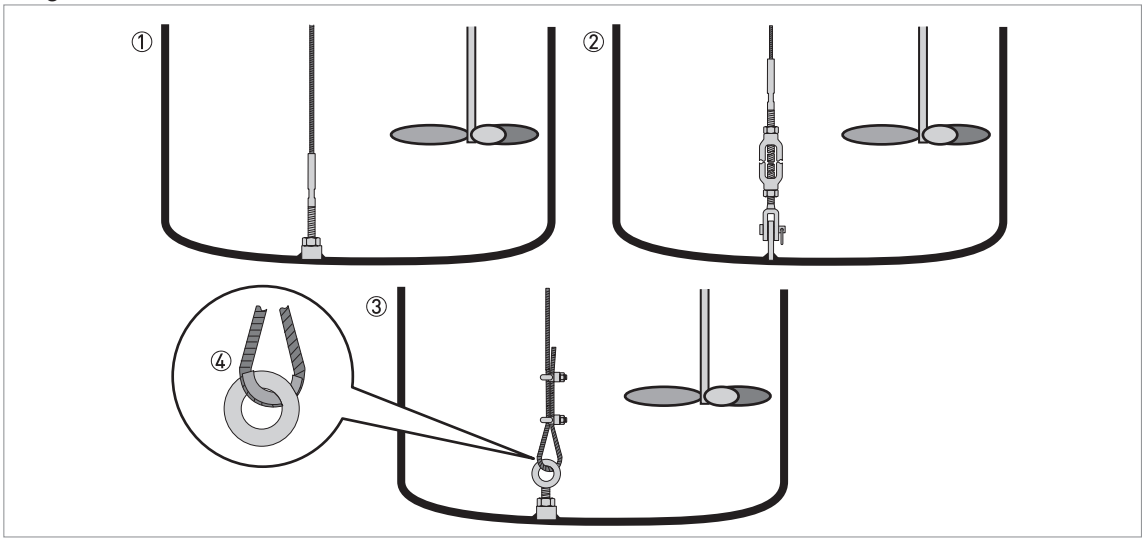


Figure 3-16: How to attach a Ø4 mm / 0.16¨ single cable probe to keep it straight

① Probe with threaded end
② Probe with turnbuckle
③ Probe with chuck
④ If you chose a chuck to anchor the probe, we recommend that you fit a ferrule (metal sheath – not supplied) at the bottom of the loop to prevent cable wear

The probe counterweight has a hole with an M8 internal thread. The other probe end options are given in the illustration.

CAUTION!
If your device has a chuck, you must recalculate the probe length. For the procedure, refer to How to decrease the length of probes on page 90. If the device is not set to the correct probe length, it is possible that the device will not measure correctly.

Coaxial Ø22 mm / 0.87¨

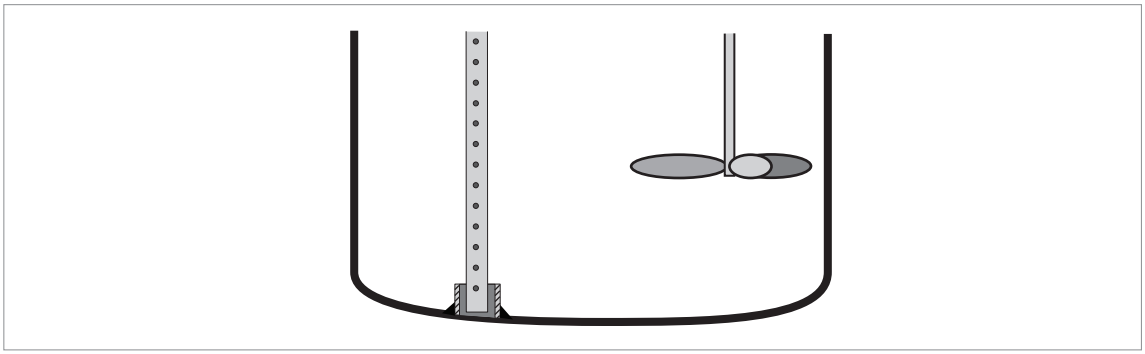


Figure 3-17: How to attach a coaxial probe to keep it straight

- **Ø22 mm / 0.87¨ coaxial probe:** Weld a tube with an internal diameter of 23...25 mm / 0.91...1¨ to the bottom of the tank.

➲ Make sure the tube aligns with the process connection at the top of the tank.

- Lower the probe into the tank.

- Put the end of the probe into the tube.

If this is not possible, you can attach braces to the probe.

3.6.3 Installation in standpipes (stilling wells and bypass chambers)

Use a standpipe if:

- The liquid is very turbulent or agitated.
- There are too many other objects in the tank.
- The device is measuring a liquid in a tank with a floating roof.

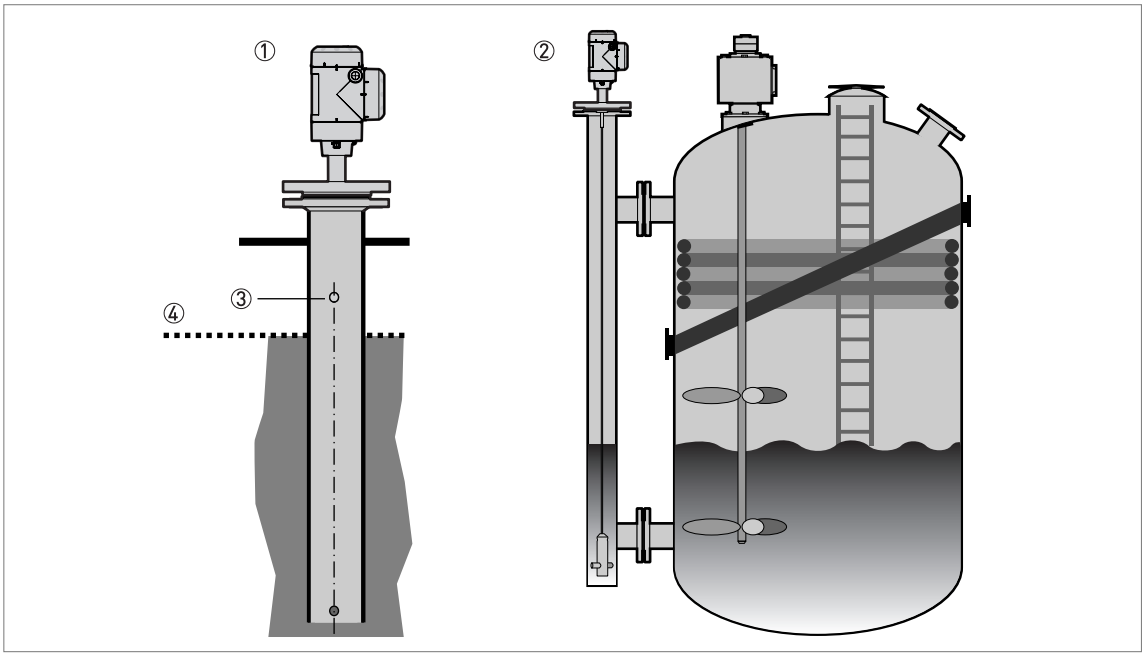


Figure 3-18: Installation recommendations for standpipes (stilling wells and bypass chambers)

① Stilling well
② Bypass chamber
③ Vent
④ Level of the liquid

INFORMATION!
Stilling wells are not necessary for devices with coaxial probes. But if there is a sudden change in diameter in the stilling well, we recommend that you install a device with a coaxial probe.

CAUTION!

- *The standpipe must be electrically conductive. If the standpipe is not made of metal, obey the instructions for empty space around the probe. For more data, refer to General requirements on page 27.*
- *The standpipe must be straight. There must be no changes in diameter from the device process connection to the bottom of the standpipe.*
- *The standpipe must be vertical.*
- *Recommended surface roughness: < ±0.1 mm / 0.004".*
- *The bottom of the stilling well must be open.*
- *Adjust the probe to the center of the standpipe.*
- *Make sure that there are no deposits at the bottom of the standpipe which can cause blockage of the process connections.*
- *Make sure that there is liquid in the standpipe.*

3.7 How to install the device on the tank: general notes

3.7.1 How to install a device with a flange connection

Equipment needed:

- Device
- Gasket (not supplied)
- Wrench (not supplied)

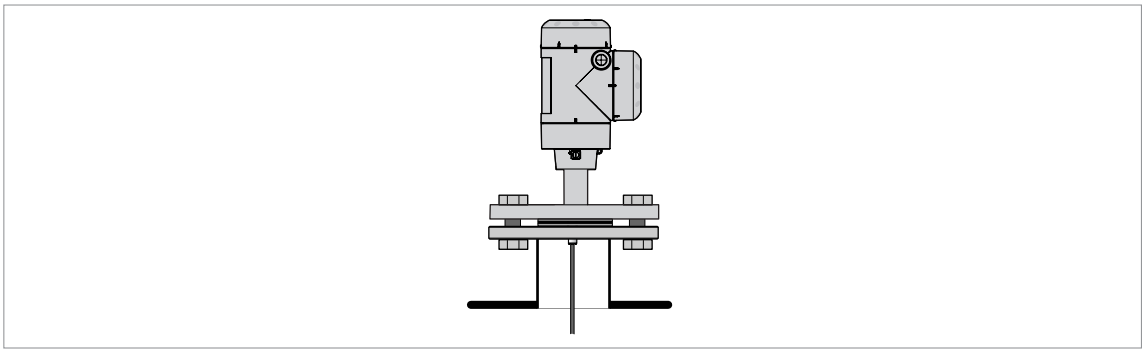


Figure 3-19: Flange connection

- Make sure that the flange on the nozzle is level.
- Make sure that you use the applicable gasket for the flange and the process.
- Align the gasket correctly on the flange facing of the nozzle.
- Lower the probe carefully into the tank.

➲ For more data on cable probes, refer to *How to install a cable probe in the tank* on page 34.

- Tighten the flange bolts.

➲ Refer to local rules and regulations for the correct torque to apply to the bolts.

3.7.2 How to install a device with a threaded connection

Equipment needed:

- Device
- Gasket (not supplied)
- 50 mm / 2¨ wrench (not supplied)

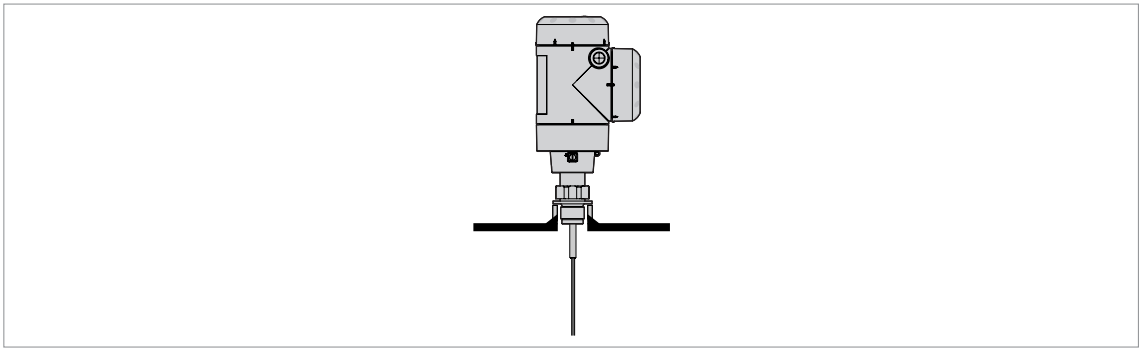


Figure 3-20: Threaded connection

- Make sure the tank connection is level.
- Make sure that you use the applicable gasket for the connection and the process.
- Align the gasket correctly.
- If the device is installed on a tank made of plastic or other non-conductive material, refer to *Recommendations for pits and tanks made of non-conductive materials* on page 35.
- Lower the probe carefully into the tank.

➲ For more data on cable probes, refer to *How to install a cable probe in the tank* on page 34.

- Use 50 mm / 2¨ wrench to attach the process connection to the tank.
- Tighten the nut.

➲ Refer to local rules and regulations for the correct torque to apply to the connection.

INFORMATION!

If there is not sufficient clearance to install the device, remove the housing. Install the probe and then put the housing back on the process connection. For more data, refer to How to turn or remove the signal converter on page 36.

3.7.3 How to install a cable probe in the tank

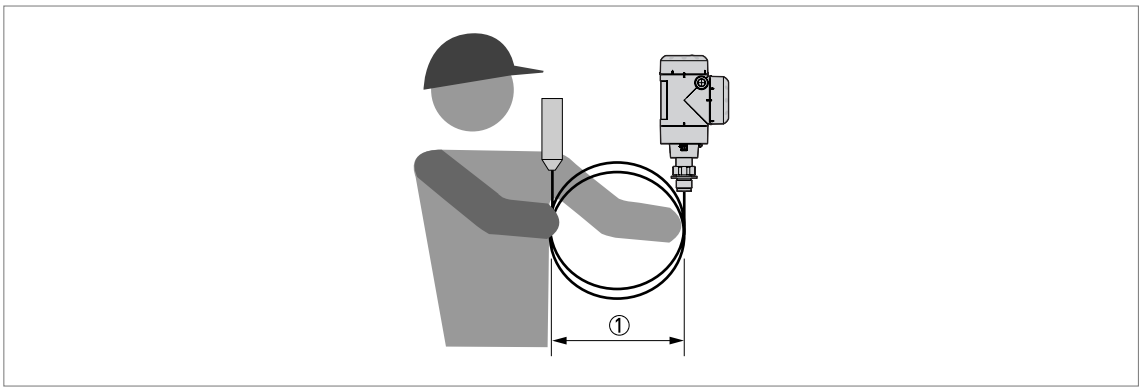


Figure 3-21: Wind cable probes carefully

① Do not wind cable probes less than 400 mm / 16¨ in diameter.

WARNING!
If you bend the probe too much, you will damage the device and it will not measure accurately.

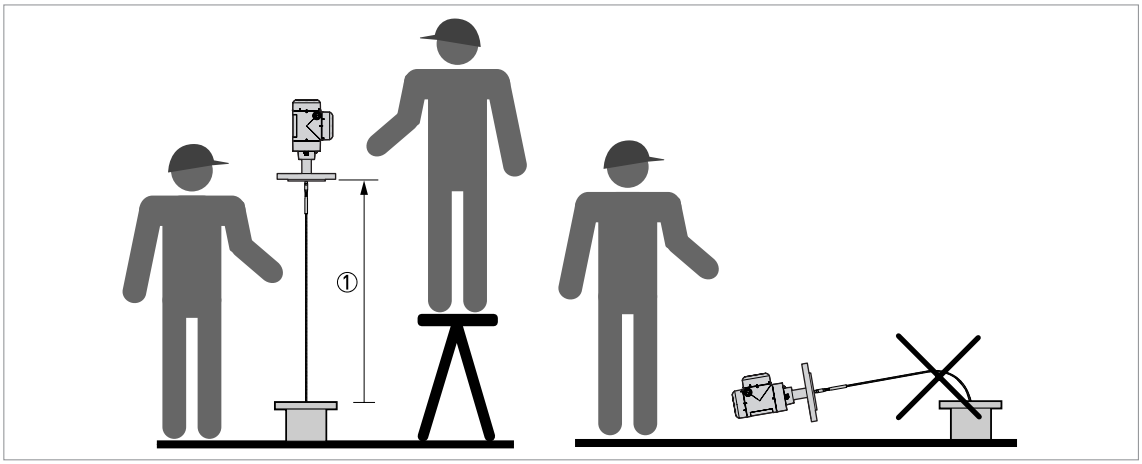


Figure 3-22: Installation of devices with cable probes

① >1 m / 3½ ft

- Use two persons to lift the housing and the probe above the process connection.
- Hold the device 1 m / 3½ ft above the tank.
- Unwind the probe carefully into the tank.

3.7.4 Recommendations for pits and tanks made of non-conductive materials

If you have a device with a single rod or a single cable probe and a thread connection, obey these instructions:

- Put a metal sheet between the device and the process connection.

➲ It must have a diameter greater than 200 mm / 8¨.

- Make sure that the metal sheet is in contact with the thread stop on the device.

We recommend that you use DN≥200 / ≥8¨ for flange connections.

If you have a device with a double rod, double cable or coaxial probe, you can ignore these instructions.

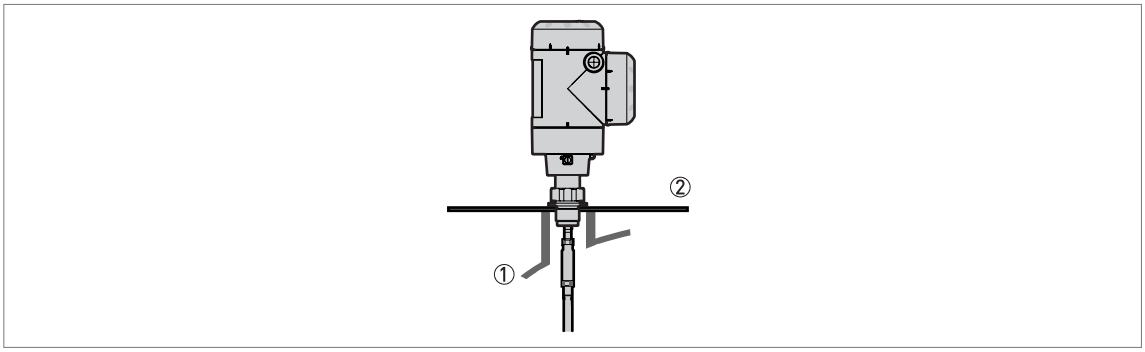


Figure 3-23: Installation in a non-metallic tank or pit with a thread connection

① Non-metallic (plastic etc.) tank or pit
② Metal sheet, Ø ≥200 mm / 8¨

CAUTION!
When the device is installed, make sure that the tank roof has no deformation.

3.7.5 How to turn or remove the signal converter

The converter turns 360°. The converter can be removed from the process connection assembly under process conditions.

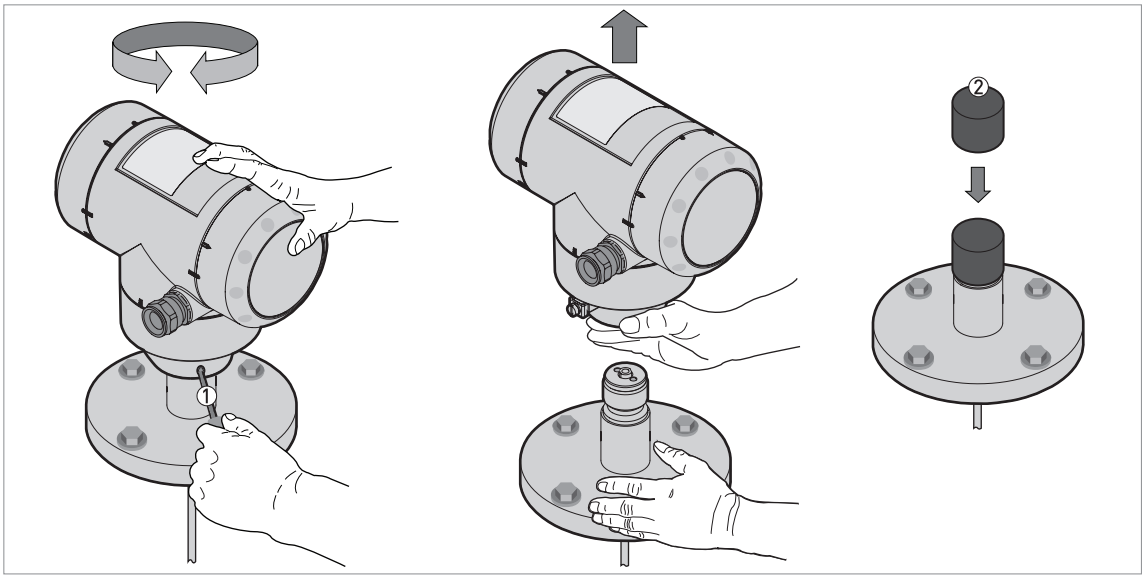


Figure 3-24: How to turn or remove the signal converter

① Tool: 5 mm Allen wrench (not supplied) for the lock screw on the signal converter
② Cover for the coaxial hole on top of the process connection assembly (not supplied)

CAUTION!
If you remove the housing, put a cover on the coaxial hole on top of the process connection assembly.
When the housing is attached to the process connection assembly, tighten the lock screw with the 5 mm Allen wrench ①.

3.7.6 How to attach the weather protection to the device

The device and the weather protection option are supplied disassembled in the same box. The weather protection can also be supplied as an accessory. You must attach the weather protection when you install the device.

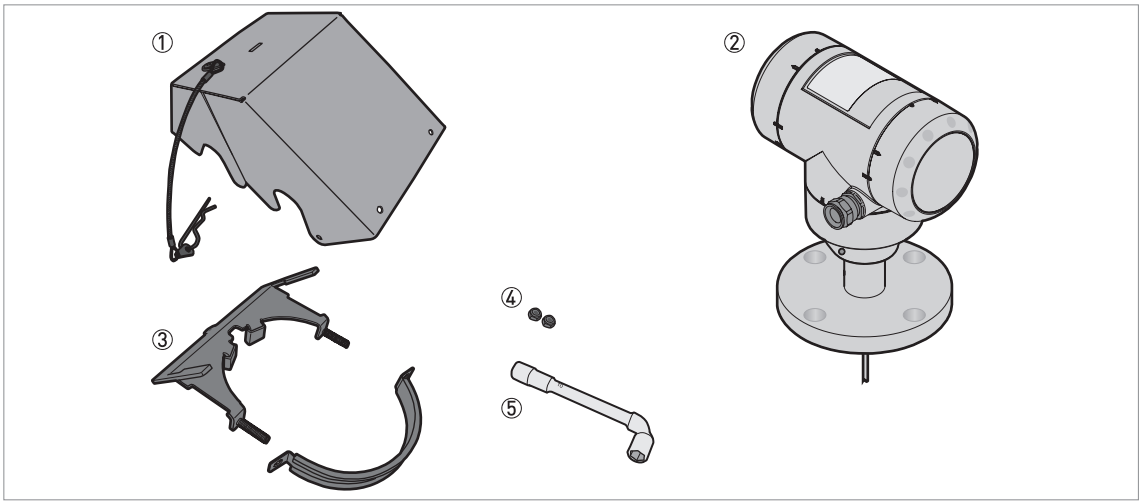


Figure 3-25: Equipment needed

① Weather protection cover (with an R-clip to hold the cover on the clamp)
② Device (with or without the optional display screen)
③ Weather protection clamp (2 parts)
④ 10 mm socket wrench (not supplied)
⑤ 2 locking nuts

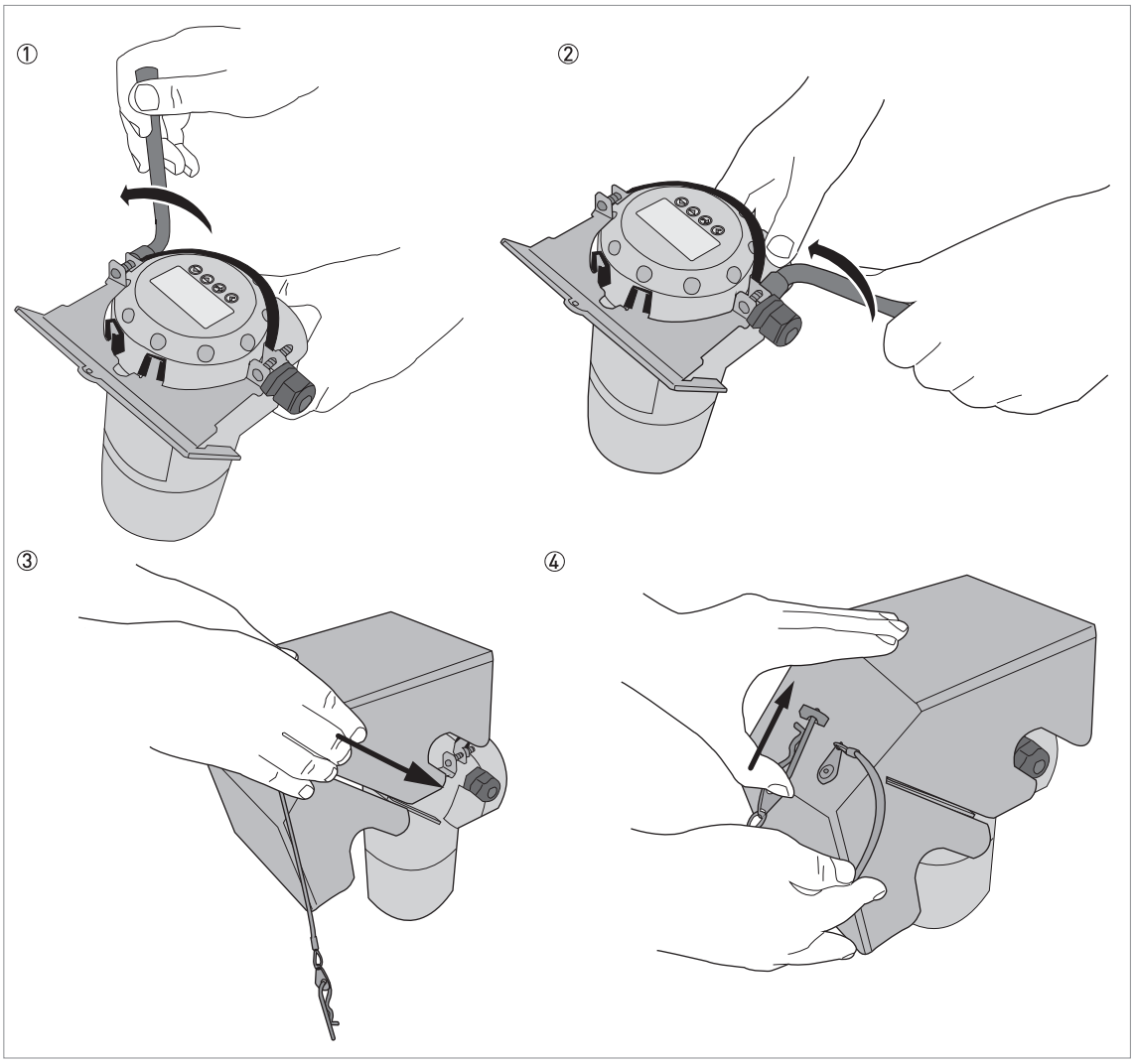


Figure 3-26: Installation of the weather protection on a vertical signal converter

① Put the weather protection clamp around the top of the device.
② Attach the two locking nuts to the threads on the weather protection clamp. Tighten the locking nuts with a 10 mm socket wrench.
③ Lower the weather protection cover onto weather protection clamp until the hole for the lock is in the slot at the front of the cover.
④ Put the R-clip into the hole at the front of the weather protection cover.
➲ End of the procedure.

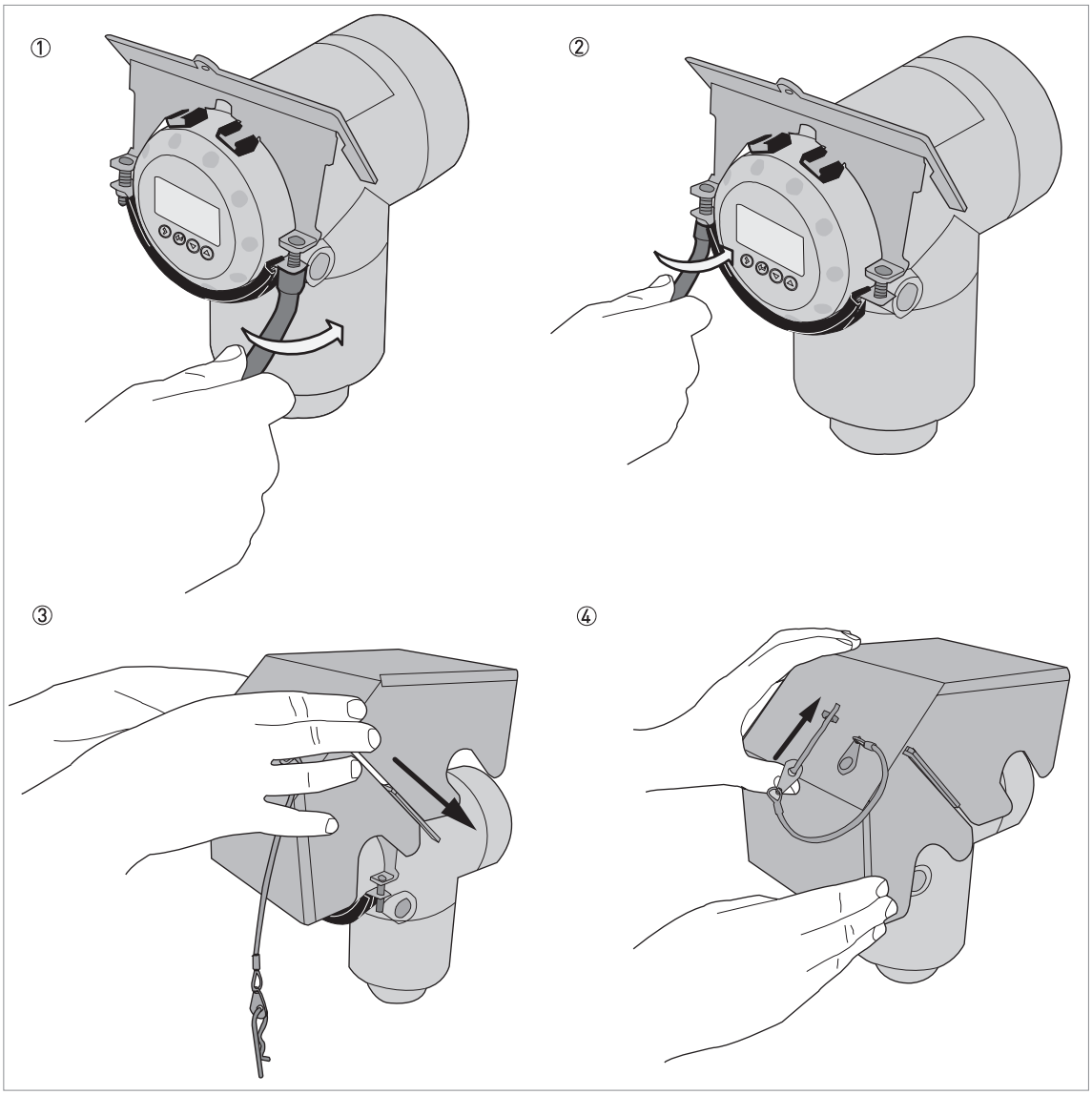


Figure 3-27: Installation of the weather protection on a horizontal signal converter

① Put the weather protection clamp around the front of the device (the end of the device that is nearest to the cable entry).
② Attach the two locking nuts to the threads on the weather protection clamp. Tighten the locking nuts with a 10 mm socket wrench.
③ Lower the weather protection cover onto weather protection clamp until the hole for the lock is in the slot at the front of the cover.
④ Put the R-clip into the hole at the front of the weather protection cover.
➲ End of the procedure.

The overall dimensions of the weather protection are on page 116.

3.7.7 How to open the weather protection

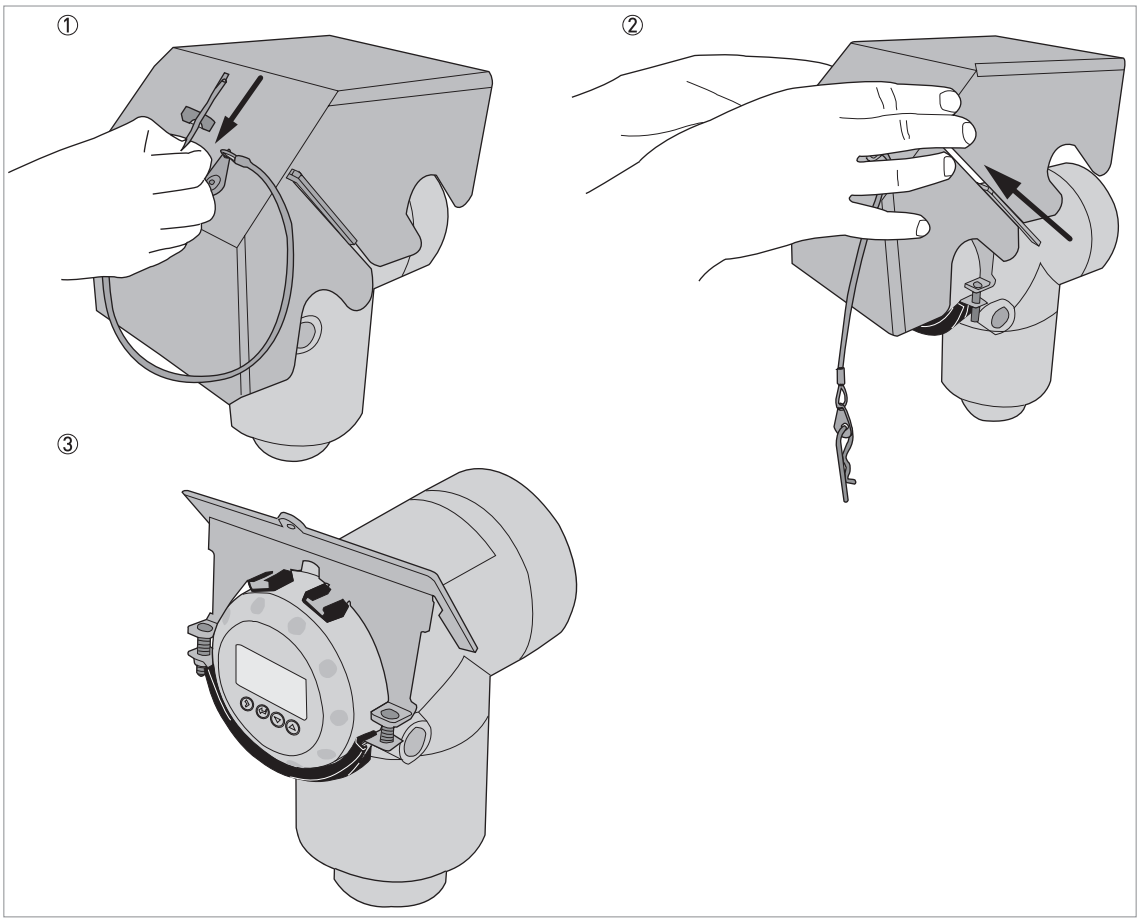


Figure 3-28: How to open the weather protection

① Remove the R-clip from the hole at the front of the weather protection cover.
② Remove the weather protection cover.
➲ End of the procedure.

3.8 How to install the device on the tank: remote version

3.8.1 Wall support for the remote version

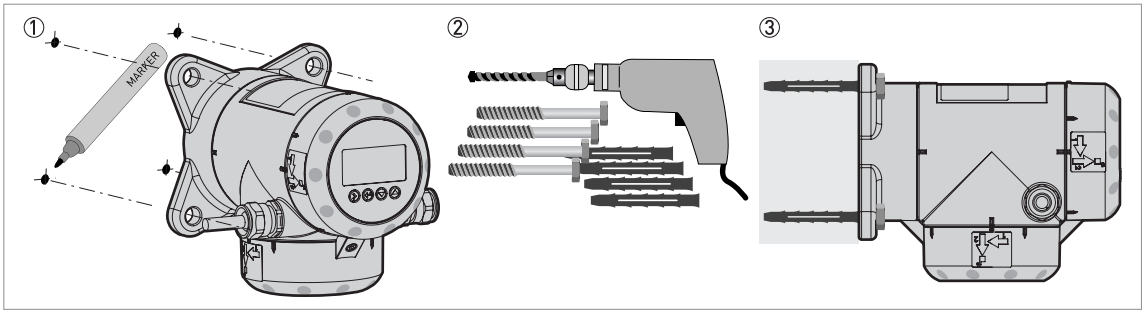


Figure 3-29: Wall support for the remote version (attached to the remote converter)

① Use marks on the wall to help you put the wall support in the correct position. For more data, refer to *Dimensions and weights* on page 116.
② Use equipment and tools that agree with health and safety regulations and good engineering practice.
③ Make sure that the wall support is correctly attached to the wall.

3.8.2 How to prepare the sensor extension for installation

The sensor extension is an option for the compact or remote version of the device.

Equipment needed:

- 5 mm Allen wrench
- 20 mm open-end torque wrench (not supplied)
- 21 mm open-end wrench (not supplied)
- 24 mm open-end wrench (not supplied)
- 55 mm open-end wrench (not supplied)
- 60 mm open-end wrench (not supplied)
- Compact converter or remote converter with probe housing
- Wall bracket
- Coaxial cable with one attached length of flexible stainless steel jacket
- One length of flexible stainless steel jacket
- Process connection and probe

How to attach the wall bracket

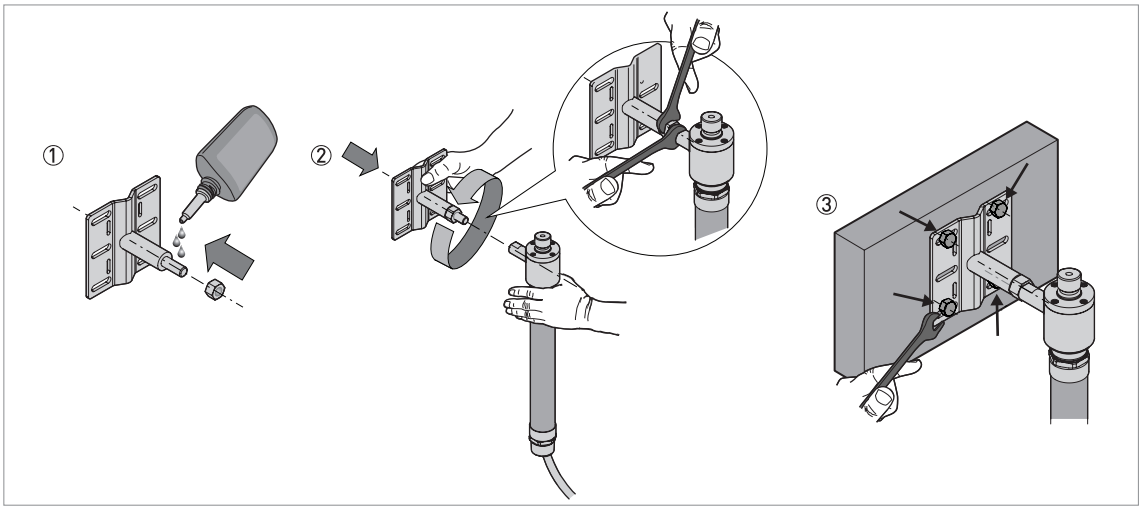


Figure 3-30: How to attach the wall bracket

CAUTION!

We recommend that you use LOCTITE® 2432™ to lock the bolts for the wall bracket. LOCTITE® 2432™ is on the PMUC list of approved materials for the nuclear industry.

① Apply LOCTITE® 2432™ to the threaded rod on the wall bracket. Attach the locking nut to the wall bracket

② Put the wall bracket thread in the fitting on the support below the signal converter (compact version) or the probe housing (remote version). Turn the wall bracket until it is fully engaged in the support. Tighten the locking nut with a 24 mm wrench and a 21 mm wrench.

③ Apply LOCTITE® 2432™ to the thread of the bolts for the wall bracket. Attach the wall bracket to a wall or pipe (DN50...100 / 2¨...4¨).

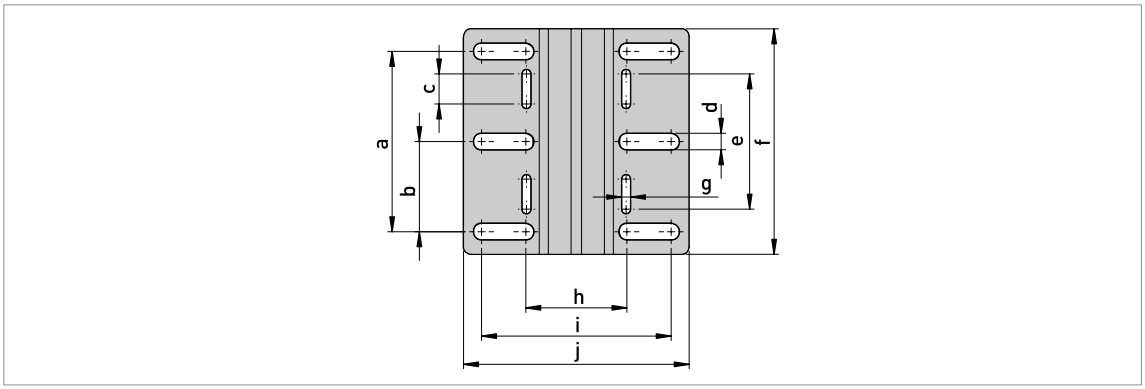


Figure 3-31: Dimensions of the wall bracket

Dimensions in mm

	Dimensions [mm]									
	a	b	c	d	e	f	g	h	i	j
Wall bracket	120	60	20	11	90	150	6	67.4	126.4	150.4

Dimensions in inches

	Dimensions [inches]									
	a	b	c	d	e	f	g	h	i	j
Wall bracket	4.7	2.4	0.8	0.4	3.5	5.9	0.2	2.65	4.98	5.92

How to attach the coaxial cable and the flexible metal jacket to the process connection

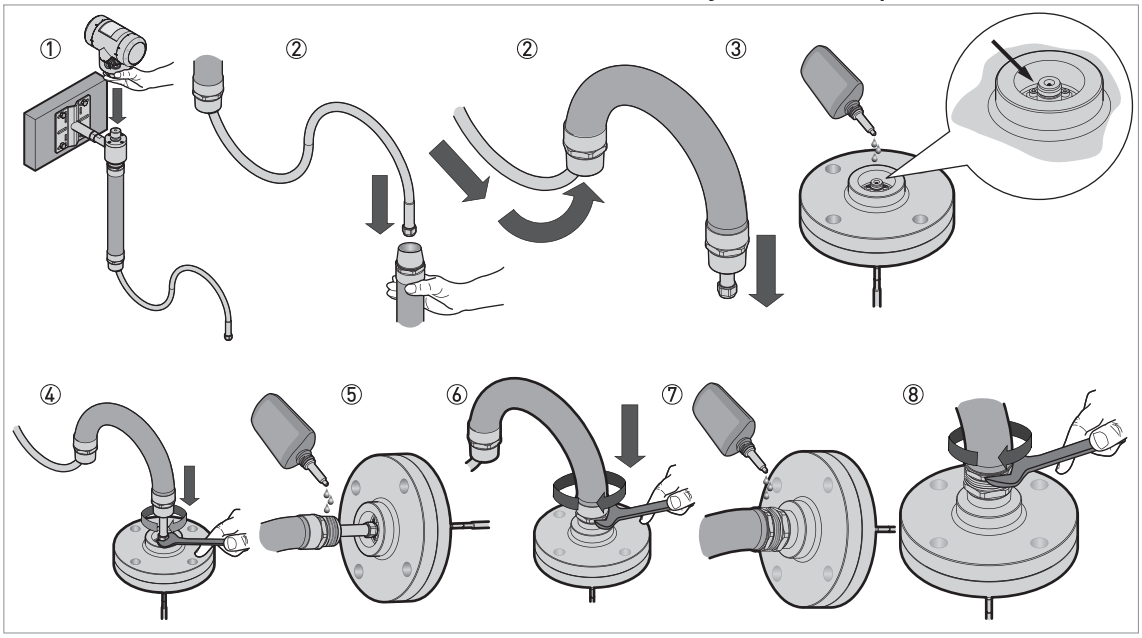


Figure 3-32: How to attach the coaxial cable and the flexible metal jacket to the process connection

CAUTION!
You must attach the stainless steel jacket to the wall with clamps. We recommend that you attach the stainless steel jacket to the wall with clamps at 50 cm / 20˝ intervals to agree with mechanical test specifications.

WARNING!
If the coaxial cable does not have a stainless steel jacket, use the applicable protective jacket for the coaxial cable and its attachments. Do not attach the coaxial cable tightly to the brackets. If there is a change in temperature, the cable will expand or contract and this can put too much force on the cable and the brackets. The cable must have sufficient space to move freely in a protective jacket.

CAUTION!
We recommend that you use LOCTITE® 2432™ Threadlocker to lock the threaded connections between the flexible jacket and the process connection. LOCTITE® 2432™ is on the PMUC list of approved materials for the nuclear industry.

① Attach the signal converter (compact version) or probe housing (remote version) to the support. Make sure the converter is fully engaged on the support and then tighten the lock screw with a 5 mm Allen wrench. For more data, refer to *How to turn or remove the signal converter* on page 36.
② One length of the flexible jacket is not attached. Put the coaxial cable in the flexible jacket and pull the cable to the end of the flexible jacket.
③ Apply LOCTITE® 2432™ Threadlocker to the thread of the Type N female connector on the top of the process connection.
④ Connect the coaxial cable to the Type N female connector on the top of the process connection. Use a 20 mm torque wrench to tighten the assembled parts to a torque of 4 N·m / 35.4 lbf·in.
⑤ Apply LOCTITE® 2432™ Threadlocker to the 1½ NPT male thread at the end of the flexible jacket.
⑥ Engage the 1½ NPT male thread at the end of the flexible jacket in the process connection socket. Tighten the flexible jacket with a 55 mm wrench.

⑦ Apply LOCTITE® 2432™ to the thread between the 1½ NPT connection and the union nut.
⑧ Tighten the union nut with a 60 mm wrench.

INFORMATION!
For more data about how to use LOCTITE® 2432™, refer to the related technical data sheet on the Henkel website.

LOCTITE® is a registered trademark of Henkel Corporation.

WARNING!
Minimum radius of the flexible metal jacket
If you bend the flexible metal jacket too far, it will damage the coaxial cable. Do not bend this part more than the minimum values in the table that follows:

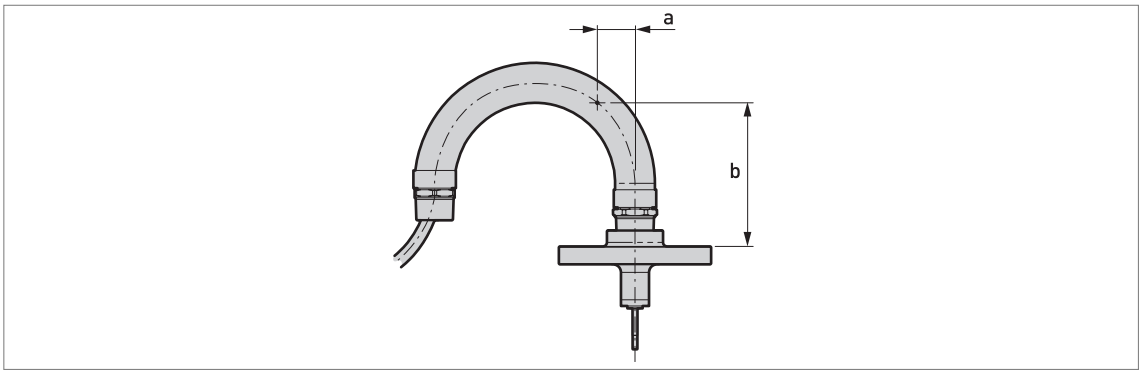


Figure 3-33: Minimum radius of the flexible metal jacket

	a		b	
	[mm]	[inches]	[mm]	[inches]
Minimum radius of flexible metal jacket	80	3.15	300	11.81

4.1 Safety instructions

DANGER!
All work on the electrical connections may only be carried out with the power disconnected.
Take note of the voltage data on the nameplate!

DANGER!
Observe the national regulations for electrical installations!

DANGER!
For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.

WARNING!
Observe without fail the local occupational health and safety regulations.
Any work done on the electrical components of the measuring device may only be carried out by properly trained specialists.

INFORMATION!
Look at the device nameplate to ensure that the device is delivered according to your order.
Check for the correct supply voltage printed on the nameplate.

4.2 Electrical installation: 2-wire, loop-powered

4.2.1 Compact version

Terminals for electrical installation

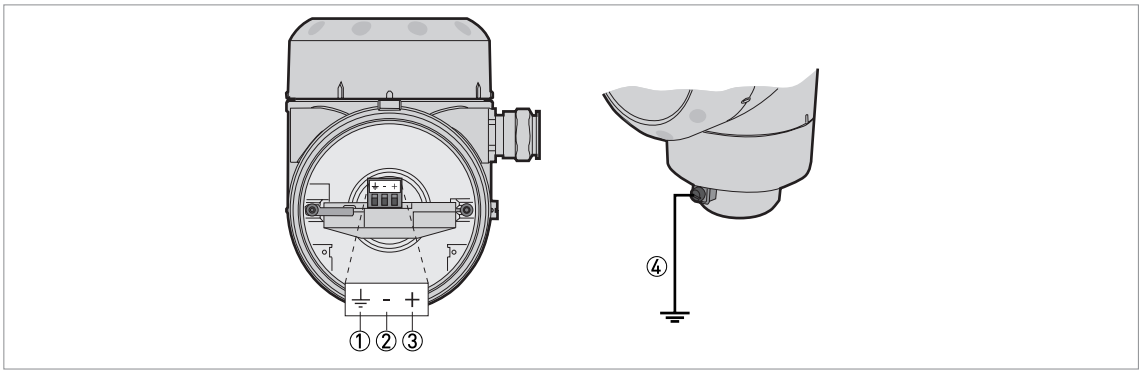


Figure 4-1: Terminals for electrical installation

① Grounding terminal in the housing (if the electrical cable is shielded)
② Current output -
③ Current output +
④ Location of the external grounding terminal (at the bottom of the converter)

INFORMATION!
Electrical power to the output terminal energizes the device. The output terminal is also used for HART® communication.

CAUTION!

- *Use the applicable electrical cables with the cable glands.*
- *Make sure that the current is not more than 5 A or that there is 5 A-rated fuse in the electrical circuit that energizes the device.*

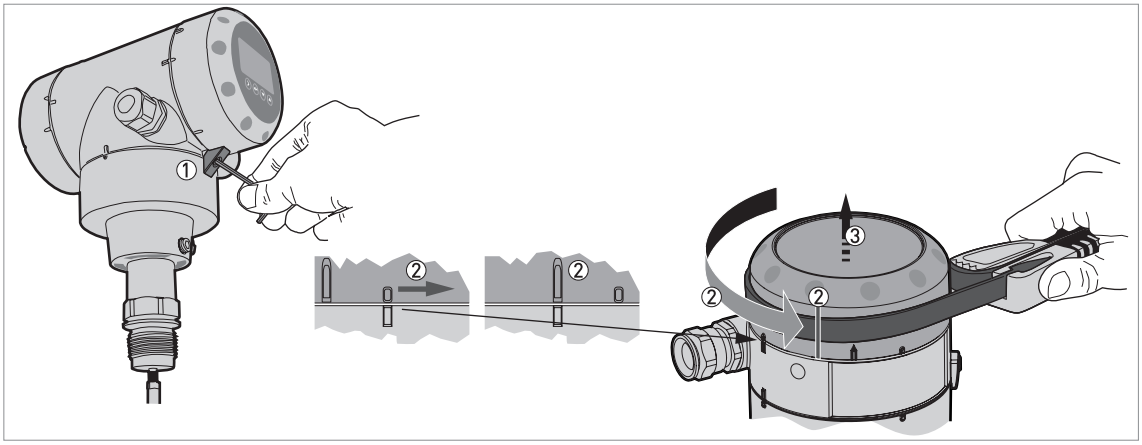


Figure 4-2: How to open the terminal compartment cover

① Loosen the lock screw with a 2.5 mm Allen wrench.
② Turn the cover counterclockwise with a strap wrench.
③ Remove the cover.

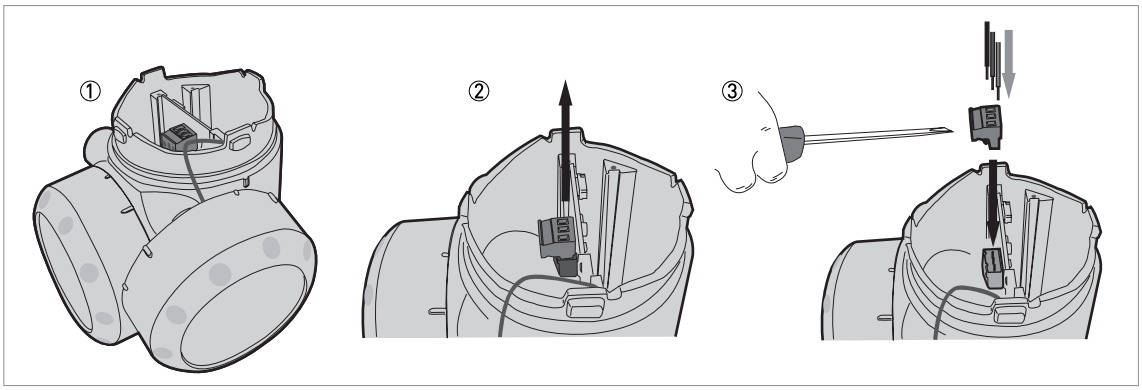


Figure 4-3: Procedure for electrical installation

Equipment needed:

- Small slotted tip screwdriver (not supplied)

Procedure:

① Do not disconnect the safety cord from the terminal compartment cover. Put the terminal compartment cover adjacent to the housing.
② Remove the connector from the circuit board.
③ Connect the electrical wires to the connector. Attach the connector to the circuit board. Tighten the cable entry glands.

Close the terminal compartment cover

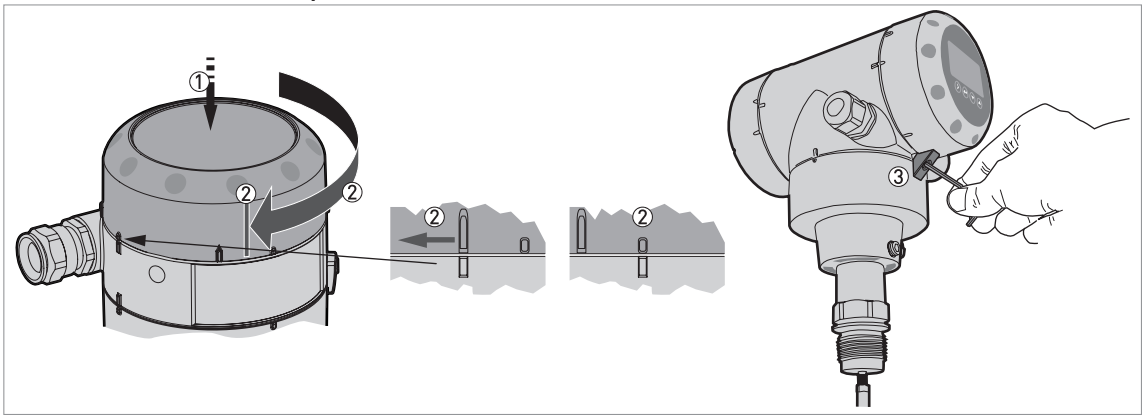


Figure 4-4: How to close the terminal compartment cover

- Put the cover on the housing and push it down.
- Turn the cover clockwise until it is fully engaged.
- Tighten the lock screw.

4.2.2 Remote version

Terminals for electrical installation

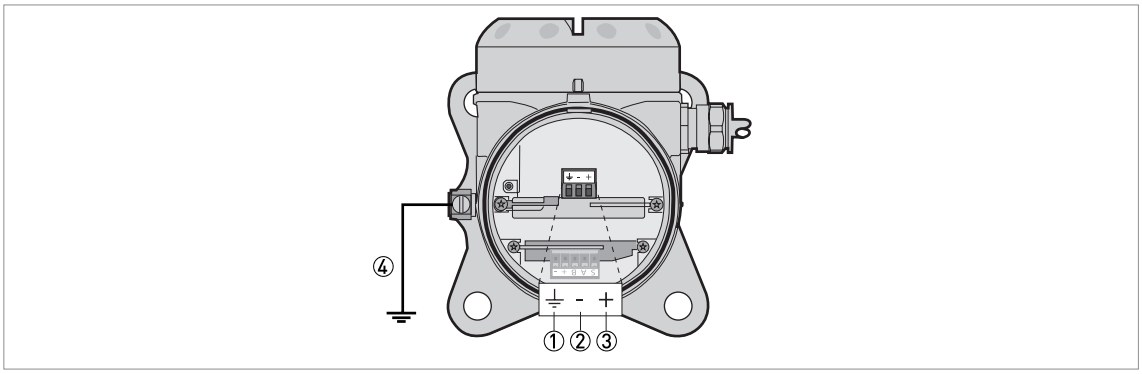


Figure 4-5: Terminals for electrical installation

① Grounding terminal in the housing (if the electrical cable is shielded)
② Current output -
③ Current output +
④ Location of the external grounding terminal (on the wall support)

INFORMATION!
Electrical power to the output terminal energizes the device. The output terminal is also used for HART® communication.

For more electrical installation data, refer to *Compact version* on page 46.

4.3 Remote device data

4.3.1 Requirements for signal cables supplied by the customer

Basic properties

- Twisted cable 2 by 2, shielded or screened.

Maximum length of the signal cable

- 300 m / 984 ft

Temperature

- Use electrical cable with the applicable temperature rating for the operating conditions.
- Ambient temperature range: -40...+80°C / -40...+176°F
- We recommend that the cable agrees with UL 94V-0.

Dimensions of the insulated conductors

- Min.-max. cross-sectional area of the conductors: 4×0.326...4×2.5 mm² (22....14 AWG), shielded cable
- Use the applicable cable for the cable glands (Ø6....10 mm / 0.24...0.39¨).
- Use the applicable cable glands for the cable entry openings in the housing.

Electrical characteristics

- Test voltage: Insulated conductor / shield (screen) ≥ 500 VAC
- Line resistance: < 55 Ω/km
- The cable must agree with EN 60811 (Low Voltage Directive) or equivalent national regulations.

Electrical characteristics and constraints for use in nuclear power stations

- The cable insulation must not release halogen (zero halogen) when it is near sources of heat.
- The cable must agree with these standards and specifications: Class C1 of NF C32-070, IEEE Std 1202 and UL 1581.

4.3.2 How to prepare a signal cable supplied by the customer

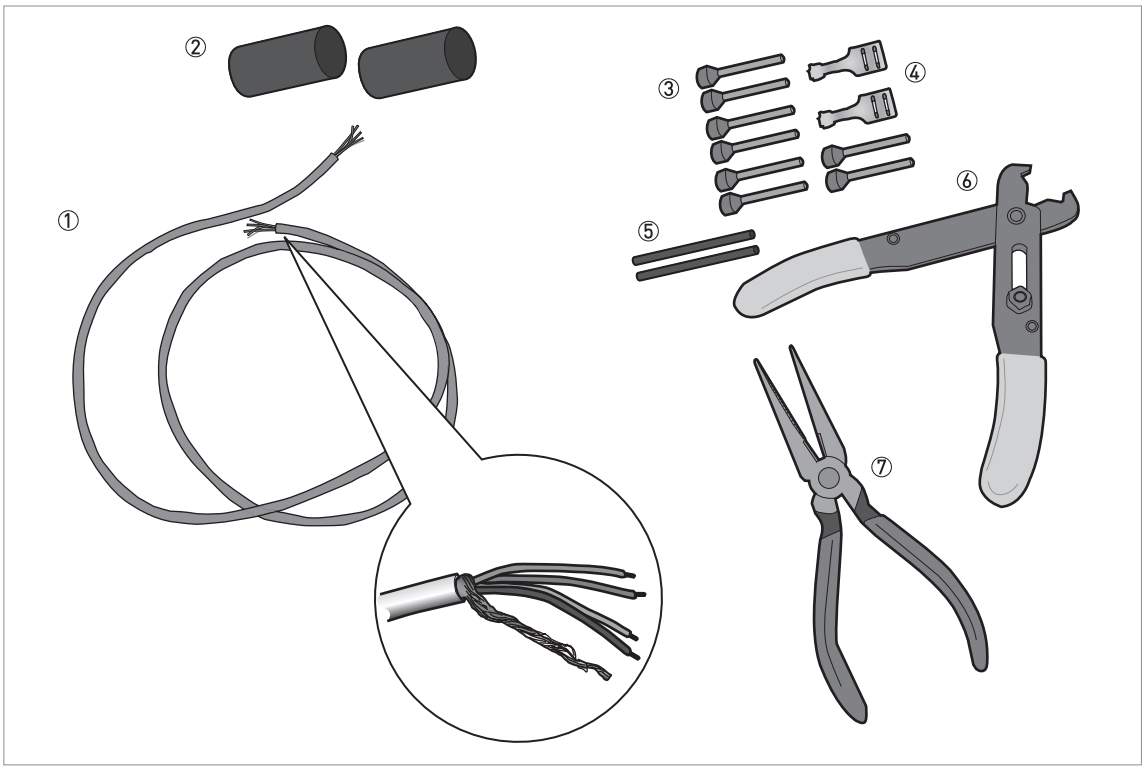


Figure 4-6: Equipment needed to prepare the signal cable

① Signal cable (supplied on request)
② 2 heat-shrinkable sleeves for the jacket (not supplied)
③ 8 ferrules for the end of the conductors (not supplied)
④ 2 Faston connectors for the shield wires
⑤ Shield wire insulation, 2 sleeves
⑥ Wire stripper (not supplied)
⑦ Crimping pliers (not supplied)

INFORMATION!

- *The Faston connector for the stranded drain wire must agree with DIN 46 228: E 1.5-8*
- *The wire end ferrules for the twisted pair of conductors must agree with DIN 46 228: E 0.5-8*

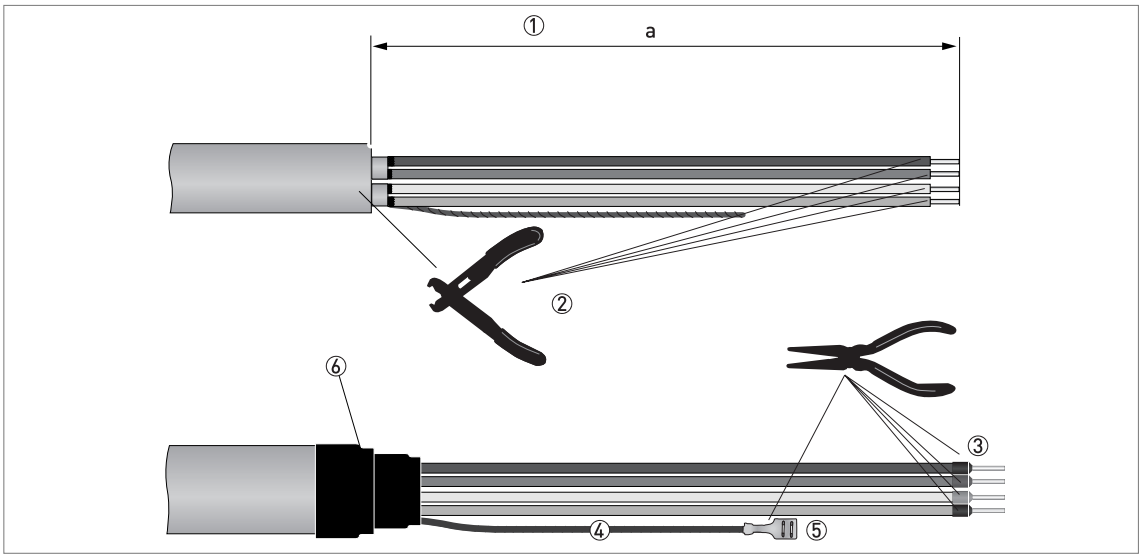


Figure 4-7: How to prepare the signal cable

① Remove the jacket from the wire to dimension "a". a = 50 mm / 2¨.
② Remove the insulation from the wire. Obey national regulations for electrical wiring.
③ Crimp the wire end ferrules on the conductors.
④ Install shield wire insulation on the 2 ends of the shield wire.
⑤ Crimp the Faston connectors on the 2 ends of the shield wire.
⑥ Install a heat-shrinkable sleeve on the jacket.

4.3.3 How to connect the signal cable to the device

DANGER!
Cables may only be connected when the power is switched off.

DANGER!
The device must be grounded in accordance with regulations in order to protect personnel against electric shocks.

WARNING!
Observe without fail the local occupational health and safety regulations.
Any work done on the electrical components of the measuring device may only be carried out by properly trained specialists.

CAUTION!
Do not wind the signal cable. This configuration will prevent interference from electromagnetic fields.

Equipment needed

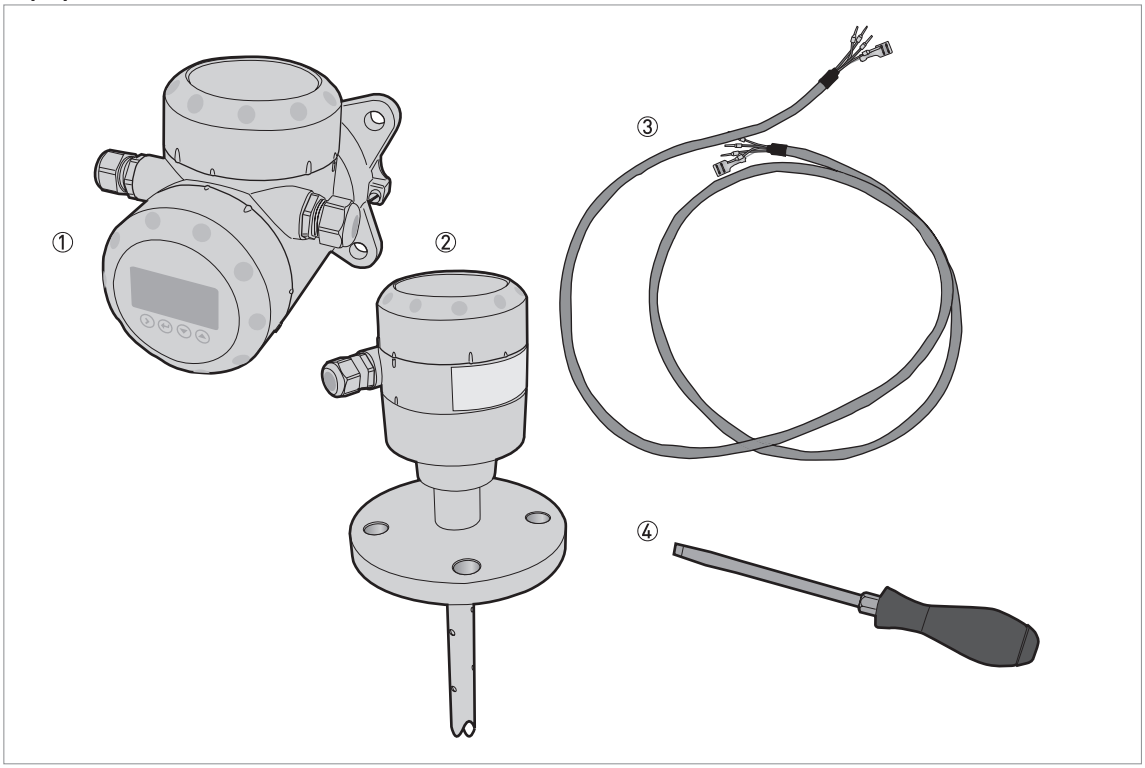


Figure 4-8: Equipment needed to prepare the signal cable

① Remote converter
② Probe housing
③ Signal cable – for more data, refer to *How to prepare a signal cable supplied by the customer* on page 50
④ Small slotted-tip screwdriver (not supplied)

Connections between the remote converter and the probe housing

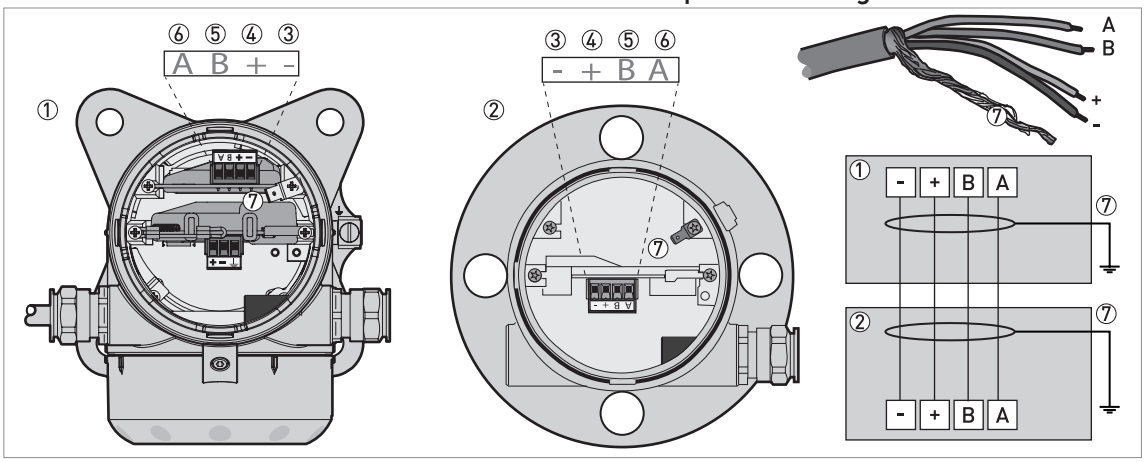


Figure 4-9: Connections between the remote converter and the probe housing

① Remote converter
② Probe housing
③ Power supply: voltage in -
④ Power supply: voltage in +
⑤ Signal cable B
⑥ Signal cable A
⑦ Shielding wire (attached to Faston connectors in the housings of the remote converter and the probe housing)

How to connect the signal cable to the remote converter

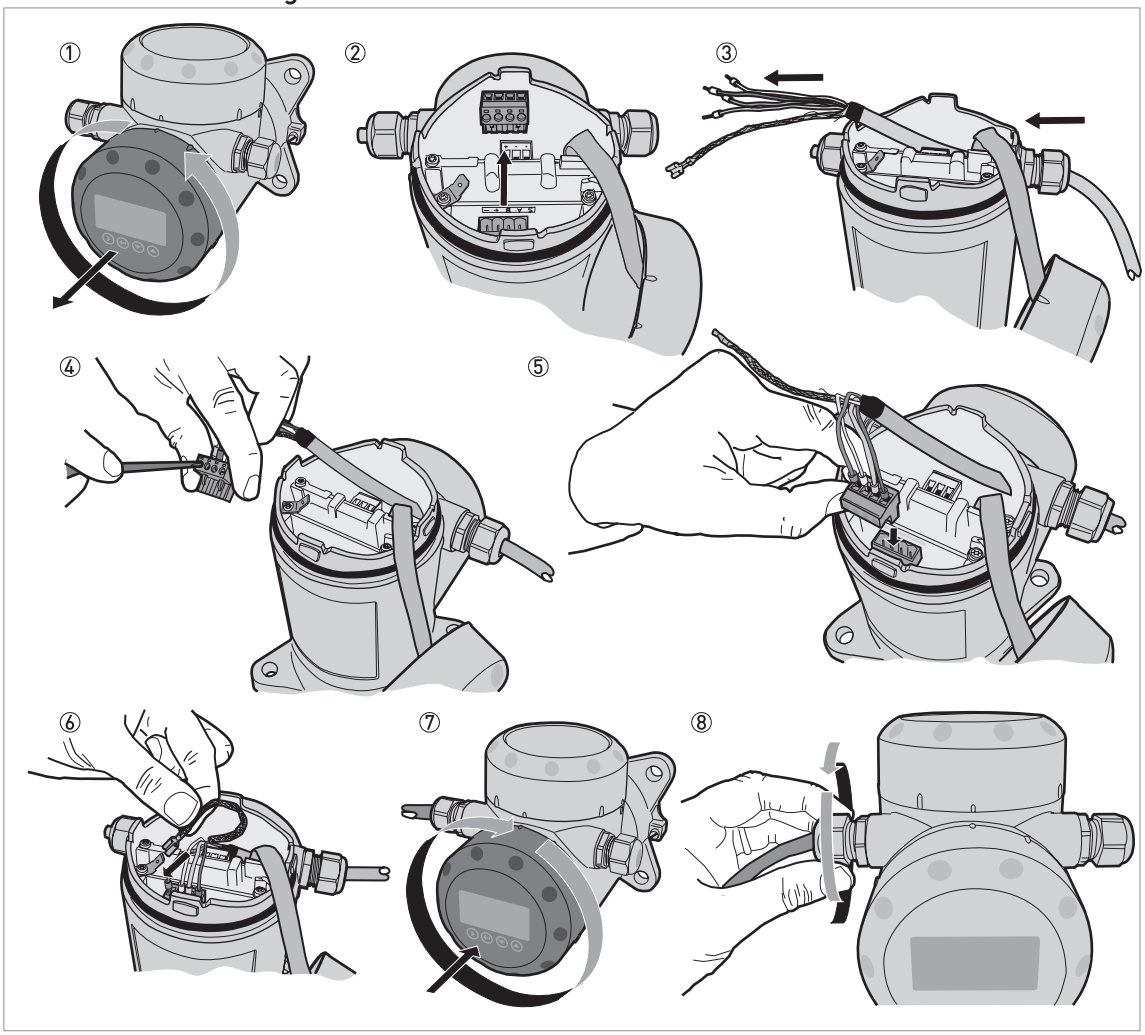


Figure 4-10: How to connect the signal cable to the remote converter

CAUTION!
Bending radius of the signal cable: ≥ 50 mm / 2"

① Remove the terminal compartment cover.
② Remove the 4-pin connector.
③ Put the signal cable into the opening of the cable gland.
④ Put the electrical wires in the connector terminals. Tighten the terminal screws with a small slotted-tip screwdriver. Make sure that the electrical wires agree with the terminals. For more data, refer to the electrical schema in this section.
⑤ Put the connector into the 4-pin socket.
⑥ Attach the Faston connector (drain wire).
⑦ Attach the terminal compartment cover.
⑧ Tighten the cable gland. Make sure that the remote converter is correctly sealed.

How to connect the signal cable to the probe housing

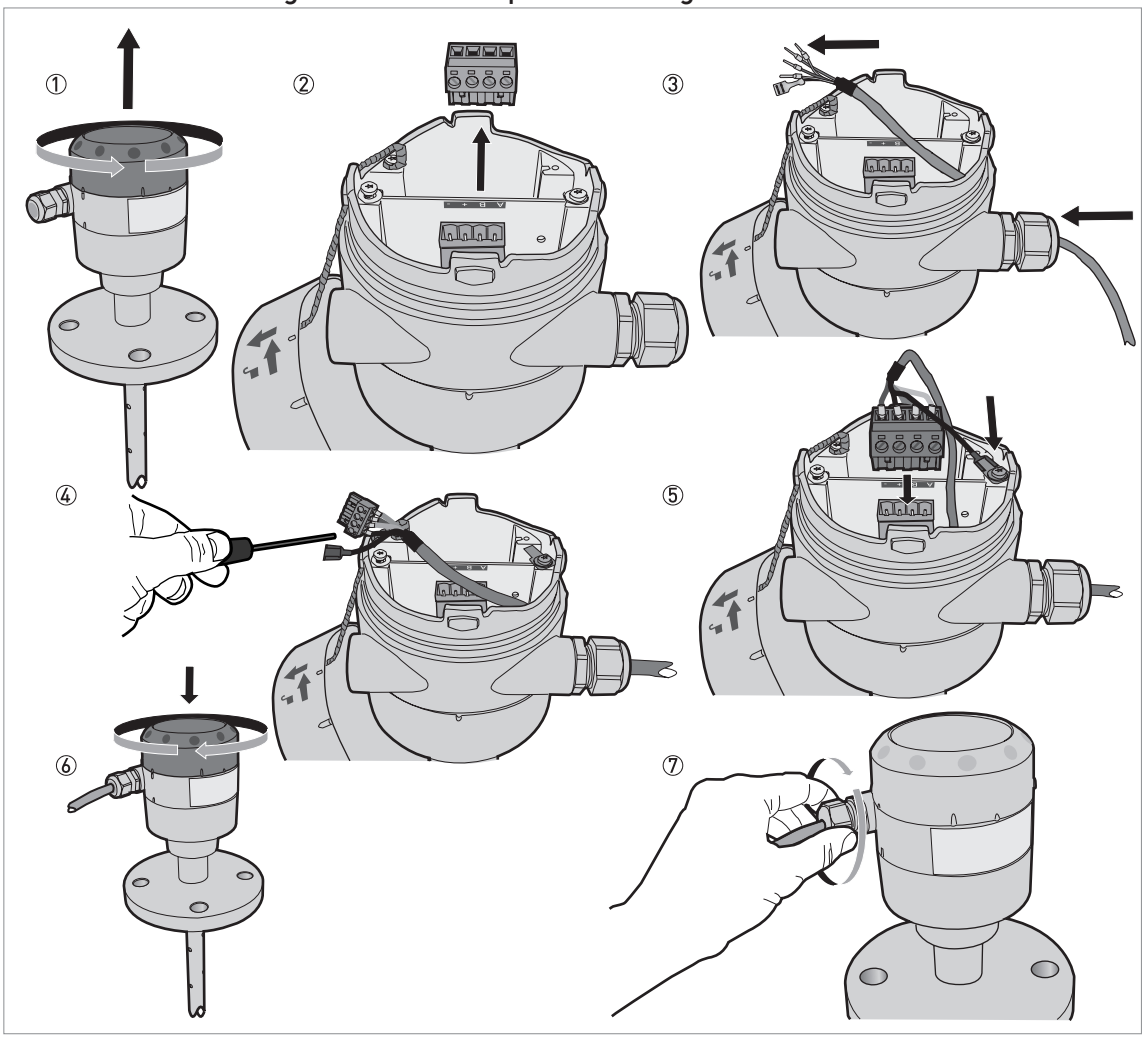


Figure 4-11: How to connect the signal cable to the probe housing

CAUTION!
Bending radius of the signal cable: ≥ 50 mm / 2"

① Remove the terminal compartment cover.
② Remove the 4-pin connector.
③ Put the signal cable into the opening of the cable gland.
④ Put the electrical wires in the connector terminals. Tighten the terminal screws with a small slotted-tip screwdriver. Make sure that the electrical wires agree with the terminals. For more data, refer to the electrical schema in this section.
⑤ Put the connector into the 4-pin socket. Attach the Faston connector (drain wire).
⑥ Attach the terminal compartment cover.
⑦ Tighten the cable gland. Make sure that the probe housing is correctly sealed.

4.4 Electrical connection for current output

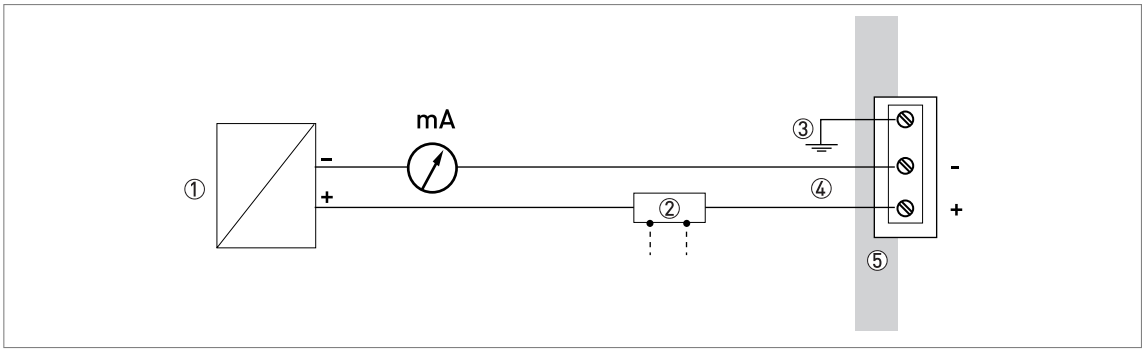


Figure 4-12: Electrical connections

① Power supply
② Optional junction box (ref. SJB 200W) for on-site readings of loop current
③ Optional connection to the grounding terminal
④ Output: 11.5...30 VDC for an output of 22 mA at the terminal
⑤ Device

4.5 Protection category

INFORMATION!
The device fulfils all requirements per protection category IP66 / IP67. It also fulfils all requirements per NEMA type 4X (housing) and type 6P (probe).

DANGER!
Make sure that the cable gland is watertight.

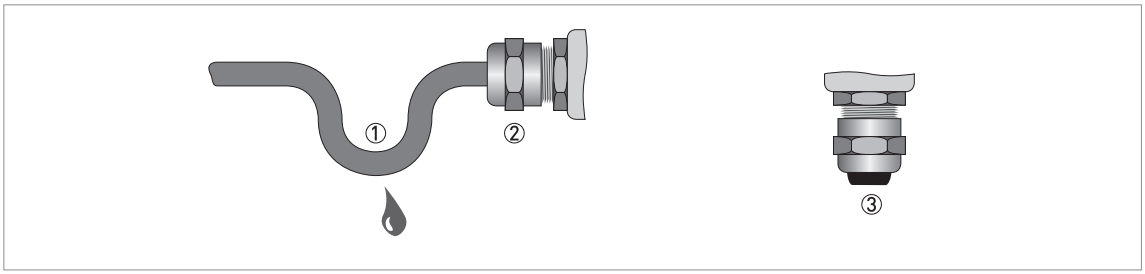


Figure 4-13: How to make the installation agree with protection category IP67

- Make sure that the gaskets are not damaged.
- Make sure that the electrical cables are not damaged.
- Make sure that the electrical cables agree with the national electrical code.
- The cables are in a loop in front of the device ① so water does not go into the housing.
- Tighten the cable feedthroughs ②.
- Close unused cable feedthroughs with dummy plugs ③.

Refer to the table that follows for the diameter of the outer sheath of the electrical cable:

Min. / Max. diameter of the electrical cable

Type of electrical cable	Min. / Max. diameter of the electrical cable	
	[mm]	[inches]
Power supply / output	6...7.5	0.24...0.3
Signal cable (for the remote version) ①	6...10	0.24...0.39

① This electrical cable is connected between the remote converter and the probe housing

4.6 Networks

4.6.1 General information

The device uses the HART® communication protocol. This protocol agrees with the HART® Communication Foundation standard. The device can be connected point-to-point. It can also have a polling address of 1 to 63 in a multi-drop network.

The device output is factory-set to communicate point-to-point. To change the communication mode from **point-to-point** to **multi-drop**, refer to *HART®* network configuration on page 84.

4.6.2 Point-to-point networks

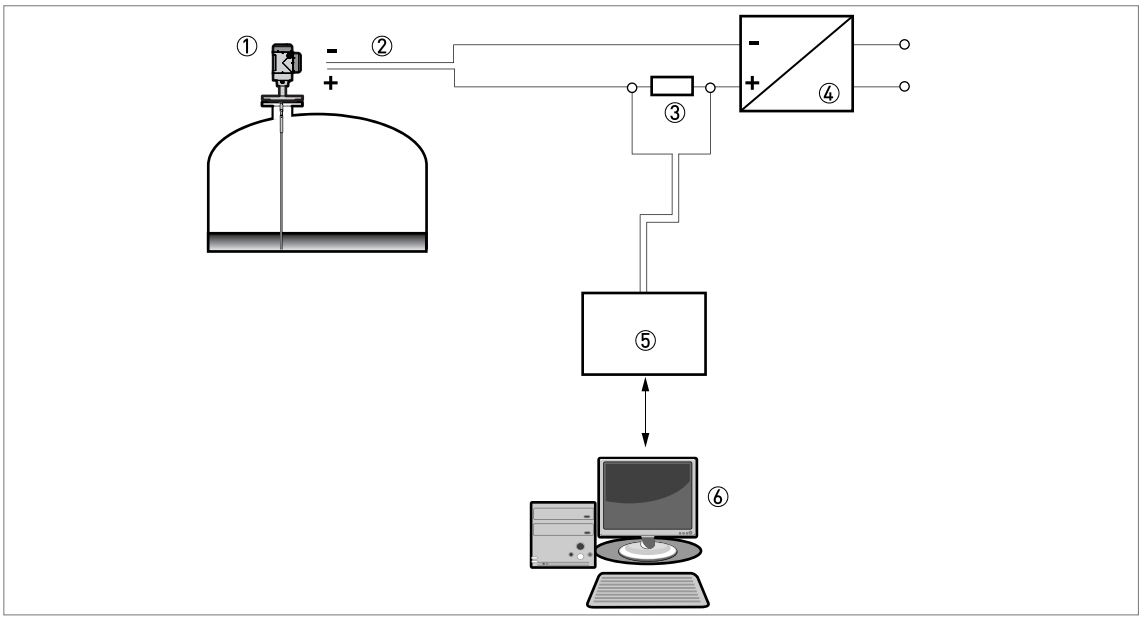


Figure 4-14: Point-to-point connection

① Address of the device (0 for a point-to-point connection)
② 4...20 mA + HART®
③ Resistor for HART® communication
④ Power supply
⑤ HART® modem
⑥ HART® communication device

4.6.3 Multi-drop networks

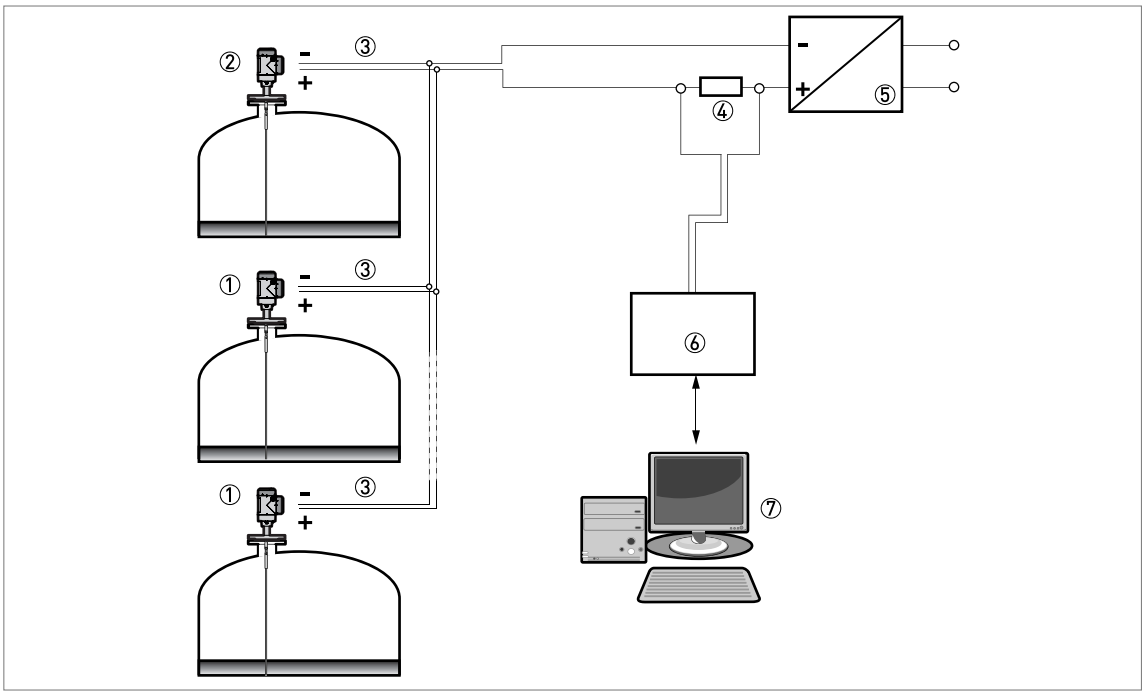


Figure 4-15: Multi-drop network

① Address of the device (n+1 for multidrop networks)
② Address of the device (1 for multidrop networks)
③ 4 mA + HART®
④ Resistor for HART® communication
⑤ Power supply
⑥ HART® modem
⑦ HART® communication device

5.1 How to start the device

5.1.1 Start-up checklist

Check these points before you energize the device:

- Are all the wetted components (probe, process connection and gaskets) chemically resistant to the product in the tank?
- Does the information on the signal converter nameplate agree with the operating data?
- Did you correctly install the device on the tank?
- Do the electrical connections agree with the national electrical codes?

5.1.2 How to start the device

- Connect the converter to the power supply.
- Energize the converter.

➲ **Devices with the LCD display option only:** After 10 seconds the screen will display "Starting up". After 20 seconds the screen will display the software version numbers. After 30 seconds the default screen will appear.

- The device will display readings.

INFORMATION!
This chapter and the start of the chapter that follows tell you what data is given on the device display in normal mode and how to change device settings in configuration mode. If you know about how this device operates, you can ignore this data. Continue with the quick setup procedure. For more data about this procedure, refer to Commissioning on page 77.

5.2 Operating concept

You can read measurements and configure the device with:

- A digital display screen (optional).
- A junction box (ref. SJB 200W) connected to the circuit to measure loop current (optional).
- A connection to a system or PC with PACTware™. You can download the Device Type Manager (DTM) file from the website. It is also supplied on the DVD-ROM delivered with the device.
- A connection to a system or PC with AMS™. You can download the Device Description (DD) file from the website. It is also supplied on the DVD-ROM delivered with the device.
- A connection to a HART® Field Communicator. You can download the Device Description (DD) file from the website. It is also supplied on the DVD-ROM delivered with the device.

5.3 Digital display screen

5.3.1 Local display screen layout

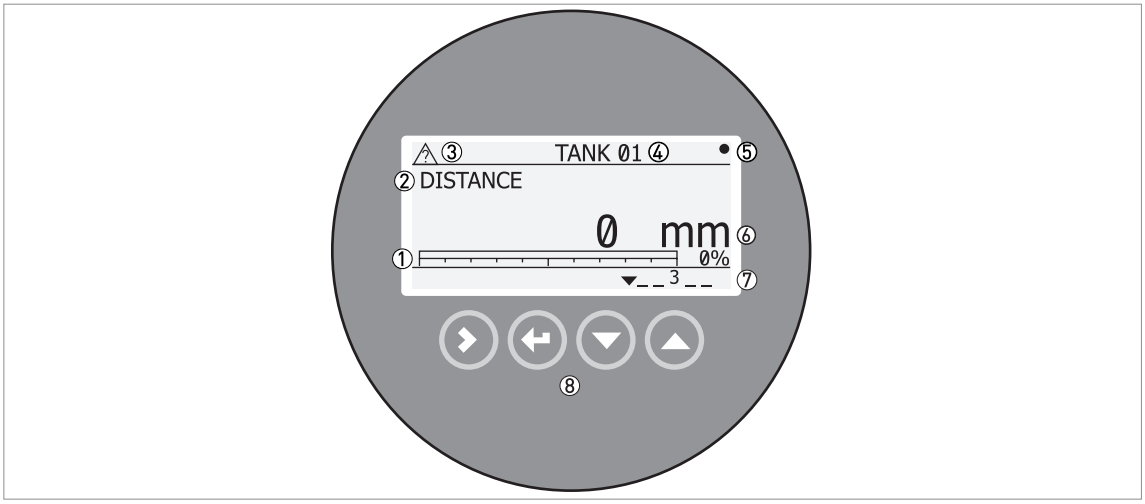


Figure 5-1: Local display screen layout in Normal mode

① Current output percentage (bar graph and text — only shown if the current output function is the same as the measurement on the screen in normal mode)
② Measurement type (in this example, distance)
③ Device status (NE 107 symbols)
④ Device tag name
⑤ Updated measurement data symbol (the symbol flashes each time the measurement data is updated)
⑥ Measurement value and units
⑦ Device status (markers)
⑧ Keypad buttons (refer to the table in the section that follows)

The current output percentage is only shown if the measurement type (refer to item ② in the illustration) is the same as the output function. The parameter is set in menu item 2.4.1 (OUTPUT FUNC.). For example, if the output function is set to "Level" and the device shows "Level" measurements in normal mode, the bar graph and value is shown (refer to item ① in the illustration).

Figure 5-2: Local display screen layout in configuration mode

① Function name
② Configuration mode symbol
③ Menu number

5.3.2 Functions of keypad buttons

Keypad button	Function
[Right]	**Normal mode:** Enter menu (Enter Configuration mode)
	Configuration mode: Move cursor to the right
[Return / Escape]	**Normal mode:** Change units (m, cm, mm, in, ft)
	Configuration mode: Exit
[Down]	**Normal mode:** Change measurement type (distance, level, output (%), output (mA), conversion, ullage conversion) ①
	Configuration mode: Decrease value or change parameter
[Up]	**Normal mode:** Change measurement type (distance, level, output (%), output (mA), conversion, ullage conversion) ①
	Configuration mode: Increase value or change parameter

① If you have made a strapping table in menu item 2.8.1 INPUT TABLE for volume or mass measurement, "Conversion" and "Ullage Conv." will be shown in the list of measurement types

For data on keypad functions, refer to *Normal mode* on page 63.

5.4 Remote communication with PACTware™

PACTware™ displays measurement information clearly and lets you configure the device from a remote location. It is an Open Source, open configuration software for all field devices. It uses Field Device Tool (FDT) technology. FDT is a communication standard for sending information between the system and the field device. This standard agrees with IEC 62453. Field devices are easily integrated. Installation is supported by a user-friendly Wizard.

Install these software programs and equipment:

- Microsoft® .NET Framework version 1.1 or later.
- PACTware.
- HART® converter (USB, RS232 etc.).
- The Device Type Manager (DTM) for the device.

INFORMATION!
The DTM for this device agrees with the FDT1.2 specification. For more data, refer to the related certificate in the Product Catalog on the FDT Group website (http://www.fdtgroup.org/product-catalog/certified-dtms).

You can download the latest version of PACTware™ and the DTM from our website.

Refer also to the PACTware™ consortium site at http://www.pactware.com.

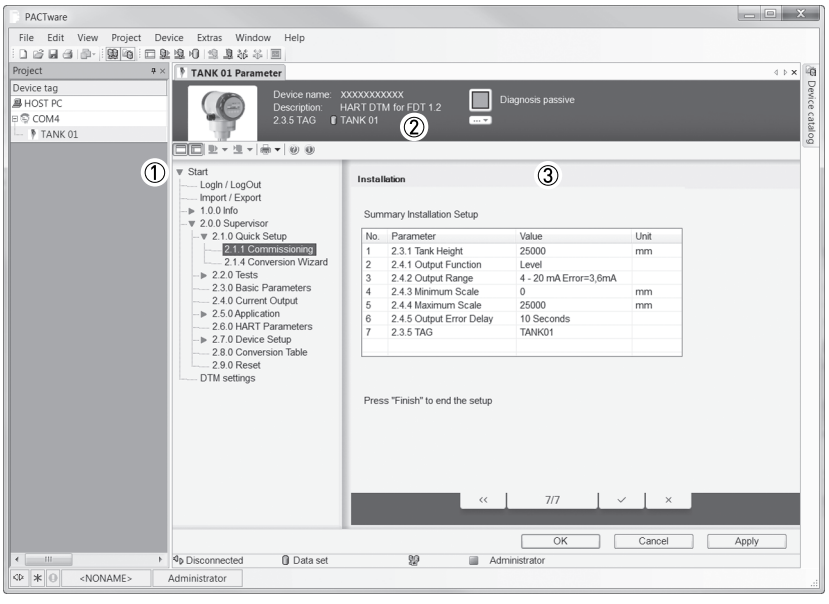


Figure 5-3: Screen from the PACTware™ user interface

① DTM menu
② Information for device identification
③ Configuration summary

5.5 Remote communication with the AMS™ Device Manager

The AMS™ Device Manager is an industrial Plant Asset Management (PAM) software tool. Its role is to:

- Store configuration information for each device.
- Support HART® devices.
- Store and read process data.
- Store and read diagnostic status information.
- Help plan preventive maintenance to reduce a plant's downtime to a minimum.

You can download the DD file from our website.

6.1 User modes

Normal mode

This mode displays measurement data. For more data, refer to *Normal mode* on page 63.

Configuration mode

Use this mode to view parameters, commission the device, create tables for volume or mass measurement, and change critical values to measure in difficult process conditions. To get access to supervisor menu, refer to *Protection of the device settings* on page 83. For more data on menu items, refer to *Function description* on page 70.

6.2 Normal mode

This mode shows measurement data. Use the table that follows:

- for the selection of the measurement type (level, distance, percentage and conversion) and
- for the selection of the measurement units

Some measurement types will only be available if the device has the correct parameters entered in the configuration mode.

Keypad functions

Button	Description	Function	"Hot key" function
	Right	Enter configuration mode.	—
	Return / Escape	Change the measurement units.	The device will show the firmware version numbers in menu item 1.1.0 IDENT..
	Down	Change the measurement type.	—
	Up	Change the measurement type.	The display language will change when you push this button for 2 seconds. Push the button again and it will go back to the original language.

Measurement definitions

Measurement name	Description	Available units
LEVEL	This is a display and an output function option. It is the height from the bottom of the tank to the surface of the liquid contents (Tank height - Distance).	m, cm, mm, in (inches), ft (feet)
DISTANCE	This is a display and an output function option. It is the distance from the face of the flange to the surface of the liquid contents of the tank.	m, cm, mm, in (inches), ft (feet)
CONVERSION	This is a display and an output function option. It gives the volume or mass of the tank contents. This data is available if you prepare a volume or mass table in configuration mode. For data on how to prepare the conversion table, refer to *How to configure the device to measure volume or mass* on page 86.	kg, t, Ston, Lton, m, cm, mm, in, ft, m3, L, gal, Imp, ft3, bbl
ULLAGE CONV.	This is a display and an output function option. It gives the empty volume or remaining mass that can be put in the tank. This data is available if you prepare a volume or mass table in configuration mode. For data on how to prepare the conversion table, refer to *How to configure the device to measure volume or mass* on page 86.	kg, t, Ston, Lton, m, cm, mm, in, ft, m3, L, gal, Imp, ft3, bbl
EPSILON R	The dielectric constant of the contents of the tank. An electrical property of the liquid contents of the tank. Also known as ε_r, DK and relative permittivity. This gives the strength of the measurement pulse reflection. This data is shown if the menu item AUTO Er CALC (2.5.2) is used to calculate the dielectric constant value.	No unit
OUTPUT I (mA)	The current output of the device.	mA
OUTPUT I (%)	The percentage of the current output. 0% = 4 mA. 100% = 20 mA.	%

6.3 Configuration mode

6.3.1 General notes

Change the settings of your device in **Configuration** mode. Data about the menus is given on page 70. You can:

- Use the **1.0.0 INFORMATION** menu to read settings, device software versions and error records. For more data about the Information menu, refer to Table 1: Info.
- Use the **2.0.0 SUPERVISOR** menu to commission the device, to run diagnostic tests, set up a conversion table for volume or mass measurement, change critical parameters for difficult process conditions, reset the device and change basic parameters (tank height etc.), output settings, HART Address etc. For more data about the Supervisor menu, refer to Table 2: Supervisor.

CAUTION!
The commissioning procedure is mandatory.

INFORMATION!
It is not possible to enter the 3.0.0 SERVICE and 4.0.0 MASTER menus. These menus are for factory calibration and approved personnel only.

6.3.2 How to get access to the commissioning menu

Do the steps that follow:

- Push the [>] button.

➲ This shows the **Information** menu. The **Information** menu is read only and does not have password security.

- Push the [▲] button one time to scroll up to the **Supervisor** menu.

➲ The screen shows the text "2.0.0 SUPERVISOR".

- Push the [>] button one time.

➲ The screen shows a line. You must enter the password. Push the buttons under the display screen 6 times (in total and in a given order) to get access to Configuration mode.

- Type in the password. The factory-set password is [>], [↵], [▼], [▲], [>] and [↵].

➲ The device shows the text "2.1.0 COMMISSION.". Make a selection from the items in the supervisor menu.

INFORMATION!
HOW TO SET THE SUPERVISOR PASSWORD TO "ON" OR "OFF"
The supervisor password is set to "on" by default. If it is necessary to set this function to "off", refer to Function description on page 70, Table 2: Supervisor menu, menu item PSWD YES/NO (2.7.4).

INFORMATION!
HOW TO CHANGE THE SUPERVISOR PASSWORD
You can change the password for the supervisor menu. For more data, refer to Function description on page 70, Table 2: Supervisor menu, menu item PASSWORD (2.7.5).

6.3.3 Menu overview

1.0.0 Info. (Information)

1.1.0	Ident. (Identification)
1.2.0	Output
1.3.0	History

2.0.0 Supervisor

2.1.0	Quick Setup
2.2.0	Tests
2.3.0	Basic Param. (Basic Parameters)
2.4.0	Output I
2.5.0	Application
2.6.0	Communicat. (Communication)
2.7.0	Display
2.8.0	Conv. Table (Conversion Table)
2.9.0	Config/Reset

3.0.0 Service

n/a	Password locked. Menus for factory calibration and qualified service personnel only.

4.0.0 Master

n/a	Password locked. Menus for factory calibration and qualified service personnel only.

6.3.4 Keypad functions

Figure 6-1: Local display screen layout in configuration mode

① Function name
② Configuration mode symbol
③ Menu number

This is what you see when you are in Configuration mode. The functions of the buttons are given in the table that follows:

Functions of buttons for menu navigation

Button	Description	Function
☞	Right	• Go down to the sub-menu level (for example, from menu 1.0.0 to sub-menu 1.1.0). • Enter the menu item
☞	Enter / Esc (Escape)	• Go up to the menu level (for example, from sub-menu 1.1.0 to menu 1.0.0). • Go to Normal mode. If you changed settings in Configuration mode, you must save or cancel your new settings. For more data, refer to the end of this section.
☞	Down	• Scroll down the menu list (for example, from menu 2.0.0 to menu 1.0.0). • Scroll down the sub-menu list (for example, from sub-menu 2.2.0 to sub-menu 2.1.0).
☞	Up	• Scroll up the menu list (for example, from menu 1.0.0 to menu 2.0.0). • Scroll up the sub-menu list (for example, from sub-menu 2.1.0 to sub-menu 2.2.0).

Lists of parameters in menu items

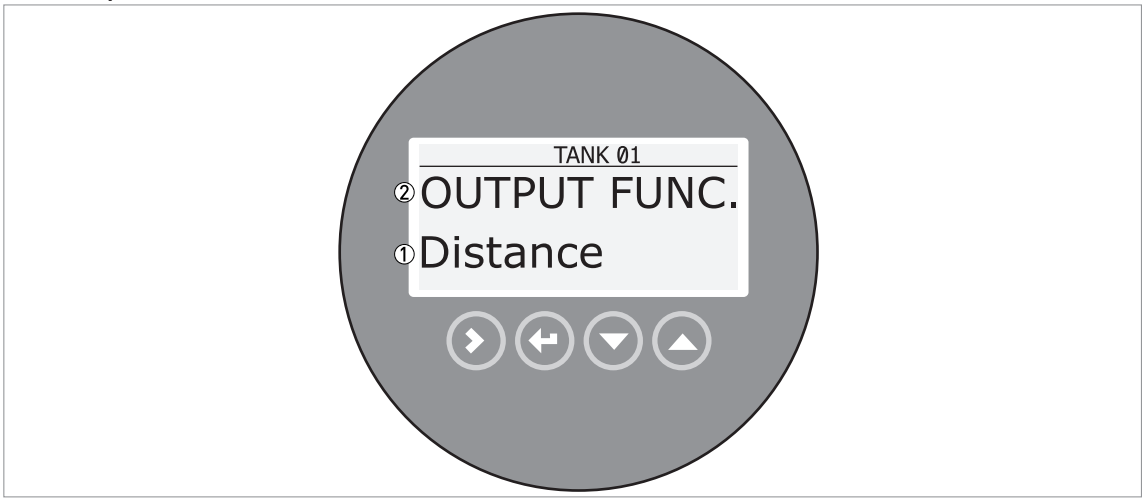


Figure 6-2: Lists of parameters in menu items

① Parameter
② Menu name

This is what you see when you select a menu item that has a list of parameters. The functions of the buttons are given in the table that follows:

Function of buttons in menu items that have a list of parameters

Button	Description	Function
☞	Right	n/a
☞	Enter / Esc (Escape)	Select the parameter and go back to the menu
☞	Down	Move down the list
☞	Up	Move up the list

Values in menu items

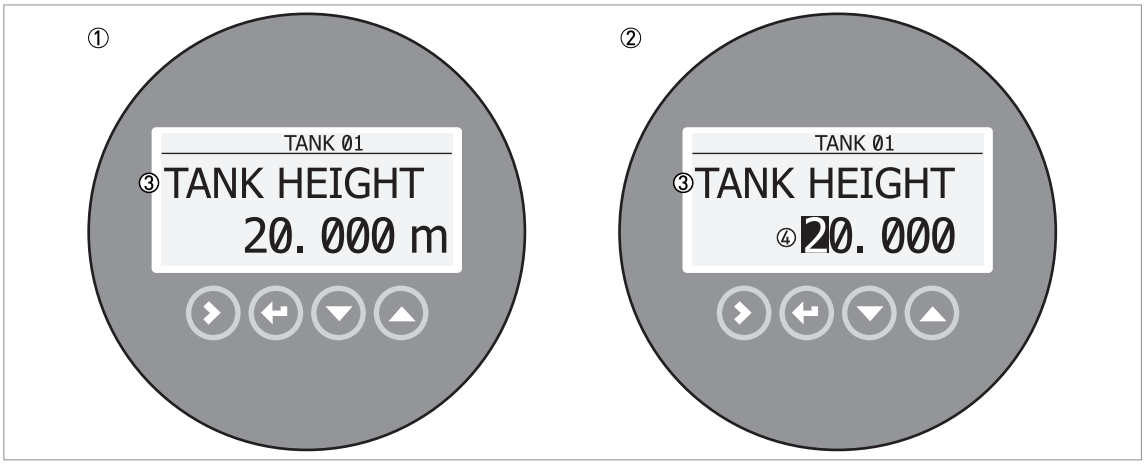


Figure 6-3: Values in menu items

① Menu item with values stored at this time (first screen)
② Push [>] again to change the values. A cursor shows on the first digit.
③ Menu item name
④ Cursor on the selected digit

This is what you see when you select a menu item that has a value. The functions of the buttons are given in the table that follows:

Function of buttons in menu items that have values

Button	Description	Function
☞ ▶	Right	• Enter the menu item and see the value stored at this time. • Enter the menu item configuration level to change the value. • Move the cursor to the next digit on the right. If the cursor is on the last digit, push [>] again to go back to the first digit.
☞ ↵	Enter / Esc (Escape)	Accept the value and go back to the sub-menu.
☞ ▼	Down	Decrease the digit value.
☞ ▲	Up	Increase the digit value.

How to save settings changed in the supervisor menu (menu 2.0.0)

- When you have changed parameters in all the necessary menu items, push [↵] to accept the new parameter.
- Push [↵] to go back to the "STORE" screen.
- The device will ask you to save or cancel your settings. Push [▲] or [▼] to select **STORE YES** or **STORE NO**. Push [↵] to accept or reject the new settings.

➲ The display goes back to Normal mode.

6.3.5 Function description

1.0.0 Information (Info.) menu

Menu No.	Function	Function description	Selection list or range of values	Default
1.1.0 IDENT.				
1.1.1	SERIAL NUM.	The device serial number.	Read only.	
1.1.2	CONV.FIRM.VER	The converter firmware version.	Read only.	
1.1.3	SEN.FIRM.VER	The sensor firmware version.	Read only.	
1.1.4	HMI.FIRM.VER	The HMI (device display screen) firmware version.	Read only.	
1.2.0 OUTPUT I				
1.2.1	SUMMARY I	Push [>] to read the setting at this time for the output function (OUTPUT FUNC.). Push [>] again to read the settings for the output range (RANGE I), 4 mA setting (SCALE 4mA), 20 mA setting (SCALE 20mA), and error delay (ERROR DELAY).	Read only.	
1.3.0 HISTORY				
1.3.1	ERROR RECORD	A log of device errors. Push [>] to read the errors. Push [▲] or [▼] to scroll up or down the list. Each error is identified by a code. Push [>] again to show the number of incidents and the time since the last incident in days, hours, minutes and seconds. For more data about errors, refer to *Status and error messages* on page 92.	Read only.	

2.0.0 Supervisor menu

Menu No.	Function	Function description	Selection list or range of values	Default
2.1.0 QUICK SETUP				
2.1.0	COMMISSION.	This starts a quick set-up procedure applicable to most applications. The supervisor can give the tank height (TANK HEIGHT), output function (OUTPUT FUNC.), current output range (RANGE I), 4 mA setting (SCALE 4mA), 20 mA setting (SCALE 20mA), error delay (ERROR DELAY) and tag name (TAG NAME). **CAUTION!** Make sure that you do this procedure before you use the device. The settings in this procedure have an effect on the performance of the device.		

Menu No.	Function	Function description	Selection list or range of values	Default
2.1.2	SNAPSHOT	This starts a quick set-up procedure to find and filter out parasite signals that do not move along the probe. We recommend that you completely empty the tank before you do this procedure. Push "Accept" at the end the procedure and set the STORE screen to "STORE YES" to use the data. For more data, refer to *Snapshot* on page 80. If you decreased the length of the cable on site, do the procedure in menu item 2.1.3 first.		
2.1.3	CALC.PROBE.L	This starts a quick set-up procedure to correct the length of the probe if it was shortened on site. Do this procedure before you do a snapshot recording. Make sure that there is no liquid in the tank before you do this procedure. For more data, refer to *Probe length calculation* on page 79.		

2.2.0 TESTS

2.2.1	SET OUTPUT	This sets the analog output to a test value [mA] selected from a list. The output will change to the selected value after 5 seconds, independent of the measured value.	3.5, 4, 6, 8, 10, 12, 14, 16, 18, 20 or 22 mA	3.5 mA
2.2.2	DIAGNOSTIC	This starts the hardware test. Push [**>**] many times to show: the time of operation (D1), temperature of the electronic converter board (T1), loop current (I1), load current (I2), voltage 5.6 V (V1), voltage on capacitors (V2), voltage 3.3 V (V3), amplitude reference pulse (P1), amplitude level pulse (P2), amplitude probe end pulse (P3), reset counter (C1). If you push [**>**] again, the display goes back to the menu level. For more data, refer to *Error handling* on page 94.		

2.3.0 BASIC PARAM.

2.3.1	TANK HEIGHT	The distance from the tank connecting flange face / thread stop down to the tank bottom.	min-max: 0…80 m / 0…262.48 ft	If tank height is not specified in customer order, the probe length value is used
2.3.2	BLOC. DIST.	Blocking distance. The non-measuring range at the top of the probe. It depends on the probe type and the installation. Refer to the "Default values for menu item 2.3.2 BLOC. DIST." table at the end of this section.	min.: 0 m / 0 ft max: 2.3.4 PROBE LENGTH	This depends on the probe type
2.3.3	TIME CONST.	Increasing the time constant will smoothen the integrated readings, decreasing will roughen the readings.	min-max: 0 to 100 seconds	5 seconds

Menu No.	Function	Function description	Selection list or range of values	Default
2.3.4	PROBE LENGTH	Probe length is the distance from the flange face / thread stop of the device down to the bottom end of the probe (including counterweight for cable versions). If probe length has been modified, enter the new value here. For more data, refer to *How to decrease the length of probes* on page 90.	min-max: Probe length depends on the measuring range for each type of probe. For more data about probe length, refer to the "Technical data" section (Probe options / Measuring range).	This value is given in the customer order
2.3.5	TAG NAME	The device has a code (tag name) to identify it. If the tag name is given in the customer order data, it will be set at the factory. A maximum of 8 characters can be used.		TANK 01
2.3.6	DETECT.DELAY	This parameter makes the device ignore reflexions in a specified area immediately below the process connection. We recommend that this value is 50 mm / 2¨ less than the value in menu item 2.3.2 BLOC.DIST.	min.: 0 mm / 0¨ max.: 2.3.4 PROBE LENGTH	0 mm / 0¨

2.4.0 OUTPUT I

2.4.1	OUTPUT FUNC.	The output function. Select an output function to scale the current values in relation to a given point (usually the device process connection or the tank bottom). The output current value is shown on a bar graph in normal mode if the measurement name (displayed measurement) is the same as the output function. Conversion parameters (Distance Conversion, Level Conversion) are shown if there is volume or mass data in 2.8.1 INPUT TABLE.	Distance, Level, Distance conversion, Level conversion	Level
2.4.2	RANGE I	This menu item sets the limits of the output current range to 1 of the 2 available options: standard limits (4...20 mA) or NAMUR NE 43-compliant limits (3.8...20.5 mA). It also tells the device what to do if an error occurs. If you set RANGE I to **4-20/22E** and an error occurs (e.g. the tank is too full etc.), the device output current will change to an error value of 22 mA. If you set RANGE I to **4-20** and the device senses a measurement error, the value will stop at the last correct measurement.	4-20, 4-20/22E, 4-20/3.6E, 3.8-20.5/22E, 3.8-20.5/3.6E	4-20/3.6E (If the device is used in safety-related systems (SIL2), do not use the "4-20" setting)
2.4.3	SCALE 4mA	This gives a measurement value to 4 mA.	min-max: ①	②
2.4.4	SCALE 20mA	This gives a measurement value to 20 mA.	min-max: ①	②
2.4.5	ERROR DELAY	The time after which the current output changes to an error value. The error value shows that there is a measurement error. MN=minutes and S=seconds.	0 S, 10 S, 20 S, 30 S, 1 MN, 2 MN, 5 MN,15 MN	10 S

2.5.0 APPLICATION

2.5.1	TRACING VEL.	Tracing velocity. This value must agree with the maximum rate of change of the level of the liquid contents in the tank.	min-max: 0.1…1000 m/min	10.0 m/min

Menu No.	Function	Function description	Selection list or range of values	Default
2.5.2	AUTO Er CALC	Automatic dielectric constant (ε_r) calculation. The device automatically calculates the ε_r value of the liquid contents in the tank when this menu item is set to "Yes".	YES, NO	YES. If the probe length is unknown, then it is set to "NO".
2.5.3	GAS EPS. R	Dielectric constant (ε_r) of the gas in the tank. A major parameter for TDR level measurement devices. If the dielectric constant of the gas is very different from the default value (air), set 2.5.3 GAS EPS. R to the ε_r value of the gas.	min-max: 0.8...115.00	1
2.5.4	EPS.R CALCUL.	The calculated ε_r value for the liquid contents in the tank. The result of the calculation in 2.5.2 AUTO EPSI. R. This menu item will not be available if 2.5.2 AUTO EPSI. R is not used.	Read only.	
2.5.5	PROD. EPS. R	Do not use this menu item.	—	—
2.5.6	LEVEL AMP.	Level amplitude. This is the amplitude of the signal (after reflection on the surface of the tank contents) compared with the amplitude of the reference pulse. This value helps you to set the measurement threshold in menu item 2.5.7 LEVEL THRESH.. For more data, refer to *Thresholds and parasitic signals* on page 88. Refer to the "Default values for menu item 2.5.7 LEVEL THRESH." table at the end of this section.	Read only.	
2.5.7	LEVEL THRESH.	Level threshold. If it is difficult to identify the level signal (for example: too many parasite signals), you can increase the threshold. This value is measured in thousandths (1...1000). A threshold of 100 is equivalent to 10% of the amplitude of the reference pulse at a distance of 1 m / 3.3 ft from the flange facing. For more data, refer to *Thresholds and parasitic signals* on page 88.	min-max: 0 to 1000	This value depends on the probe type.
2.5.8	PROB.END AMP	Do not use this menu item.	—	
2.5.9	PROBE END TH.	Do not use this menu item.	—	—
2.5.10	MEASUR.MODE	In Direct mode, the device measures the time it takes to receive a reflection of the signal from the surface of the tank contents. Direct mode is used for products with an εr ≥1.6 (this depends on the probe type). Automatic mode is not used for applications in the nuclear power industry.	Direct, Automatic	Direct

Menu No.	Function	Function description	Selection list or range of values	Default
2.5.11	SNAPSHOT MOD.	The snapshot function operates in one of three modes. "Dynamic" mode examines signals from objects that move in the tank and filters those signals that are identified by the signal converter as parasitic signals. Snapshot function data is not saved if you de-energize the device. "Static" mode uses data from the quick setup procedure in menu item 2.1.2 SNAPSHOT. This mode identifies and filters parasitic signals from objects that do not move in the tank. Snapshot function data is saved if you de-energize the device. "Static & Dynamic" mode puts "Static" and "Dynamic" modes together. This permits the device to filter two types of parasitic signal (objects that move and those that do not move) at the same time. You must do the quick setup procedure in menu item 2.1.2 SNAPSHOT before you set menu item 2.5.11 SNAPSHOT MOD. to "Static & Dynamic". **CAUTION!** Do not set this menu item to "Static" or "Static & Dynamic" modes before you do the quick setup procedure.	Static & Dynamic, Static, Dynamic, Disable	Static & Dynamic: coaxial probe Dynamic: other probe types
2.5.12	DIST.SNAPSH.	Snapshot distance. This gives the distance along the probe where all signals are examined and parasitic signals are filtered. This value is used for the "Static" and "Dynamic" Snapshot modes. If the device is in "Static" Snapshot mode, this value is given in the commissioning procedure (max: the level of the product or (2.3.3 PROBE LENGTH - 3.1.1 COUNTERWEIGHT)). If the device is in "Dynamic" Snapshot mode, this value gives the maximum limit for the parasitic signal filter.	min.: 0 m / 0 ft max.: 2.3.3 PROBE LENGTH - 3.1.1 COUNTERWEIGHT or 20000 mm / 787.4¨ - 3.1.1 COUNTERWEIGHT or the level of the product	If the probe length < 20 m / 65.6 ft, DIST.SNAPSH.= 2.3.3 PROBE LENGTH - 3.1.1 COUNTERWEIGHT If the probe length ≥ 20 m / 65.6 ft, DIST.SNAPSH.= 20 m / 65.6 ft - 3.1.1 COUNTERWEIGHT

2.6.0 COMMUNICATION

2.6.1	HART ADDRESS	Any HART® address greater than 0 will activate HART® multidrop mode. The current output stays constant at 4 mA. If 2.6.1 HART ADDRESS is set to 0, the device will operate in point-to-point mode.	min-max: 0…63	0

2.7.0 DISPLAY

2.7.1	LANGUAGE	Data can be shown in any of the languages stored in the device.	9 languages are available in 3 packs: (1) English, French, German and Italian; (2) English, French, Spanish and Portuguese; (3) English, Chinese (Simplified), Japanese and Russian	③
2.7.2	LENGTH UNIT	The length unit of measurement shown in normal mode.	m, cm, mm, in (inches), ft (feet)	m

Menu No.	Function	Function description	Selection list or range of values	Default
2.7.3	CONV UNIT	Conversion unit. The length, volume or mass conversion unit for the conversion table and shown in normal mode.	kg, t, Ston, Lton, m, cm, mm, in, ft, m3, L, gal, Imp, ft3, bbl	kg
2.7.4	PSWD YES/NO	If it is necessary to protect your settings in the supervisor menu with a password, set this menu item to **YES**.	YES, NO	YES
2.7.5	PASSWORD	This changes the password for the supervisor menu. Push the buttons up to 6 times in any order. This will be the new password. To confirm the change, enter the new password a second time. For more data, refer to *Protection of the device settings* on page 83.		[>], [↵], [▼], [▲], [>] and [↵]
2.7.6	CONTRAST	The contrast control for the display screen. You can select a shade of grey between light grey (level 20) and black (level 54).	min-max: 20…54	36

2.8.0 CONV. TABLE

2.8.1	INPUT TABLE	The device uses a conversion table (strapping table) to convert measurements to volume and mass readings. The readings are shown in normal mode. Go to this menu item and enter the entry number (01...30). Then enter the level and the related volume / mass value for that entry. Push [↵] to confirm the entry values. Continue the procedure until the device has data for all the entries. For more data, refer to *How to configure the device to measure volume or mass* on page 86.	min. 2 entries max. 30 entries (level / volume or mass)	0 entries
2.8.2	DELETE TABLE	This menu item erases the data in the conversion table.	YES, NO	NO

2.9.0 CONFIG/RESET

2.9.3	RESTART	This menu item starts the device again.	YES, NO	NO
2.9.4	RESET FACT.	If you set this menu item to "YES", the device goes back to its initial settings (set by the manufacturer in the factory).	YES, NO	NO

① Units and range depend on the output function, length unit and volume unit selected

② This depends on the data given in the customer order

③ If the device has the LCD display option, this depends on the data given in the customer order

Default values for menu item 2.3.2 BLOC. DIST.

Probe type	Blocking distance	
	[mm]	[inches]
Ø4 mm / 0.16¨ single cable	350	13.78
Ø8 mm / 0.32¨ single rod	250	9.84
Ø22 mm / 0.87¨ coaxial	100	3.94
Ø4 mm / 0.16¨ double cable	200	7.87
Ø8 mm / 0.32¨ double rod	200	7.87

Default values for menu items 2.4.3 SCALE 4mA and 2.4.4 SCALE 20mADefault values for menu items 2.4.3 SCALE 4mA and 2.4.4 SCALE 20mA

Probe type	SCALE 4mA		SCALE 20mA	
	[mm]	[inches]	[mm]	[inches]
Device with a probe	Value given in the customer order or (2.3.1 TANK HEIGHT - 2.3.4 PROBE LENGTH) ①		Value given in the customer order or (2.3.1 TANK HEIGHT - 2.3.2 BLOC. DIST. - 50) ②	Value given in the customer order or (2.3.1 TANK HEIGHT - 2.3.2 BLOC. DIST. - 1.97) ②
Device without a probe	0	0	9600	377.95

① This value is the first entry in the strapping table (2.8.0 CONV. TAB)
② This value is the last entry in the strapping table (2.8.0 CONV. TAB)

Default values for menu item 2.5.7 LEVEL THRESH.

Probe type	Level Threshold
Ø4 mm / 0.16¨ single cable	60
Ø8 mm / 0.32¨ single rod	60
Ø22 mm / 0.87¨ coaxial	80
Ø4 mm / 0.16¨ double cable	70
Ø8 mm / 0.32¨ double rod	70

3. Service menu

Menu No.	Function	Function description	Selection list	Default
3.0.0	SERVICE	Advanced settings. The settings in this menu are protected with a password. Only approved personnel can change the parameters in this menu. For more data, speak or write to your local sales office.		

4. Master menu

Menu No.	Function	Function description	Selection list	Default
4.0.0	MASTER	Factory settings. The settings in this menu are protected with a password. Only approved personnel can change the parameters in this menu. For more data, speak or write to your local sales office.		

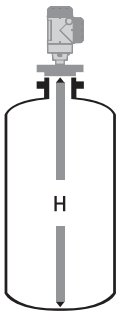
6.4 Further information on device configuration

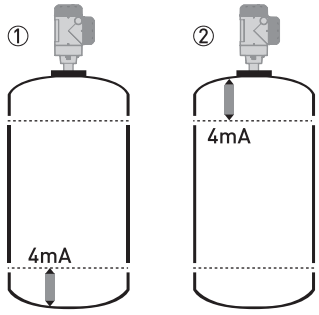
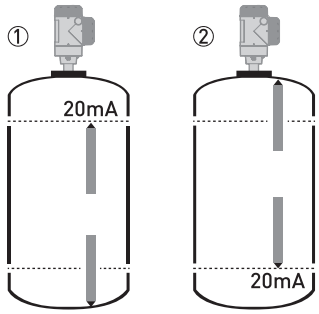
6.4.1 Commissioning

Use this procedure to change the probe length and give the top and bottom measuring limits. Values and parameters that can be changed are shown between « ... » in the illustrations that follow. Push the keypad buttons in the correct sequence:

CAUTION!
Make sure that you do this procedure before you use the device. The settings in this procedure have an effect on the performance of the device.

Procedure

Screen	Steps	Description
VMI_2 LEVEL 5000 mm	• [>], [▲] and [>].	Default screen. Enter configuration mode (2.0.0 SUPERVISOR).
VMI_2 2.0.0 _____	• [>], [↵], [▼], [▲], [>] and [↵].	Enter the password (the default password is shown). If it is necessary to change the password, refer to *Function description* on page 70, menu item 2.7.5 PASSWORD.
VMI_2 2.1.1 COMMISSION.	• [>] and [>]	Push this button 2 times to start the commissioning procedure.
VMI_2 TANK HEIGHT «25000»	• [>] to change the tank height (H). • [>] to change the position of the cursor. • [▼] to decrease the value or [▲] to increase the value. • [↵] to confirm.	
VMI_2 OUTPUT FUNC. «Level»	• [▲] or [▼] for the selection of the measurement name (Distance, Level, Conversion or Ullage Conv.). • [↵] to confirm.	The manufacturer sets the output function to “Level” before delivery. If it is necessary to measure volume, ullage volume, mass or ullage mass (Conversion or Ullage Conv.), refer to *How to configure the device to measure volume or mass* on page 86.
VMI_2 RANGE I «4-20/3.6E»	• [▲] or [▼] for the selection of the current output range (4-20 mA/3.6E, 4-20, 3.8-20.5/3.6E, etc.). • [↵] to confirm.	

Screen	Steps	Description
VMI_2 SCALE 4 mA «0000»	• [>] to change Scale 4 mA. • [>] to change the position of the cursor. • [▼] to decrease the value or [▲] to increase the value. • [↵] to confirm.	Use this step to give the 4 mA output setting (0% limit) in the tank. Refer to the illustrations that follow. Illustration ① shows the settings for level. Illustration ② shows the settings for distance. 
VMI_2 SCALE 20 mA «03350»	• [>] to change Scale 20 mA. • [>] to change the position of the cursor. • [▼] to decrease the value or [▲] to increase the value. • [↵] to confirm.	Use this step to give the 20 mA output setting (100% limit) in the tank. Refer to the illustrations that follow. Illustration ① shows the settings for level. Illustration ② shows the settings for distance. 
VMI_2 ERROR DELAY «10 S»	• [▲] or [▼] for the selection of the error delay (0 s, 10 s, 20 s, 30 s, 1 mn, 2 mn, 5 mn or 15 mn). • [↵] to confirm.	The time after which the current output changes to an error value. The error value shows that there is a measurement error.
TANK 01 TAG NAME «TANK 01»	• [>] to change the tag name. • [>] to change the position of the cursor. • [▼] to decrease the alphanumeric value (A, B, etc. / 1, 2, etc.) or [▲] to increase the alphanumeric value. • [↵] to confirm.	
VMI_2 2.0.0 «STORE NO»	• 3 × [↵] to confirm. • [▲] or [▼] for the selection of the save option (STORE NO or STORE YES). • [↵] to confirm.	Set to STORE YES to save and use the data. Set to STORE NO to cancel the changes to the device settings.

6.4.2 Probe length calculation

CAUTION!

- *Make sure that you do this procedure before you use the device.*
- *If you decrease the probe length, do the probe length calculation procedure before the snapshot procedure.*
- *The probe length cannot be less than 600 mm / 23.6¨ for coaxial probes and 1000 mm / 39.4¨ for other probe types. Shorter probe lengths can be delivered on request.*
- *Make sure that the tank is empty.*
- *Make sure that there are no objects adjacent to the probe. For more data about empty space, refer to General requirements on page 27.*

Do this quick set-up procedure (menu item 2.1.3) if:

- it is the first time that the device is used,
- the probe length was changed or
- the signal converter was replaced.

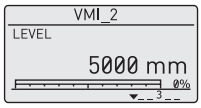
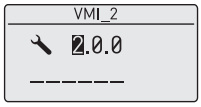
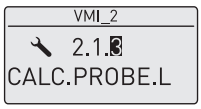
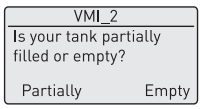
When you do this procedure, the device automatically calculates and records the probe length.

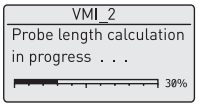
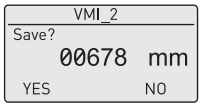
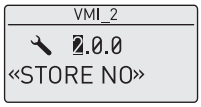
WARNING!

If the probe material is pickled and passivated, do not decrease the probe length. Surfaces without protection can cause contamination.

Values and parameters that can be changed are shown between the « ... » marks in the illustrations that follow. Push the keypad buttons in the correct sequence:

Procedure

Screen	Steps	Description
	• [>], [▲] and [>].	Default screen. Enter configuration mode (2.0.0 SUPERVISOR).
	• [>], [↵], [▼], [▲], [>] and [↵].	Enter the password (the default password is shown). If it is necessary to change the password, refer to *Function description* on page 70, menu item 2.7.5 PASSWORD.
	• [>], [▲], [▲] and [>]	
	• [>] for the selection of "Partially filled" or [▲] for the selection of "Empty".	Is your tank partially filled or empty? If the tank is partially filled, the procedure will not start. While the tank is partially filled, the device cannot correctly calculate the probe length.

Screen	Steps	Description
		The device measures the new probe length. If the display screen shows the error message "Failure! Pulse Lost" then speak to the supplier.
	• [>] for the selection of YES or [▲] for the selection of NO.	The device shows the new probe length. Set to YES to save the data. Set to NO to erase the data.
	• 3 × [↵] to confirm. • [▲] or [▼] for the selection of the save option (STORE NO or STORE YES). • [↵] to confirm.	Set to STORE YES to use the data. Set to STORE NO to cancel the changes to the device settings.

CAUTION!
If the probe length calculated in this procedure is much shorter than the real probe length, then do the procedure that follows:

- Go to menu item 2.3.6 DETECT.DELAY in the supervisor menu.
- Record the initial value.

➲ Is the initial value the same as 2.3.2 BLOC. DIST.?

- If the initial value is different, change the value to the blocking distance in menu item 2.3.2 BLOC. DIST..
- Do the probe length calculation procedure again.
- After you complete the procedure, change the value back to its initial setting.

For more data about menu items, refer to *Function description* on page 70.

6.4.3 Snapshot

The snapshot procedure is very important for the performance of the device. Make sure that the tank is empty or only filled to the minimum level before you do the procedure.

Use this procedure (menu item 2.1.2) if there are objects adjacent to the probe that can cause parasitic signals. The device does a scan for objects that do not change their vertical positions in the tank (heating tubes, agitators, fuel assemblies etc.) and records the data. The device can then use this data to put the measurement signal through a filter (Dynamic Parasite Rejection).

INFORMATION!
Dynamic Parasite Rejection *(DPR) is a function that automatically puts parasitic signals through a signal filter. Parasitic signals are caused by internal vessel installations or build-up on the probe during normal operation. Use the DPR function to get the best possible performance during level measurement. To use the device with the DPR function, do the snapshot procedure (refer to menu item 2.1.2). During this procedure, the software finds, marks, and saves all parasitic signals.*

When the device is in DPR mode (when menu item 2.5.11 SNAPSHOT MOD. is set to "static" or "static and dynamic"), it will automatically update this data to ignore old and new parasitic signals. Thus, it is not necessary to do the snapshot procedure again. Because the device records the data from the SNAPSHOT procedure (for "static" or "static and dynamic" modes), it is also not necessary to do the procedure again if you de-energize the device.

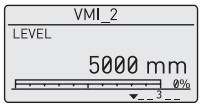
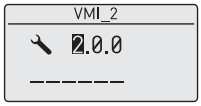
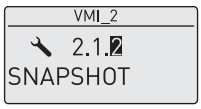
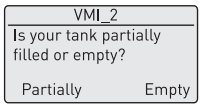
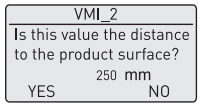
CAUTION!

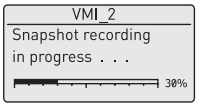
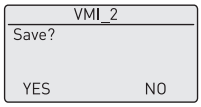
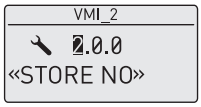
- *If you decrease the probe length, do the probe length calculation procedure before the snapshot procedure.*
- *Make sure that the tank is empty or only filled to the minimum level.*
- *Make sure that there are no objects adjacent to the probe. For more data about empty space, refer to General requirements on page 27.*

Before you do the snapshot procedure, install the device on the tank. For more data about how to install the device, refer to *Installation* on page 21.

Values and parameters that can be changed are shown between the « ... » marks in the illustrations that follow. Push the keypad buttons in the correct sequence:

Procedure

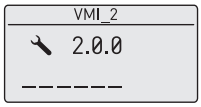
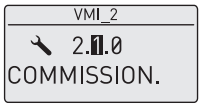
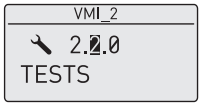
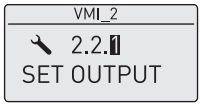
Screen	Steps	Description
	• [>], [▲] and [>].	Default screen. Enter configuration mode (2.0.0 SUPERVISOR).
	• [>], [↵], [▼], [▲], [>] and [↵].	Enter the password (the default password is shown). If it is necessary to change the password, refer to *Function description* on page 70, menu item 2.7.5 PASSWORD.
	• [>], [▲] and [>]	Push these buttons to start the snapshot procedure.
	• [>] for the selection of "Partially filled" or [▲] for the selection of "Empty".	Is your tank partially filled or empty? If the tank is partially filled, the device will scan for the first reflection in the tank. Continue to the subsequent step. NOTE: If you set this step to "Partially filled", but the tank is empty, the device will show the error message "Failure! Pulse Lost". Push one of the keypad buttons to go back to the start of the Snapshot procedure. If the tank is empty, the scan will start immediately. Ignore the 2 subsequent steps.
	• [>] for the selection of YES or [▲] for the selection of NO.	The device shows the distance to the surface of the tank contents. Set to YES if the distance is correct. The scan will start immediately. Set to NO if the distance is incorrect. The scan will start immediately, but the device will ignore the reflection found at this distance from the device.

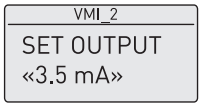
Screen	Steps	Description
		The device does a scan for objects that do not change their vertical positions in the tank (heating tubes, agitators, fuel assemblies etc.) and records the data.
	• [>] for the selection of YES or [▲] for the selection of NO.	The device completes the scan. Set to YES to save the data. Set to NO to erase the data.
	• 3 × [↵] to confirm. • [▲] or [▼] for the selection of the save option (STORE NO or STORE YES). • [↵] to confirm.	Set to STORE YES to use the data. Set to STORE NO to cancel the changes to the device settings.

6.4.4 Test

Use this procedure to test the loop current. Values and parameters that can be changed are shown between the « ... » marks in the illustrations that follow. Push the keypad buttons in the correct sequence:

Procedure

Screen	Step	Description
		Default screen.
	• [>], [▲] and [>].	
	• Enter the password: [>], [↵], [▼], [▲], [>] and [↵]. • [↵]	
	• [▲].	
	• [>].	

Screen	Step	Description
	• [>]. • [▼] to decrease the value or [▲] to increase the value. • [↵] to confirm.	This step sets the loop current value. Make a selection from 3.5, 4, 6, 8, 10, 12, 14, 16, 18, 20 or 22 mA.
	• [↵] 3 times to go back to the default screen.	The loop current goes back to initial value. Default screen.

6.4.5 Protection of the device settings

The menu item PASSWORD (2.7.5) lets you change the supervisor menu password.

How to change the supervisor menu password

- After you enter the supervisor menu, push 6 × [▲], [>] and 4 × [▲] to go to the menu item PASSWORD (2.7.5).
- Enter the new 6-character password (push the 4 buttons in any sequence).
- Enter the new 6-character password again.

➲ If the second entry is the same as the first, the device will go back to the sub-menu list (2.7).If the second entry is not the same as the first, the device will not go back to the sub-menu list. Push [↵] to start the password sequence again and enter the new 6-character password 2 times.

- Push [↵] to go back to the "STORE" screen.
- Push [▲] or [▼] to set the screen to **STORE YES** and push [↵].

➲ The device will save the new password and go back to normal mode.

INFORMATION!

Make a note of the password and keep it in a safe place. If you lose the password, please speak or write to your supplier.

How to set the supervisor password to "on" or "off"

The supervisor password is set to "on" by default. If it is necessary to set this function to "off", refer to *Function description* on page 70, Table 2: Supervisor menu, menu item PSWD YES/NO (2.7.4).

6.4.6 HART® network configuration

INFORMATION!
For more data, refer to Networks on page 56.

The device uses HART® communication to send information to HART®-compatible equipment. It can operate in either point-to-point or multidrop mode. The device will communicate in multidrop mode if you change the address.

CAUTION!
Make sure that the address for this device is different from others in the multi-drop network.

How to change from point-to-point to multidrop mode

- Enter the supervisor menu.
- Push [>], 5 × [▲] and [>] to go to menu item ADDRESS (2.6.1).
- Push [>] to change the value. Enter a value between 1 and 63 and push [↵] to confirm (refer to the caution before this procedure).
- Push [↵] to go back to the "STORE" screen.
- Push [▲] or [▼] to set the screen to **STORE YES** and push [↵].

➲ The output is set to multidrop mode. The current output is set to 4 mA. This value does not change in multidrop mode.

How to change from multidrop to point-to-point mode

- Enter the supervisor menu.
- Push [>], 5 × [▲] and [>] to go to menu item ADDRESS (2.6.1).
- Push [>] to change the value. Enter the value 0 and push [↵] to confirm.
- Push [↵] to go back to the "STORE" screen.
- Push [▲] or [▼] to set the screen to **STORE YES** and push [↵].

➲ The output is set to point-to-point mode. The current output changes to a range of 4...20 mA or 3.8...20.5 mA (this range is set in menu item RANGE I (2.4.2)).

6.4.7 Distance measurement

The device current output agrees with the distance measurement when the output is set to "Distance". Menu items used for distance measurement are:

- Output Function (2.4.1 OUTPUT)
- Tank Height (2.3.1 TANK HEIGHT)
- Blocking Distance (2.3.2 BLOC. DIST.)

Use the flange facing or thread stop as the reference point for the 4 and 20 mA current output settings. The 4 and 20 mA current output settings are the minimum and maximum points of the measurement scale.

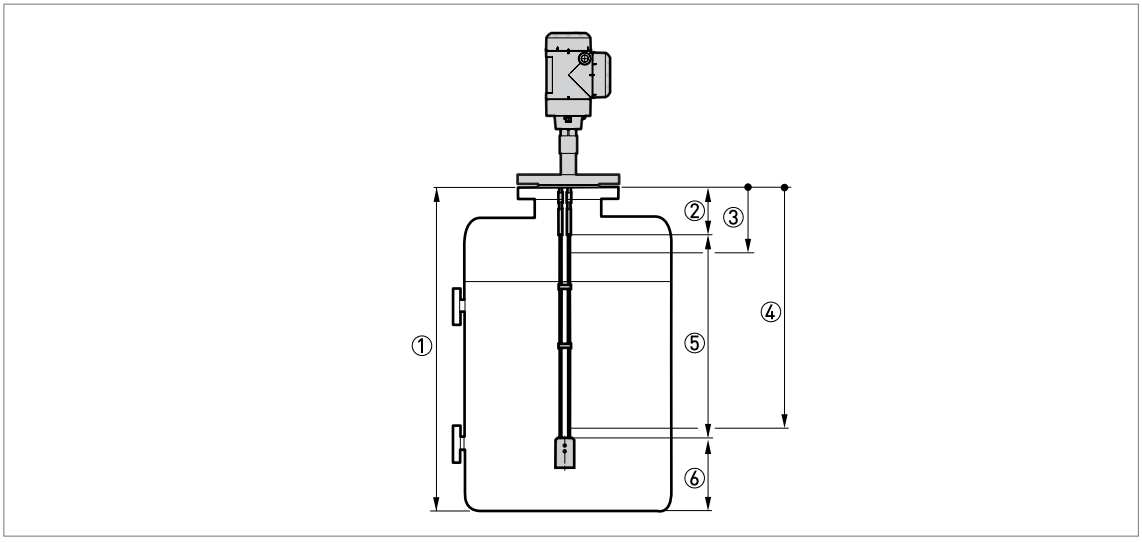


Figure 6-4: Distance measurement

① Tank Height (2.3.1 TANK HEIGHT)
② Blocking Distance (2.3.2 BLOC. DIST.)
③ 4 mA Setting (2.4.3 SCALE 4mA)
④ 20 mA Setting (2.4.4 SCALE 20mA)
⑤ Maximum effective measuring range
⑥ Non-measurement zone

For more data about the menu items, refer to *Function description* on page 70.

6.4.8 Level measurement

The device current output agrees with the level measurement when the output is set to "Level". Menu items related to level measurement are:

- Output Function (2.4.1 OUTPUT)
- Tank Height (2.3.1 TANK HEIGHT)
- Blocking Distance (2.3.2 BLOC. DIST.)

Use the tank bottom as the reference point for the 4 and 20 mA current output settings. The 4 and 20 mA current output settings are the minimum and maximum points of the measurement scale.

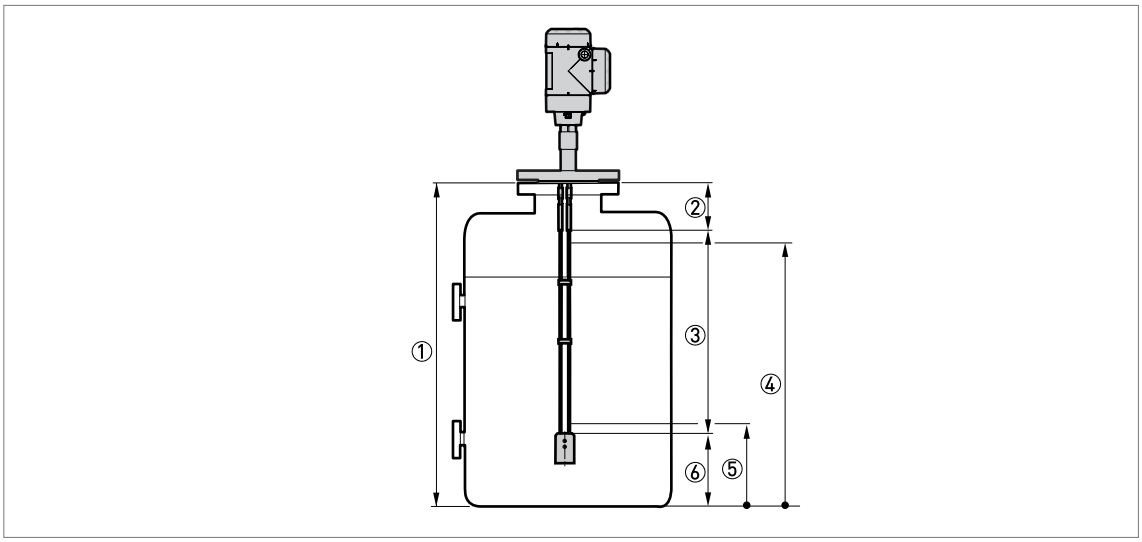


Figure 6-5: Level measurement

① Tank Height (2.3.1 TANK HEIGHT)
② Blocking Distance (2.3.2 BLOC. DIST.)
③ Maximum effective measuring range
④ 20 mA Setting (2.4.4 SCALE 20mA)
⑤ 4 mA Setting (2.4.3 SCALE 4mA)
⑥ Non-measurement zone

For more data about the menu items, refer to *Function description* on page 70.

6.4.9 How to configure the device to measure volume or mass

The device can be configured to measure volume or mass. You can set up a strapping table in the conversion table (2.8.0 CONV. TAB) sub-menu. Each entry is a pair of data (level – volume or level – mass). The strapping table must have a minimum of 2 entries and a maximum of 30. The reference point for the table is the bottom of the tank (as given in menu item 2.3.1 TANK HEIGHT).

CAUTION!
Enter the data in numerical sequence (strapping table entry number 01, 02 etc.).

How to prepare a strapping table (conversion table)

- Enter the supervisor menu.
- Push [>], 6 × [▲], [>] and [▲] to go to 2.7.2 LENGTH UNIT.
- Push [▲] and [▼] to find the length unit that you will use in the table.
- Push [↵] to go to the sub-menu level.
- Push [▲] to go to 2.7.3 CONV UNIT (conversion unit)
- Push [▲] and [▼] to find the conversion unit that you will use in the table.
- Push [↵] to go to the sub-menu level and then [▲] and [>] to go to the menu item 2.8.1 INPUT TAB
- Push [>] to make the strapping table. Enter the table entry number (01).
- Enter the length value and push [↵].
- Enter the conversion value and push [↵].
- Push [>] to enter the subsequent table entry number (02, 03, ..., 30).
- Repeat the last 3 steps to complete the table.

- Push [↵] to go back to the "STORE" screen.
- Push [▲] or [▼] to set the screen to **STORE YES** and push [↵].

➲ The device will store the data for the strapping table and go back to normal mode.

The device will give more accurate volume readings if you give more conversion data in these areas:

- Surfaces with curves.
- Sudden changes in the cross section.

Refer also to the illustration that follows:

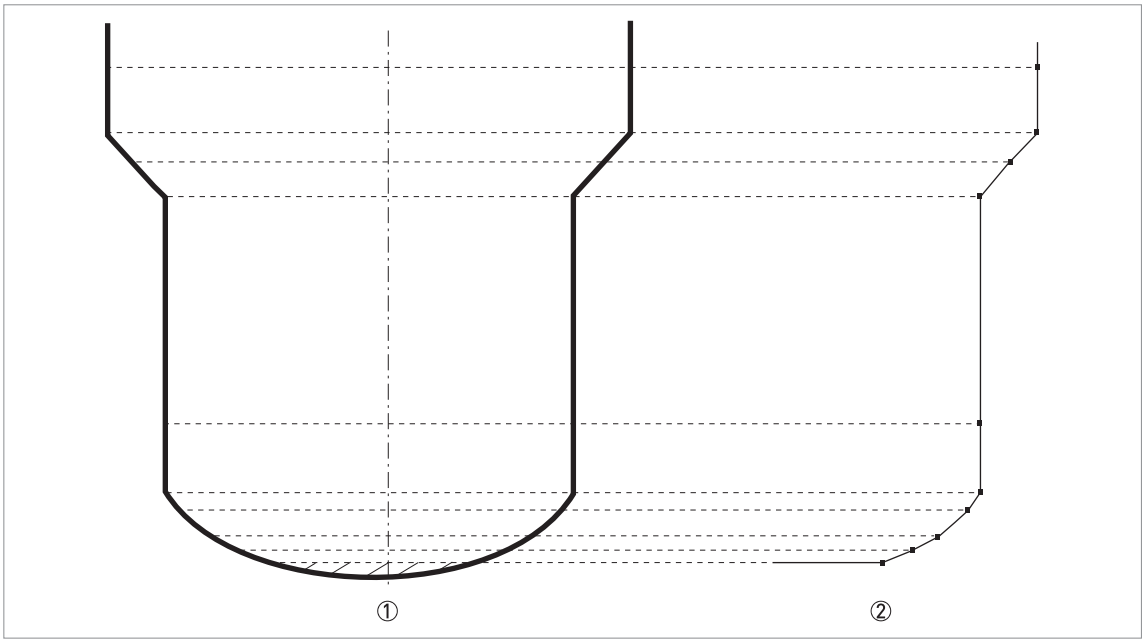


Figure 6-6: A plot of points for a volume or mass table

① Tank with reference points
② Tank model with plotted points

How to delete a volume or mass table

- Enter the supervisor menu.
- Push 7 × [▲], [>], and [▲] to go to 2.8.2 DELETE TABLE.
- Push [>] and [▲] to set the parameter to **YES**.
- Push [↵] to go back to the "STORE" screen.
- Push [▲] or [▼] to set the screen to **STORE YES** and push [↵].

➲ The device will delete the data for the strapping table and go back to normal mode. The "CONVERSION" and "ULLAGE CONV." data are not available in normal mode.

6.4.10 Thresholds and parasitic signals

General notes

The low-power electromagnetic signal from the device goes down the probe. The surface of the liquid, and objects in the tank, make reflections. These reflections go back up the probe to the signal converter. The signal converter changes the reflections into voltage amplitudes. Reflections from objects in the tanks are interference signals (parasitic signals).

You can also use a signal filter (snapshot) to remove parasitic signals from the measurement signal. For more data about the snapshot procedure, refer to *Snapshot* on page 80.

How thresholds work

Thresholds let the device ignore reflections with small amplitudes and monitor changes in level.

The device uses the menu item 2.5.7 LEVEL THRESH. (level threshold) to set the threshold for the reflection on the surface of the liquid.

The user can do a check of the signal amplitude after reflection on the surface of the liquid. 2.5.6 LEVEL AMP. (level pulse amplitude) is the amplitude of the signal after it makes a reflection on the surface of the liquid in the tank and is compared with the reference pulse amplitude. It is measured in thousandths (1...1000) of the reference pulse amplitude (value= 1000). The device measures the distance from the process connection to the level signal, and the signal amplitude. The signal converter then does a mathematical conversion (that agrees with a law of signal attenuation) to show the signal amplitude at a standard distance of 1 m / 3.3 ft from the process connection. This value helps you to set the measurement threshold in menu item 2.5.7 LEVEL THRESH..

INFORMATION!
For more data on menu items, refer to Function description on page 70.

How to use thresholds

INFORMATION!
If there is a parasitic signal above the level and the threshold is too low, the device can incorrectly use it as the level signal.

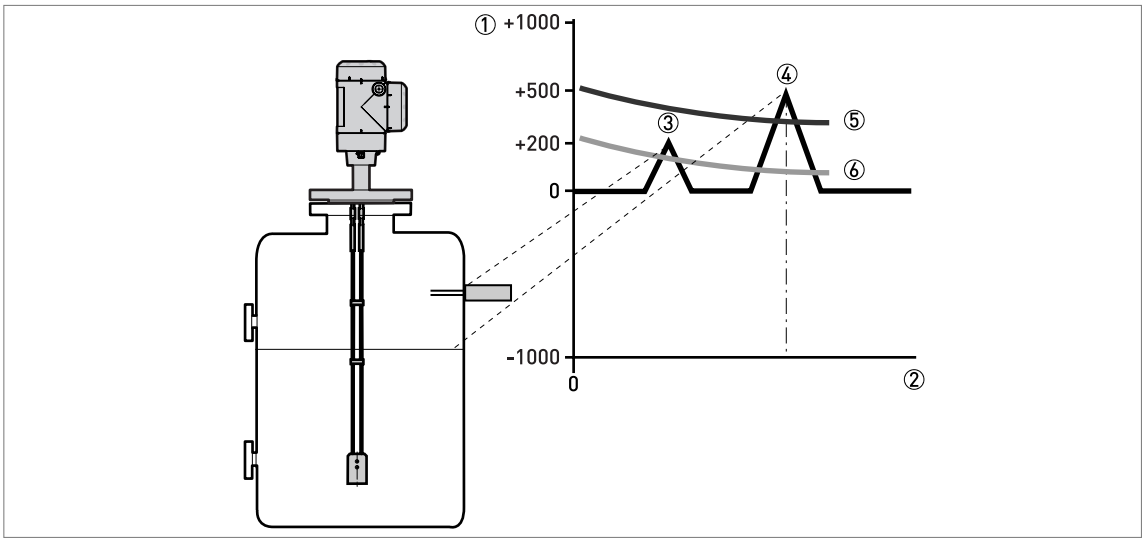


Figure 6-7: Signal intensity/distance graph: thresholds

① Signal intensity given as a fraction of the reference pulse (measured in thousandths)
② Distance from the process connection
③ Parasitic signal. A signal from a level switch that is in the limits of the electromagnetic field around the probe.
④ Level signal of the liquid
⑤ The level threshold is correct. The device ignores the parasitic signal and measures level correctly.
⑥ The level threshold is too low. The device can use the parasitic signal as the level signal. Do the snapshot procedure (menu item 2.1.2) to make sure that the device ignores the parasite signal.

If the parasitic signal is smaller than the correct level, you can manually change the threshold to find the signal. This procedure tells you how to change the level threshold to find the correct signal:

- Look at the menu item 2.5.6 LEVEL AMP..

➲ Make a note of the amplitude of the correct level signal. Use this value to calculate the new value for 2.5.7 LEVEL THRESH..

- Go to 2.5.7 LEVEL THRESH..
- Increase the amplitude of the level threshold.

➲ This value must be more than the incorrect signal. We recommend that you set the level threshold at half the amplitude of the correct signal.

- Save the settings.

➲ The threshold increases. It ignores the parasite signal and uses the first signal it finds.

6.4.11 How to decrease the length of probes

WARNING!
If the probe material is pickled and passivated, do not decrease the probe length. Surfaces without protection can cause contamination.

INFORMATION!
This data is for the probe types that follow:
- *Ø4 mm / 0.16" double cable*
- *Ø8 mm / 0.32" single rod*
- *Ø4 mm / 0.16" single cable*

Single rod probes

How to decrease the length of single rod probes and change the device setting (if the tank is not empty)

- Measure the length of the rod from the flange facing or thread stop. Use a scriber to put a mark on the rod.
- Cut the rod to the correct length.
- Enter the supervisor menu.
- Push [>], 2 × [▲], [>] and 2 × [▲] to go to menu item 2.3.4 PROBE LENGTH.
- Enter the new value. Push [↵] to go back to the sub-menu level.
- Push 4 × [↵] to save settings.
- Set the parameter to STORE YES and push [↵].

➲ End of the procedure.

How to decrease the length of single rod probes (if the tank is empty)

- Measure the length of the rod from the flange facing or thread stop. Use a scriber to put a mark on the rod.
- Cut the rod to the correct length.
- Enter the supervisor menu.
- Push 2 × [>], 2 × [▲], to go to menu item 2.1.3 CALC PROBE.L (probe length calculation). Do the probe length calculation procedure on page 79.

➲ End of the procedure.

CAUTION!
Do the snapshot procedure after you decrease the length of the probe. For more data about the procedure, refer to Snapshot on page 80.

Cable probes

How to decrease the length of cable probes and change the device setting (if the tank is not empty)

- Loosen the socket set screws that hold the counterweight with a 3 mm Allen wrench.
- Remove the counterweight.
- Measure the length of the cable from the flange facing or thread stop. Use a scriber to put a mark on the cable.

➲ Add the length of the counterweight and subtract the length of the cable engaged in the counterweight. This gives the total probe length. Refer to the illustration and table that follows.

- Cut the cable to the correct length.

- Attach the cable to the counterweight. Tighten the socket set screws with a 3 mm Allen wrench.
- Enter the supervisor menu.
- Push [>], 2 × [▲], [>] and 2 × [▲] to go to menu item 2.3.4 PROBE LENGTH.
- Enter the new value. Push [↵] to go back to the sub-menu level.
- Push 4 × [↵] to save settings.
- Set the parameter to STORE YES and push [↵].

➲ End of the procedure.

How to decrease the length of cable probes and change the device setting (if the tank is empty)

- Loosen the socket set screws that hold the counterweight with a 3 mm Allen wrench.
- Remove the counterweight.
- Measure the length of the cable from the flange facing or thread stop. Use a scriber to put a mark on the cable.

➲ Add the length of the counterweight and subtract the length of the cable engaged in the counterweight. This gives the total probe length. Refer to the illustration and table that follows.

- Cut the cable to the correct length.
- Attach the cable to the counterweight. Tighten the socket set screws with a 3 mm Allen wrench.
- Enter the supervisor menu.
- Push 2 × [>], 2 × [▲], to go to menu item 2.1.3 CALC PROBE.L (probe length calculation). Do the probe length calculation procedure on page 79.

➲ End of the procedure.

CAUTION!

Do the snapshot procedure after you decrease the length of the probe. For more data about the procedure, refer to Snapshot on page 80.

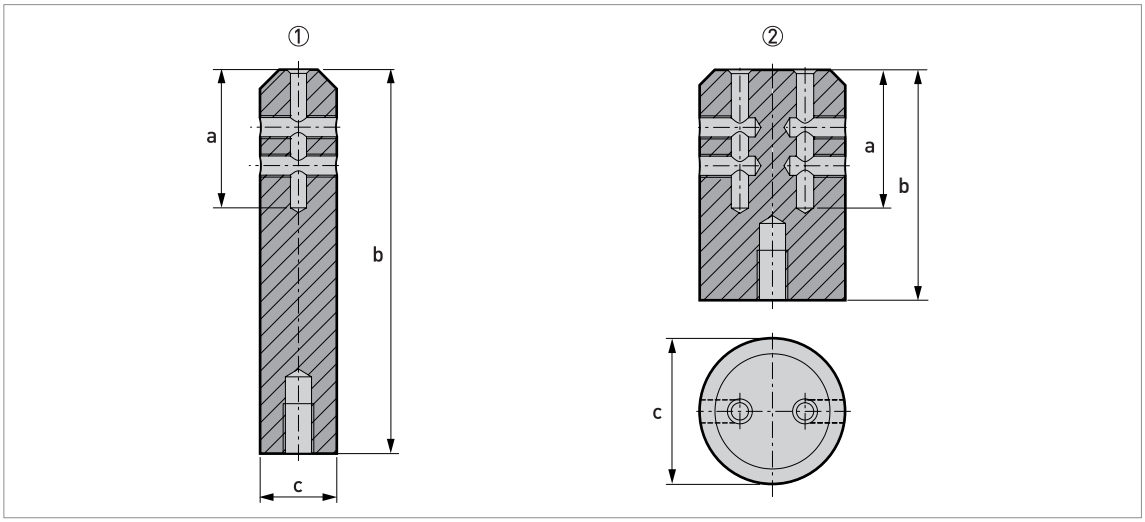


Figure 6-8: Dimensions of the counterweights

① Ø4 mm / 0.16¨ single cable probe
② Ø4 mm / 0.16¨ double cable probe

Dimensions in mm

Probe type	Dimensions [mm]		
	a	b	Øc
Single cable Ø4 mm	36	100	20
Double cable Ø4 mm	36	60	38

Dimensions in inches

Probe type	Dimensions [inches]		
	a	b	Øc
Single cable Ø0.16¨	1.4	3.9	0.8
Double cable Ø0.16¨	1.4	2.4	1.5

6.5 Status and error messages

6.5.1 Device status (markers)

If the device senses a change in device status, the display screen will show 1 or more status markers at the bottom right side of the display screen. The display screen will also show a symbol that agrees with NAMUR Recommendation NE 107 (Self-Monitoring and Diagnosis of Field Devices) and VDI/VDE 2650. This is shown at the top left side of the display screen. Error codes and data are shown on the device display screen.

Menu item 2.2.2 DIAGNOSTIC (Configuration mode / Supervisor menu) supplies more data. This includes internal voltages, the loop current and the reset counter (watchdog timer). You can see this data on the device display screen and in the DTM.

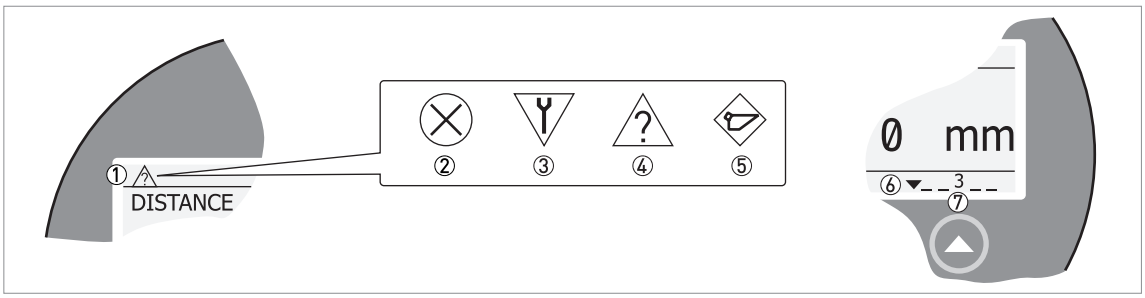


Figure 6-9: Status markers

① Device status (NAMUR NE 107 symbols)
② Symbol: Failure
③ Symbol: Function check
④ Symbol: Out of specification
⑤ Symbol: Maintenance
⑥ Status marker line (marker 3 is shown)
⑦ When the status marker is on, a number is shown

Types of error message

NE 107 status	Type of error	Description
Failure	Error	If an error message is shown in ERROR RECORD (menu item 1.3.1), the current output goes to the error signal value set in menu item RANGE I (menu item 2.4.2) after the time set in ERROR DELAY (menu item 2.4.5). For more data about menu items, refer to *Function description* on page 70.
Out of specification	Warning	If a warning message is shown, there is no effect on the current output value.
Maintenance		

NE 107 symbol shown	NE 107 Status	Description	Status marker shown	Error code (Type)	Possible errors
	Failure	The device does not operate correctly. The fault message stays on. The user cannot remove the "Failure" message from the Normal mode screen.	1	ERR 101 (Error)	Current Output Drift
			3	ERR 102 (Error)	Temperature Out of Range
			1	ERR 103 (Error)	Converter EEPROM
			1	ERR 103 (Error)	Converter RAM
			1	ERR 103 (Error)	Converter ROM
			1	ERR 104 (Error)	Converter Voltage
			2	ERR 200 (Error)	Reference Lost
			2	ERR 202 (Error)	Peak Lost (Level Lost)
			3	ERR 203 (Error)	Sensor Processing Failure
			2	ERR 204 (Error)	Overfill
			3	ERR 205 (Error)	Internal Communication
			1	ERR 206 (Error)	No Probe detected
			1	ERR 207 (Error)	Sensor EEPROM
			1	ERR 207 (Error)	Sensor RAM
			1	ERR 207 (Error)	Sensor ROM
			1	ERR 208 (Error)	Oscillator Frequency
			3	ERR 209 (Error)	Sensor Not compatible
			2, 4	ERR 210 (Error)	Empty
	Function check	The device operates correctly, but the measured value is incorrect. This fault message is only temporary. This symbol is shown when the user configures the device with the DTM or a HART® Communicator.	—	—	—
	Out of specification	It is possible that the measured value is unstable if the operating conditions do not agree with the device specification.	4	(Warning)	Peak Lost
			4	(Warning)	Overfill
			4	(Warning)	Empty
			4	(Warning)	Temperature out of range

NE 107 symbol shown	NE 107 Status	Description	Status marker shown	Error code (Type)	Possible errors
	Maintenance	The device does not operate correctly because of bad environmental conditions. The measured value is correct, but maintenance is necessary a short time after this symbol is shown.	5	(Warning)	Snapshot Invalid
			4	(Warning)	Flange Lost
			4	(Warning)	Reference Position Outside Range
			4	(Warning)	Audio Signal Offset Outside Range
			3	(Warning)	Temperature <-35°C / -31°F ①
			3	(Warning)	Temperature >+75°C / +167°F ①
—	—	—	6	(Warning)	Calc.Probe L. Not Valid

① CAUTION! The device display screen does not operate at this temperature

If an "Out of specification" or a "Maintenance" status symbol is shown, refer to menu item 2.2.2 DIAGNOSTIC (Configuration mode / Supervisor menu) for more data.

For data on errors, error records and error codes, refer to *Error handling* on page 94.

6.5.2 Error handling

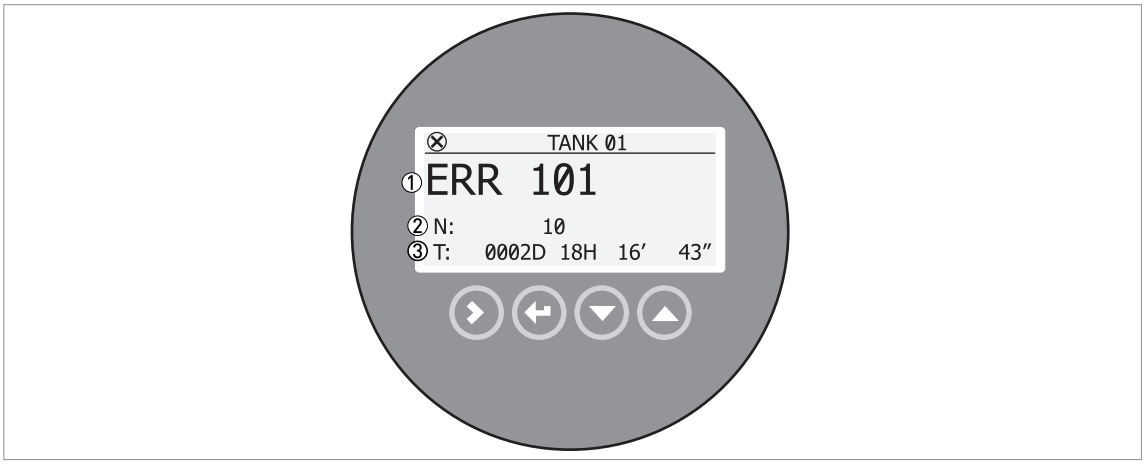


Figure 6-10: Error record data

① Error code for the error
② Number of times the error occurred
③ Time since the last error record (2 days, 18 hours, 16 minutes and 43 seconds shown in this example)

How to find an error record

- Push [>] to enter configuration mode from normal mode.
- Push [>], 2 × [▲] and [>] to go to menu item 1.3.1 ERROR RECORD.
- Push 2 × [>] to look at the error list. Push [▲] or [▼] for the selection of an error.

➲ The error record gives the number of times the error occurred and the time since the last error message.

INFORMATION!
The time since the error occurred is measured in Days (D), Hours (H), Minutes (') and Seconds ("). It only includes the time when the device is energized. The error is saved in the memory of the device when it is de-energized. The counter continues when the device is energized again.

Menu item 2.2.2 DIAGNOSTIC (Configuration mode / Supervisor menu) supplies more data. This includes internal voltages, the loop current and the reset counter (watchdog timer). You can see this data on the device display screen and in the DTM.

Description of data in menu item 2.2.2 DIAGNOSTIC

Hardware test	Description	Normal operating range	Full range	Cause	Corrective action
Time of operation (D1)	This shows the time in seconds that the device is energized.	—	—	—	For information only.
Temperature of the electronic converter board (T1)	This shows the temperature (in °C) of the converter board.	-40...+80°C	-40...+85°C	See error **ERR 102** in the table that follows.	See error **ERR 102** in the table that follows.
Loop current (I1)	This shows the current output of the device (in mA).	4...20 mA	—	—	—
Voltage 5.6 V	Voltage transmitted to the sensor board	5.4...5.7 V	5.4...5.7 V	—	If the device senses a hardware error, give this data to your supplier.
Voltage on capacitors (V2)	Voltage transmitted to the capacitor on the converter board	16...19 V	16...19 V	—	If the device senses a hardware error, give this data to your supplier.
Voltage 3.3 V	Voltage transmitted to the sensor board and the converter board	3.2...3.5 V	3.2...3.5 V	—	If the device senses a hardware error, give this data to your supplier.
Amplitude reference pulse (P1)	Absolute amplitude of the reference signal converted to a digital sample.	3000...5000	0...6000		If the device senses a hardware error, give this data to your supplier.
Amplitude level pulse (P2)	Absolute amplitude of the level signal converted to a digital sample.	0...5500	0...6000		If the device senses a hardware error, give this data to your supplier.
Amplitude probe end pulse (P3)	Absolute amplitude of the probe end signal converted to a digital sample.	0...5500	0...6000		This is not applicable to this version of the device.

Description of errors and corrective actions

Error code	Error Message	Status marker shown	Cause	Corrective action
Back end errors				
ERR 100	Device reset	1	The device detected an internal error. (watchdog timer issue)	Record the data that is in menu item 2.2.2 DIAGNOSTIC (Configuration mode / Supervisor menu). Speak to the supplier.
ERR 101	Current output drift	1	The current output is not calibrated.	Speak to the supplier to get the calibration procedure.
		1	Hardware error.	Replace the device.
ERR 102	Temperature out of range	3	The ambient temperature is outside the given range. This can cause loss or corruption of data.	Measure the ambient temperature. De-energize the device until the ambient temperature is back in the given range. If the temperature does not stay in the correct range, make sure that there is insulation around the signal converter.
ERR 103	Converter memory failure	1	The device's hardware is defective.	Replace the signal converter. For more data, refer to *How to turn or remove the signal converter* on page 36.
ERR 104	Converter voltage failure	1	The device's hardware is defective.	Replace the signal converter. For more data, refer to *How to turn or remove the signal converter* on page 36.
Sensor errors				
ERR 200	Reference pulse lost	2	Reference amplitude is less than reference threshold. This fault could occur because the device hardware is defective.	Speak to your supplier to make sure that the electronics are still functioning correctly. Make sure that your installation has ESD protection.
ERR 201	Sensor voltage failure	1	The device's hardware is defective.	Do a check of the power supply at the device terminals. Make sure that voltage values are in the specified limits in menu item 2.2.2 DIAGNOSTIC (Configuration mode / Supervisor menu). If the voltage is correct, replace the signal converter. For more data on how to replace the signal converter, refer to *How to turn or remove the signal converter* on page 36.

Error code	Error Message	Status marker shown	Cause	Corrective action
ERR 202	Level lost error	2, 4	The device cannot find the product surface. The measurement stops at the last measured value.	Measure the level of the contents in the tank using another method of measurement. If the tank is empty (the level is below the end of the probe), then fill the tank until product level is in the measurement range. If the tank is full (the level is in the blocking distance), then remove the contents from the tank until the level is back in the measuring range. If the product was lost and the tank is neither full nor empty, wait for the device to find the level again.
		2, 4	The device cannot find the level return signal and the probe end return signal.	If the device has to measure a product with $\varepsilon_r \geq 1.6$, refer to LEVEL AMP. (Level Pulse Amplitude, menu item 2.5.6) and then adjust LEVEL THRESH. (measurement threshold, menu item 2.5.7).
				Make sure that the signal converter is correctly attached the probe. For more data, refer to *How to turn or remove the signal converter* on page 36.
ERR 203	Sensor Processing Failure	3	The device's software is defective. The converter cannot receive signals from the probe electronics.	De-energize the device. Make sure that the signal cable engages in the terminal and the screw connection is tight. Energize the device. If the problem continues, replace the signal converter. For more data, refer to *How to turn or remove the signal converter* on page 36.
ERR 204	Overfill error	2, 4	The level is in the blocking distance. There is a risk that the product will overflow and/or cover the device.	Remove some of the product until the level is below the blocking distance.
ERR 205	Internal Communication	3	The device's hardware or software is defective. The converter cannot transmit signals to or receive signals from the probe electronics.	De-energize the device. Make sure that the signal cable engages in the terminal and the screw connection is tight. Energize the device. If the problem continues, replace the signal converter. For more data, refer to *How to turn or remove the signal converter* on page 36.
ERR 206	No sensor detected	2	The device's hardware is defective.	Replace the signal converter. For more data, refer to *How to turn or remove the signal converter* on page 36.
ERR 207	Sensor memory failure	1	The device's hardware is defective.	Replace the signal converter. For more data, refer to *How to turn or remove the signal converter* on page 36.
ERR 208	Oscillator Frequency	1	The device's hardware is defective.	Replace the signal converter. For more data, refer to *How to turn or remove the signal converter* on page 36.

Error code	Error Message	Status marker shown	Cause	Corrective action
ERR 209	Sensor not compatible	1	The software version of the sensor is not compatible with the software version of the signal converter.	Go to menu 1.1.0 IDENT. in Configuration mode. Record the version numbers of the device software given in menu items 1.1.2, 1.1.3 and 1.1.4. Give this data to the supplier.
		1	Defective wiring.	
ERR 210	Empty	2, 4	The level is in the bottom dead zone. There is a risk that the tank is empty.	Add some of the product until the level is above the bottom dead zone.

Maintenance (NE 107 status signal)

—	Snapshot Invalid	5	The "static" snapshot data stored in the device does not agree with the installation. If you change the device configuration (probe length etc.), this message will be shown. The recorded "static" snapshot data will not be used by the device while this error message is shown. ①	Do the quick setup procedure in menu item 2.1.2 SNAPSHOT again.
—	Flange Lost	4	The signal converter cannot find the probe below the flange. It is possible that the probe is not correctly attached to the device.	Make sure that the probe is attached to the device. If this status does not change, speak to the supplier.
—	Reference Position Outside Range	4	The device's hardware is defective. ①	Replace the signal converter. For more data, refer to *How to turn or remove the signal converter* on page 36.
—	Audio Signal Offset Outside Range	4	The device's hardware is defective. ①	Replace the signal converter. For more data, refer to *How to turn or remove the signal converter* on page 36.
—	Temperature <-35°C / -31°F ②	3	The ambient temperature is less than -35°C / -31°F. This temperature is near to the minimum limit for device operation. ①	Measure the ambient temperature. If the temperature does not stay in the correct range, make sure that there is insulation around the signal converter.
—	Temperature >+75°C / +167°F ②	3	The ambient temperature is more than +75°C / +167°F. This temperature is near to the maximum limit for device operation. ①	Measure the ambient temperature. If the temperature does not stay in the correct range, make sure that there is insulation around the signal converter.

Error code	Error Message	Status marker shown	Cause	Corrective action
Other warnings				
—	Calc.Probe L. Not Valid	6	This warning is shown if you decrease the probe length and it is not the same as the value used in the device settings (menu item 2.3.4 PROBE LENGTH). The recorded probe length calculation will not be used by the device while this error message is shown.	Do the procedure in menu item 2.1.3 CALC.PROBE.L again. If you decreased the probe length, you must do the procedure in menu item 2.1.2 SNAPSHOT again.
			This warning is shown if: - you changed the value in menu item 2.5.3 GAS EPS. R after you did the procedure in menu item 2.1.3 CALC.PROBE.L. - the dielectric constant of the gas changed after you did the procedure in menu item 2.1.3 CALC.PROBE.L. in the tank. This can occur if you did the probe length calculation procedure in an empty tank without the correct gas. The recorded probe length calculation will not be used by the device while this error message is shown.	

① This error message does not have an effect on the current output signal

② CAUTION! The device display screen does not operate at this temperature

INFORMATION!

In 4.0.0 MASTER menu, the type of error shown for error codes 102, 201 and 203 can be changed from "Error" to "Warning" (the NE 107 status signal changes from "Failure" to "Out of specification"). The 4.0.0 MASTER menu is password locked. For more data, speak or write to the supplier.

7.1 Periodic maintenance

CAUTION!

All versions of the device with the sensor extension

If the device operates in a location where there is, for example, vibration or gamma radiation, we recommend that you do an accuracy check at intervals of 12 to 18 months. It is also important to do this check after an earthquake. Refer to the "On-site accuracy check procedure" in the addendum supplied with this device. This procedure shows you how to do a remote electrical inspection of the coaxial cable. This inspection can also give data about damage to the coaxial cable.

If necessary, recalibrate the device. Recalibration will correct the few millimetres of drift that can be the result of the aging effect of vibration and radiation on the coaxial cable.

7.2 Keep the device clean

Obey these instructions:

- Keep the thread of the terminal compartment cover clean.
- If dirt collects on the device, clean it with a damp cloth.

7.3 How to replace device components

7.3.1 Service warranty

WARNING!

Only approved personnel can do an inspection of the device and repairs. If you find a problem, send the device back to your supplier for inspection and/or repairs.

INFORMATION!

The converter housing (compact or remote version) can be detached from the process connection assembly under process conditions. For more data, refer to How to turn or remove the signal converter on page 36.

Servicing by the customer is limited by warranty to:

- The removal and installation of the device.
- **Compact version:** The removal and installation of the signal converter (with the weather protection, if this option is attached). For more data, refer to *How to turn or remove the signal converter* on page 36.
- **Remote (field) version:** The removal and installation of the remote converter and/or the probe housing. For more data, refer to *How to turn or remove the signal converter* on page 36.

For more data on how to prepare the device before you send it back, refer to *Returning the device to the manufacturer* on page 101.

7.4 Availability of services

The manufacturer offers a range of services to support the customer after expiration of the warranty. These include repair, maintenance, technical support and training.

INFORMATION!
For more precise information, please contact your local sales office.

7.5 Returning the device to the manufacturer

7.5.1 General information

This device has been carefully manufactured and tested. If installed and operated in accordance with these operating instructions, it will rarely present any problems.

WARNING!
Should you nevertheless need to return a device for inspection or repair, please pay strict attention to the following points:

- *Due to statutory regulations on environmental protection and safeguarding the health and safety of the personnel, the manufacturer may only handle, test and repair returned devices that have been in contact with products without risk to personnel and environment.*
- *This means that the manufacturer can only service this device if it is accompanied by the following certificate (see next section) confirming that the device is safe to handle.*

WARNING!
If the device has been operated with toxic, caustic, radioactive, flammable or water-endangering products, you are kindly requested:

- *to check and ensure, if necessary by rinsing or neutralising, that all cavities are free from such dangerous substances,*
- *to enclose a certificate with the device confirming that it is safe to handle and stating the product used.*

7.5.2 Form (for copying) to accompany a returned device

CAUTION!
To avoid any risk for our service personnel, this form has to be accessible from outside of the packaging with the returned device.

Company:		Address:
Department:		Name:
Tel. no.:		Fax no. and/or Email address:
Manufacturer's order no. or serial no.:		
The device has been operated with the following medium:		
This medium is:		radioactive
		water-hazardous
		toxic
		caustic
		flammable
		We checked that all cavities in the device are free from such substances.
		We have flushed out and neutralized all cavities in the device.
We hereby confirm that there is no risk to persons or the environment through any residual media contained in the device when it is returned.		
Date:		Signature:
Stamp:		

7.6 Disposal

WARNING!
Disposal must be carried out in accordance with national and international legislation and treaties applicable to the treatment and storage of radioactive waste.

8.1 Measuring principle

This Guided Radar (TDR) level transmitter has been developed from a proven technology called Time Domain Reflectometry (TDR).

The device transmits low-intensity electromagnetic pulses of approximately one nanosecond width along a rigid or flexible conductor. These pulses move at the speed of light. When the pulses reach the surface of the product to be measured, the pulses are reflected back to the signal converter.

The device measures the time from when the pulse is emitted to when it is received: half of this time is equivalent to the distance from the reference point of the device to the surface of the product. The time value is converted into an output current of 4...20 mA.

Dust, foam, vapour, agitated surfaces, boiling surfaces, changes in pressure, changes in temperature, changes in dielectric constant and changes in density do not have an effect on device performance.

The illustration that follows shows a snapshot of what a user would see on an oscilloscope, if the level of one product is measured.

TDR measurement of level

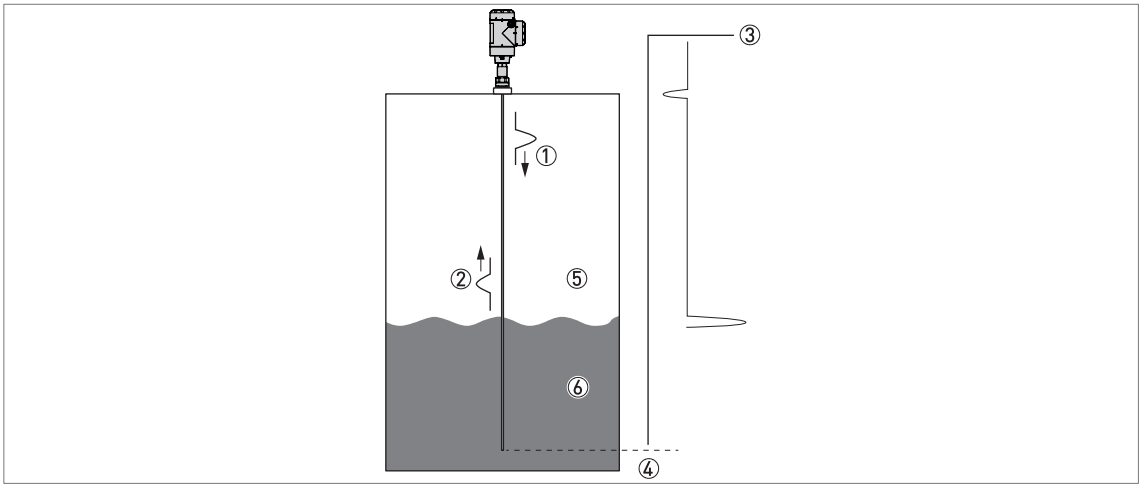


Figure 8-1: TDR measurement of level

① Transmitted pulses
② Reflected pulse
③ Pulse amplitude
④ Time of flight
⑤ Air, $\varepsilon_r = 1$
⑥ $\varepsilon_r \geq 1.4$

8.2 Technical data

INFORMATION!

- *The following data is provided for general applications. If you require data that is more relevant to your specific application, please contact us or your local sales office.*
- *Additional information (certificates, special tools, software,...) and complete product documentation can be downloaded free of charge from the website (Downloadcenter).*

Converter

Measuring system

Application	Level and volume measurement of liquids and pastes
Measuring principle	TDR (time domain reflectometry)
Construction	**Compact version (C):** Measuring probe attached directly to a signal converter **Compact version with sensor extension (S):** Measuring probe with a sensor extension cable (max. length 100 m / 328 ft) attached to a signal converter **Compact version with LOCA sensor extension (S LOCA):** Measuring probe with a sensor extension cable (max. length 150 m / 492 ft) attached to a signal converter **Remote version (F):** Measuring probe with a signal cable (max. length 300 m / 984 ft) attached to a signal converter **Remote version with sensor extension (D):** Measuring probe with a sensor extension cable (max. length 100 m / 328 ft) and signal cable (max. length 300 m / 984 ft) attached to a signal converter **Remote version with LOCA sensor extension (D LOCA):** Measuring probe with a sensor extension cable (max. length 150 m / 492 ft) and signal cable (max. length 300 m / 984 ft) attached to a signal converter

Operating conditions

Ambient temperature	**Compact (C) and Remote (F) versions:** -40…+80°C / -40…+176°F Integrated LCD display: -20...+60°C / -4...+140°F; if the ambient temperature is not in these limits, the display switches off
	Compact version with sensor extension (S) and Remote version with sensor extension (D): Converter: -40…+80°C / -40…+176°F Integrated LCD display: -20...+60°C / -4...+140°F; if the ambient temperature is not in these limits, the display switches off Probe, process connection and sensor extension: -40…+85°C / -40…+185°F Probe, process connection and LOCA sensor extension: -40…+150°C / -40…+302°F
Storage temperature	-50…+85°C / -60…+185°F (min. -40°C / -40°F for devices with the integrated LCD display option)
Ingress protection	IEC 60529: IP66/67
	NEMA 250: NEMA type 4X (housing) and type 6P (probe)
Radioactivity	**C version** 57 Gy
	F, S and D versions Probe: 2700 kGy / Sensor electronics block: 105 Gy / Converter: 57 Gy
	S LOCA and D LOCA versions Probe: 5000 kGy / Sensor electronics block: 105 Gy / Converter: 57 Gy

Materials

Housing	Stainless steel (1.4404 / 316L)
Cable entry	Stainless steel (for RCC-E nuclear-qualified plug-in connectors etc.)

Electrical connections

Power supply (terminals)	11.5…30 VDC; min./max. value for an output of 22 mA at the terminal
Current output load	R_L [Ω] ≤ ((U_{ext} -11.5 V)/22 mA). For more data, refer to *Minimum power supply voltage* on page 109.
Cable entry	M20 × 1.5; ½ NPT
Cable gland	Standard: none
	Options: M20×1.5 (cable diameter: 6...7.5 mm / 0.24...0.3¨); others are available on request
Signal cable – remote (F) version	None (4-wire shielded cable of max. length 300 m / 984 ft to be supplied by the customer). For more data, refer to *Remote device data* on page 49

Sensor extension ①	50-ohm cable of max. length 100 m / 328 ft, agrees with the standards and specifications that follow: – zero halogen – CST 74 C 068 Level K2, this includes thermal and radiation qualifications – NF C32-070 Class C1 – IEEE Std 1202; UL 1581
LOCA sensor extension ②	50-ohm cable of max. length 150 m / 492 ft, agrees with the standards and specifications that follow: – zero halogen – NF C32-070 Class C1 – IEC 60332-3-23 – radiation-hardened
Cable entry capacity (terminal)	0.5…2.5 mm²

Input and output

Measured variable	Time between the emitted and received signal
Current output / HART®	
Output signal	4…20 mA HART® or 3.8…20.5 mA acc. to NAMUR NE 43 ③
Resolution	±3 µA
Temperature drift (analog)	Typically 100 ppm/K
Temperature drift (digital)	Max. ±15 mm for the full temperature range
Error signal options	High: 22 mA; Low: 3.6 mA acc. to NAMUR NE 43; Hold (frozen value – not available if the output agrees with NAMUR NE 43)

Display and user interface

User interface options	LCD display (128 × 64 pixels in 8-step greyscale with 4-button keypad)
Languages	9 languages are available: English, German, French, Italian, Spanish, Portuguese, Japanese, Chinese (simplified) and Russian

Approvals and certification

CE	This device fulfils the statutory requirements of the EU directives. The manufacturer certifies successful testing of the product by applying the CE mark.
Nuclear	RCC-E (category K3ad equipment)
	IEEE Std 323 (class 1E equipment)
	OPB-88/97 (safety class 3N equipment)
	IEC 61513
	Others on request
Pressure safety (conformity to design and construction regulations)	RCC-M
	ASME Section III; B31.1; B31.3
	CODAP
Vibration resistance	EN 60721-3-4 (1...9 Hz: 3 mm / 10...200 Hz:1g; 10g shock ½sinus: 11 ms) For coaxial probes: <2 m / 6.56 ft, 0.5g or category 4M3 according to EN 60721-3-4 <6 m / 19.68 ft, 0.5g or category 4M1 according to EN 60721-3-4
Mechanical integrity	IEC 60068-2-57 / IEC 60068-2-6 (design and test conditions) – for cable probes only
Thermal aging tests	+107°C / +224.6°F for 196 days
Seismic tests	CRT 91 C 112 00 (EDF technical specification); RCC-E
	IEEE Std 344-1987; IEEE Std 344-2004
	IEC 60980:1989

Other standards and approvals	
EMC	Electromagnetic Compatibility Directive 2014/30/EU in conjunction with EN 61326-1 (2013). The device agrees with this standard if: – the device has a coaxial probe or – the device has a single / double probe that is installed in a metallic tank. For more data, refer to *Electromagnetic compatibility* on page 8.
	IEC 61000-4
	MIL-STD-461F
NAMUR	NAMUR NE 21 Electromagnetic Compatibility (EMC) of Industrial Process and Laboratory Control Equipment
	NAMUR NE 43 Standardization of the Signal Level for the Failure Information of Digital Transmitters
	NAMUR NE 53 Software and Hardware of Field Devices and Signal Processing Devices with Digital Electronics
	NAMUR NE 107 Self-Monitoring and Diagnosis of Field Devices

① Cable for the compact version with a sensor extension (S) and the remote version with a sensor extension (D)

② Cable for the compact version with a sensor extension (S LOCA) and the remote version with a sensor extension (D LOCA)

③ HART® is a registered trademark of the HART Communication Foundation

Probe options

	Single cable Ø4 mm / 0.16¨	Single rod Ø8 mm / 0.32¨

Measuring system

Application	Liquids	
Measuring range	**Compact (C) and Remote (F) versions:** 1...40 m / 3.3...131 ft	1...4 m / 3.3...13.1 ft
	Compact version with sensor extension (S) and Remote version with sensor extension (D): 1...20 m / 3.3...65.6 ft	
Dead zone	This depends on the type of probe. For more data, refer to "Measurement limits" in this chapter.	

Measuring accuracy

Accuracy	**Standard:** ±10 mm / ±0.4¨, when distance ≤ 10 m / 32.8 ft; ±0.1% of distance, when distance > 10 m / 32.8 ft ±0.1% of the coaxial cable length (if the device has a sensor extension option – device versions S or D)
	Optional: ±3 mm / ±0.1¨, when distance ≤ 10 m / 32.8 ft; ±0.03% of distance, when distance > 10 m / 32.8 ft ±0.1% of the coaxial cable length, if the device has a sensor extension option – device versions S or D
Resolution	1 mm / 0.04¨
Repeatability	Compact versions (C or S): ±2 mm / ±0.08¨
	Remote versions (F or D): ±2 mm / ±0.08¨, if the ambient temperature is stable
Maximum rate of change at 4 mA	60 m/min / 196.9 ft/min

Operating conditions

Min./Max. temperature at the process connection	-50…+150°C / -58…+302°F; higher on request
Pressure	-1…100 barg / -14.5…1450 psig; higher on request

	Single cable Ø4 mm / 0.16¨	Single rod Ø8 mm / 0.32¨
Viscosity	10000 mPa·s / 10000 cP	
Dielectric constant	≥ 1.8	

Materials

Probe	Stainless steel (1.4401 / 316)
Gasket (process seal)	EPDM (-50...+150°C / -58...+302°F)
Process connection	Stainless steel (1.4404 / 316L); HASTELLOY® C-22® (2.4602)

Process connections

Thread	1½ NPT; G 1½A	1½ NPT; G 1½A
Flange		
EN 1092-1	DN40...200 in PN10, PN16, PN25 or PN40 ①	
ASME B16.5	1½...8¨ in 150 lb or 300 lb ①	
JIS B2220	40...200A in 10 K	

① Other flange faces are available. Refer to your local supplier for more data.

	Double cable 2 × Ø4 mm / 0.16¨	Double rod 2 × Ø8 mm / 0.32¨	Coaxial Ø22 mm / 0.87¨

Measuring system

Application	Liquids		
Measuring range	Versions C or F: 1...40 m / 3.3...131.2 ft Versions S or D: 1...20 m / 3.3...65.6 ft	1...4 m / 3.3...13.1 ft	0.6...6 m / 2.0...19.7 ft
Dead zone	This depends on the type of probe. For more data, refer to "Measurement limits" in this chapter.		

Measuring accuracy

Accuracy	**Standard:** ±10 mm / ±0.4¨, when distance ≤ 10 m / 32.8 ft; ±0.1% of distance, when distance > 10 m / 32.8 ft ±0.1% of the coaxial cable length (if the device has a sensor extension option – device versions S or D)
	Optional: ±3 mm / ±0.1¨, when distance ≤ 10 m / 32.8 ft; ±0.03% of distance, when distance > 10 m / 32.8 ft ±0.1% of the coaxial cable length, if the device has a sensor extension option – device versions S or D
Resolution	1 mm / 0.04¨
Repeatability	Compact versions (device versions C or S): ±2 mm / ±0.08¨
	Remote versions (device versions F or D): ±2 mm / ±0.08¨, if the ambient temperature is stable
Maximum rate of change at 4 mA	60 m/min / 196.8 ft/min

Operating conditions

Min./Max. temperature at the process connection	-50…+150°C / -58…+302°F; higher on request

	Double cable 2 × Ø4 mm / 0.16¨	Double rod 2 × Ø8 mm / 0.32¨	Coaxial Ø22 mm / 0.87¨
Pressure	-1…100 barg / -14.5…1450 psig; higher on request		
Viscosity	≤ 5000 mPa·s / ≤ 5000 cP		500 mPa·s / 500 cP
Dielectric constant	≥ 1.6		≥ 1.4

Materials

Probe	Stainless steel (1.4404 / 316L)	Stainless steel (1.4401 / 316)
Gasket (process seal)	EPDM (-50...+150°C / -58...+302°F)	
Process connection	Stainless steel (1.4404 / 316L)	

Process connections

Thread	1½ NPT; G 1½A	1½ NPT; G 1½A	1½ NPT; G 1½A
Flange			
EN 1092-1	DN40...200 in PN10, PN16, PN25 or PN40 ①		
ASME B16.5	1½...8¨ in 150 lb or 300 lb ②		
JIS B2220	40...200A in 10 K ③		
Others	Others on request		

① DN50...200 for double cable and double rod probes. Other flange faces are available. Refer to your local supplier for more data.
② 2...8¨ for double cable and double rod probes
③ 50...200A for double cable and double rod probes

8.3 Minimum power supply voltage

Use this graph to find the minimum power supply voltage for a given current output load.

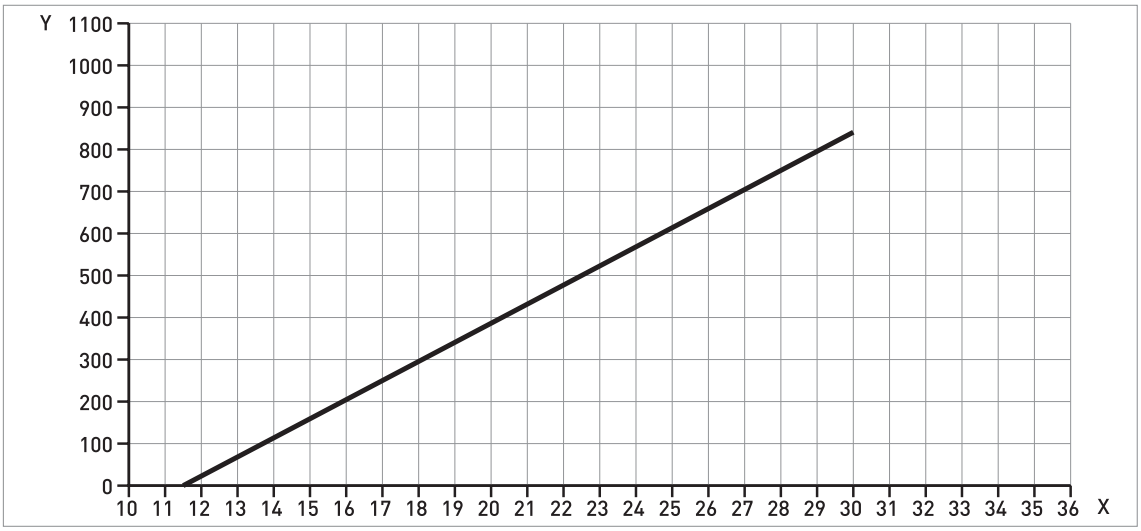


Figure 8-2: Minimum power supply voltage for an output of 22 mA at the terminals (Non-Ex and Hazardous Location approval (Ex i / IS))

X: Power supply U [V DC]
Y: Current output load R_L [Ω]

8.4 Measurement limits

Double cable and double rod probes

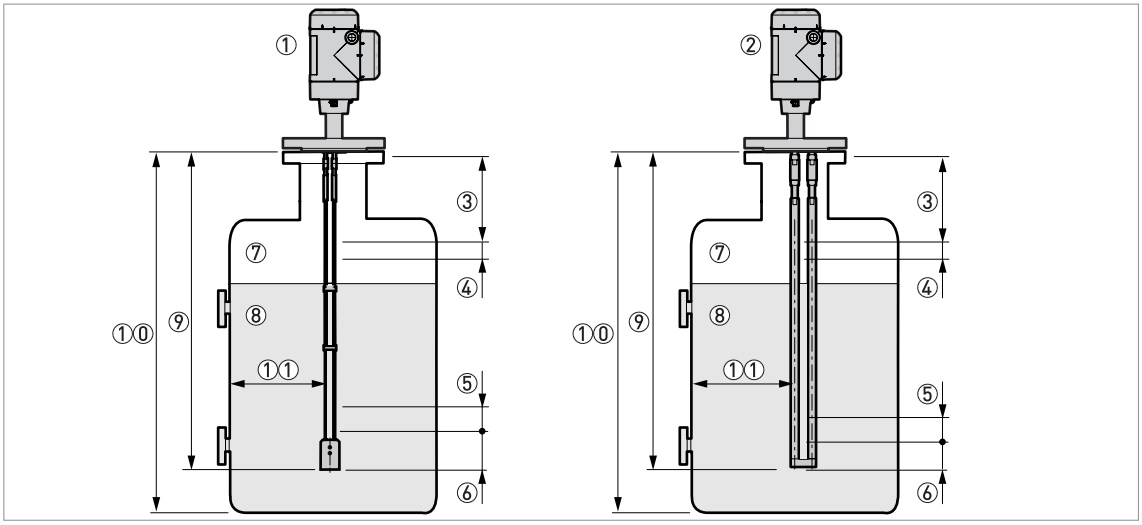


Figure 8-3: Measurement limits

① Device with a double cable probe
② Device with a double rod probe
③ **Top dead zone:** Top part of the probe where measurement is not possible
④ **Top non-linearity zone:** Top part of the probe with a lower accuracy of ±30 mm / ±1.18¨
⑤ **Bottom non-linearity zone:** Bottom part of the probe with a lower accuracy of ±30 mm / ±1.18¨
⑥ **Bottom dead zone:** Bottom part of the probe where measurement is not possible
⑦ **Gas (Air)**
⑧ **Product**
⑨ **L, Probe length**
①⓪ **Tank Height**
①① **Minimum distance from the probe to a metallic tank wall:** Double cable or double rod probes = 100 mm / 4¨

Measurement limits (dead zone) in mm and inches

Probes	ε_r = 80				ε_r = 2.5			
	Top ③		Bottom ⑥		Top ③		Bottom ⑥	
	[mm]	[inches]	[mm]	[inches]	[mm]	[inches]	[mm]	[inches]
Double cable ①	120	4.72	20	0.78	120	4.72	150	5.91
Double rod	120	4.72	20	0.78	120	4.72	150	5.91

① If the cable probe does not have a counterweight, speak or write to your local supplier for more data

Measurement limits (non-linearity zone) in mm and inches

Probes	ε_r = 80				ε_r = 2.3			
	Top ④		Bottom ⑤		Top ④		Bottom ⑤	
	[mm]	[inches]	[mm]	[inches]	[mm]	[inches]	[mm]	[inches]
Double cable ①	0	0	0	0	0	0	10	0.39
Double rod	0	0	0	0	0	0	10	0.39

① If the cable probe does not have a counterweight, speak or write to your local supplier for more data

80 is ε_r of water; 2.5 is ε_r of oil

INFORMATION!

The values in the tables are correct when the Snapshot function is on. If the snapshot function is not on, then the values for the dead zones and the non-linearity zones increase.

Single cable and single rod probes

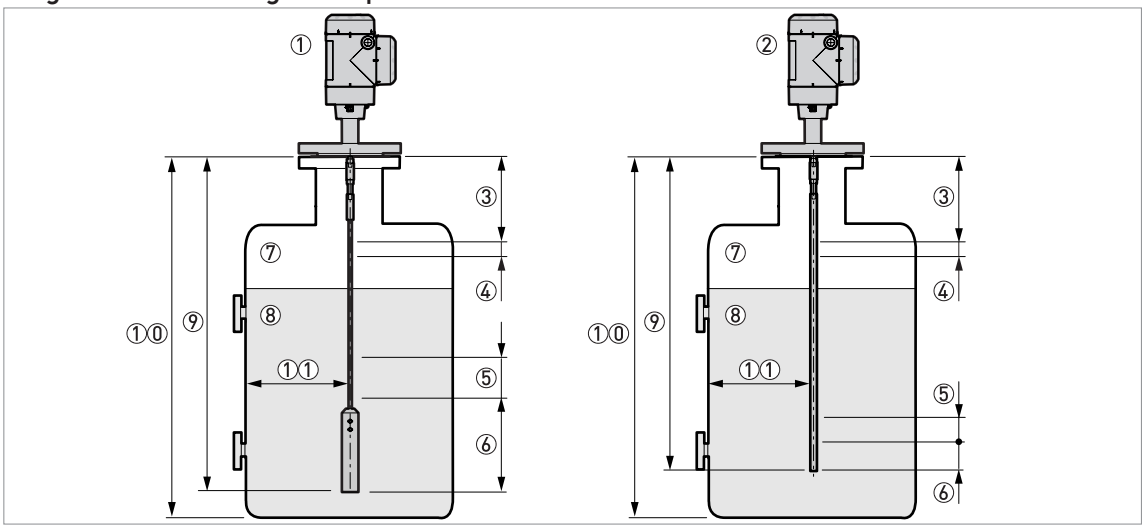


Figure 8-4: Measurement limits

① Device with a single cable probe
② Device with a single rod probe
③ **Top dead zone:** Top part of the probe where measurement is not possible
④ **Top non-linearity zone:** Top part of the probe with a lower accuracy of ±30 mm / ±1.18¨
⑤ **Bottom non-linearity zone:** Bottom part of the probe with a lower accuracy of ±30 mm / ±1.18¨
⑥ **Bottom dead zone:** Bottom part of the probe where measurement is not possible
⑦ **Gas (Air)**
⑧ **Product**
⑨ **L, Probe length**
①⓪ **Tank Height**
①① **Minimum distance from the probe to a metallic tank wall:** Single cable or single rod probes = 300 mm / 12¨

Measurement limits (dead zone) in mm and inches

Probes	ε_r = 80				ε_r = 2.5			
	Top ③		Bottom ⑥		Top ③		Bottom ⑥	
	[mm]	[inches]	[mm]	[inches]	[mm]	[inches]	[mm]	[inches]
4 mm / 0.16¨ single cable ①	120	4.72	200	7.87	120	4.72	240	9.45
Single rod	120	4.72	20	0.79	120	4.72	120	4.72

① If the cable probe does not have a counterweight, speak or write to your local supplier for more data

Measurement limits (non-linearity zone) in mm and inches

Probes	ε_r = 80				ε_r = 2.5			
	Top ④		Bottom ⑤		Top ④		Bottom ⑤	
	[mm]	[inches]	[mm]	[inches]	[mm]	[inches]	[mm]	[inches]
Ø4 mm / 0.16¨ single cable ①	0	0	0	0	0	0	0	0
Single rod	50	1.97	0	0	0	0	0	0

① If the cable probe does not have a counterweight, speak or write to your local supplier for more data

80 is ε_r of water; 2.5 is ε_r of oil

INFORMATION!
The values in the tables are correct when the Snapshot function is on. If the snapshot function is not on, then the values for the dead zones and the non-linearity zones increase.

Coaxial probe

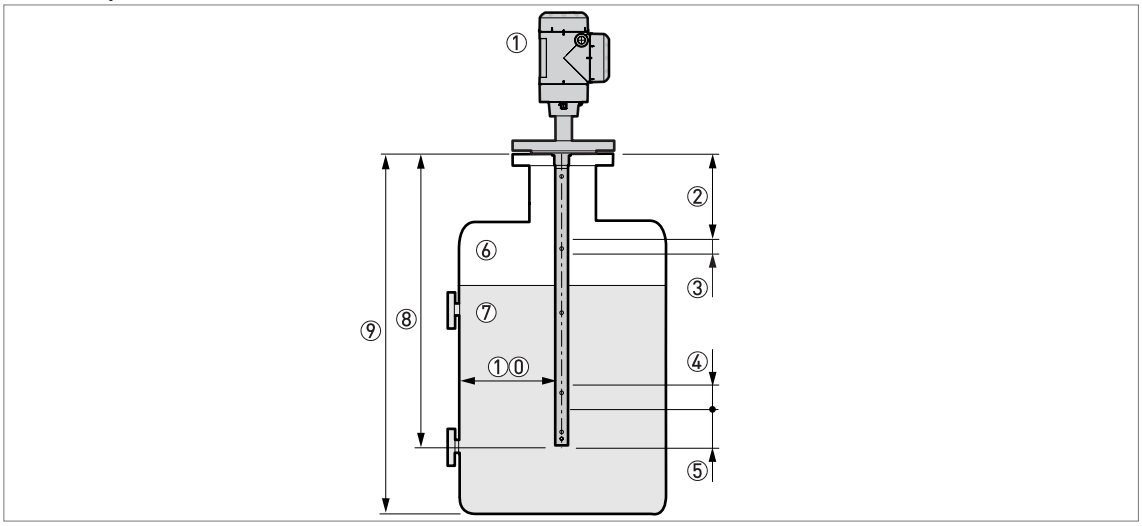


Figure 8-5: Measurement limits

① Device with a coaxial probe
② **Top dead zone:** Top part of the probe where measurement is not possible
③ **Top non-linearity zone:** Top part of the probe with a lower accuracy of ±30 mm / ±1.18¨
④ **Bottom non-linearity zone:** Bottom part of the probe with a lower accuracy of ±30 mm / ±1.18¨
⑤ **Bottom dead zone:** Bottom part of the probe where measurement is not possible
⑥ **Gas (Air)**
⑦ **Product**
⑧ **L, Probe length**
⑨ **Tank Height**
①⓪ **Minimum distance from the probe to a metallic tank wall:** Coaxial probe = 0 mm / 0¨

Measurement limits (dead zone) in mm and inches

Probe	ε_r = 80				ε_r = 2.5			
	Top ②		Bottom ⑤		Top ②		Bottom ⑤	
	[mm]	[inches]	[mm]	[inches]	[mm]	[inches]	[mm]	[inches]
Coaxial	65	2.56	20	0.79	65	2.56	20	0.79

Measurement limits (non-linearity zone) in mm and inches

Probe	ε_r = 80				ε_r = 2.5			
	Top ③		Bottom ④		Top ③		Bottom ④	
	[mm]	[inches]	[mm]	[inches]	[mm]	[inches]	[mm]	[inches]
Coaxial	0	0	0	0	0	0	0	0

80 is ε_r of water; 2.5 is ε_r of oil

INFORMATION!
The values in the tables are correct when the Snapshot function is on. If the snapshot function is not on, then the values for the dead zones and the non-linearity zones increase.

8.5 Dimensions and weights

General dimensions

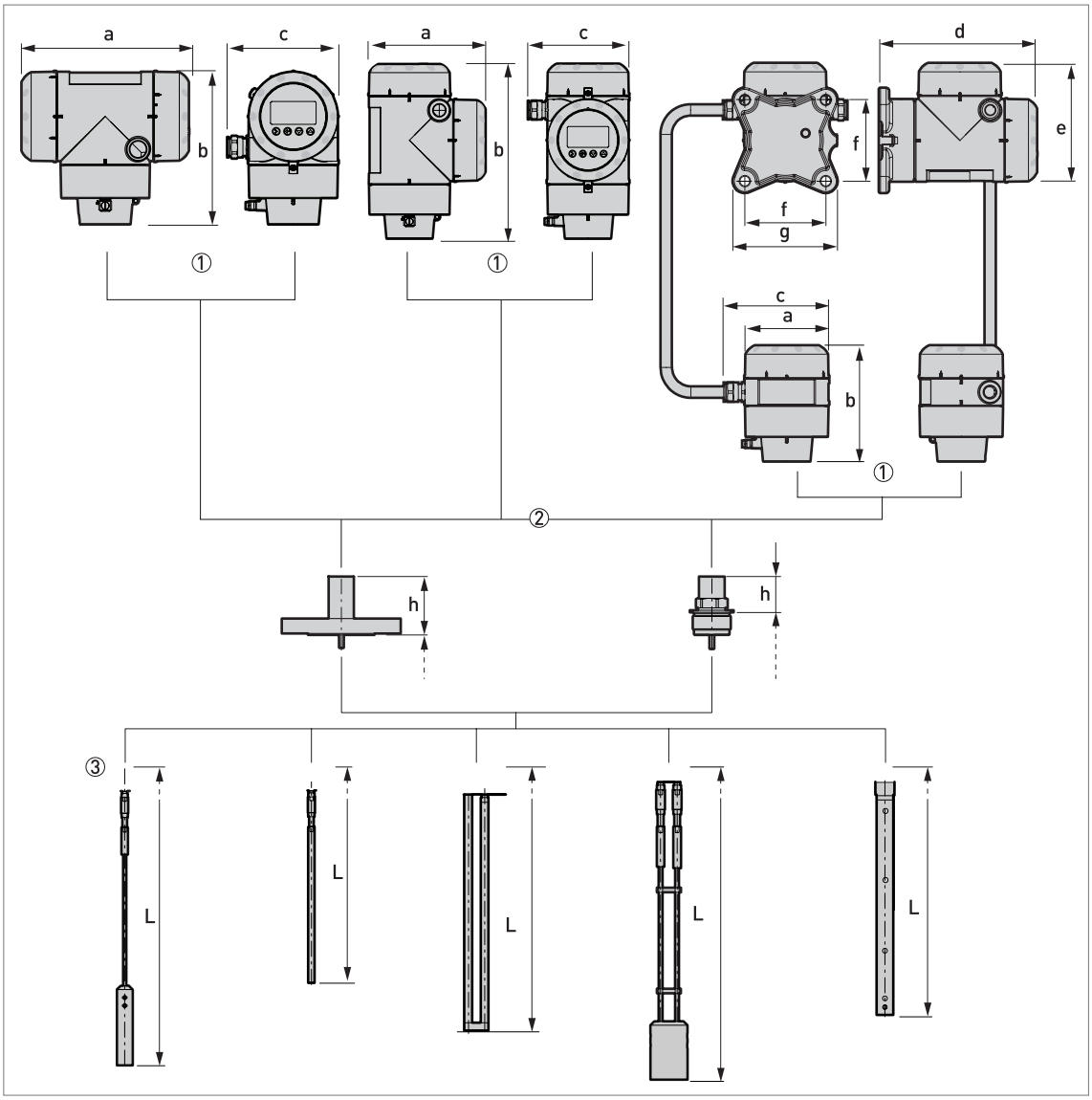


Figure 8-6: General dimensions

① **Housing options.** From left to right: compact converter with horizontal housing, compact converter with vertical housing, and remote converter (top) and probe housing (bottom)
② **Process connection options.** From left to right: flange connection for probes, threaded connection for probes
③ **Probe options.** From left to right: Ø4 mm / 0.16¨ single cable probe, single rod probe, double rod probe, Ø4 mm / 0.16¨ double cable probe and coaxial probe

Housing options: Dimensions in mm

Dimensions [mm]	Compact – horizontal	Compact – vertical	Remote
a	191	147	104
b	175	218	142
c	127	127	129
d	—	—	195
e	—	—	146
f	—	—	100
g	—	—	130

Housing options: Dimensions in inches

Dimensions [inches]	Compact – horizontal	Compact – vertical	Remote
a	7.5	5.79	4.09
b	6.89	8.23	5.59
c	5.00	5.00	5.08
d	—	—	7.68
e	—	—	5.75
f	—	—	3.94
g	—	—	5.12

Process connection and probe options: Dimensions

Dimensions [mm]	Probes with threaded connections		Probes with flange connections	
	[mm]	[inches]	[mm]	[inches]
h	45	1.77	73	2.87
L	For more data, refer to "Single probes" and "Double and coaxial probes" in this section.			

Weather protection option (vertical signal converters – for the compact version only)

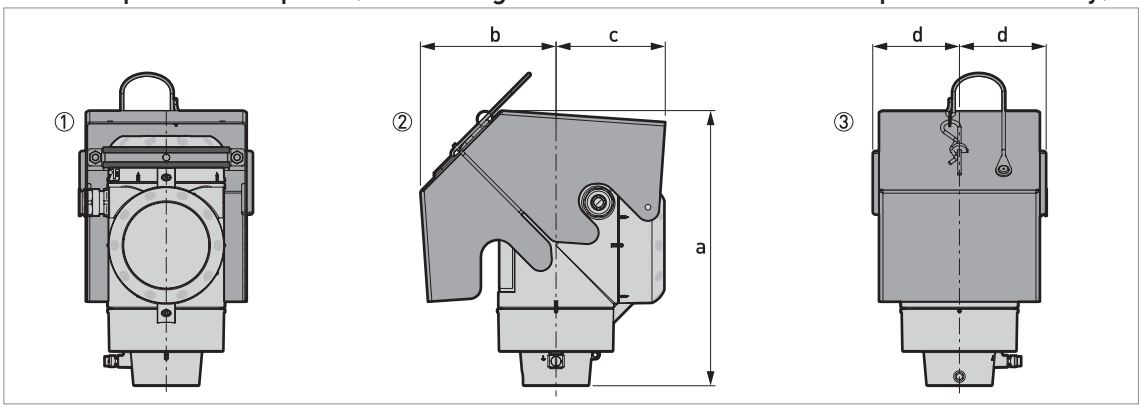


Figure 8-7: Weather protection option for vertical signal converter versions (compact version only)

① Rear view (with weather protection closed)
② Right side (with weather protection closed)
③ Front view (with weather protection closed)

Dimensions and weights in mm and kg

Weather protection	Dimensions [mm]				Weights [kg]
	a	b	c	d	
Vertical signal converter	241	120	96	77	1.3

Dimensions and weights in inches and lb

Weather protection	Dimensions [inches]				Weights [lb]
	a	b	c	d	
Vertical signal converter	9.5	4.7	3.8	3.0	2.9

Weather protection option (horizontal signal converters – for the compact version only)

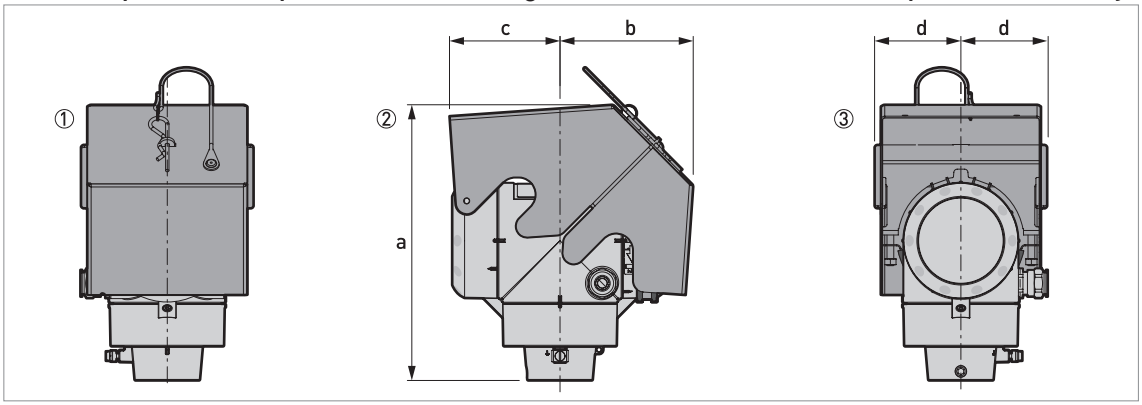


Figure 8-8: Weather protection option for horizontal signal converter versions (compact version only)

① Front view (with weather protection closed)
② Left side (with weather protection closed)
③ Rear view (with weather protection closed)

Dimensions and weights in mm and kg

Weather protection	Dimensions [mm]				Weights [kg]
	a	b	c	d	
Horizontal signal converter	243	118	98	77	1.3

Dimensions and weights in inches and lb

Weather protection	Dimensions [inches]				Weights [lb]
	a	b	c	d	
Horizontal signal converter	9.6	4.6	3.9	3.0	2.9

Sensor extension (option): Coaxial cable with flexible stainless steel jacket

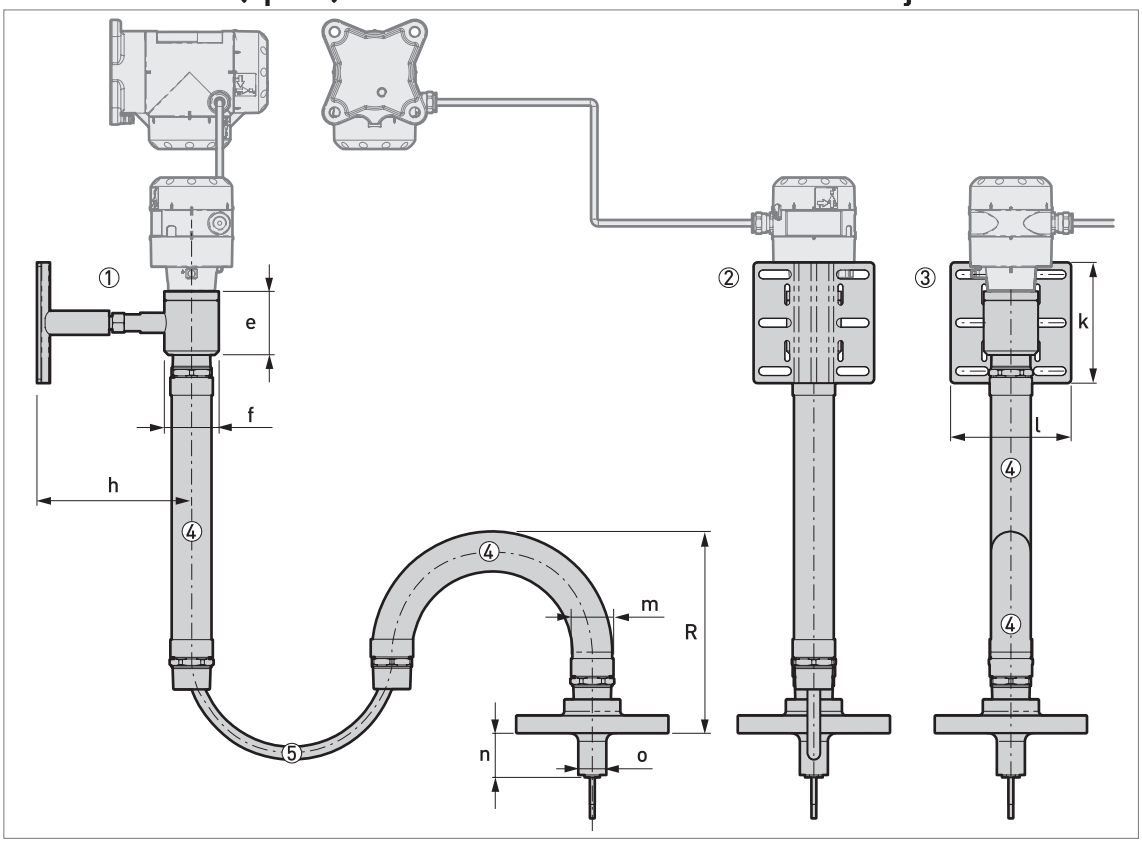


Figure 8-9: Sensor extension (option): Coaxial cable with flexible stainless steel jacket

① Left side
② Rear view
③ Front view
④ 1 or more lengths of flexible stainless steel jacket with male 1½ NPT threaded connection, maximum length 100 m / 328 ft (tolerance: +3% / -1%)
⑤ Coaxial cable, maximum length 100 m / 328 ft (tolerance: +3% / -1%)

There are 2 alternatives for the position of this subassembly in the device:

- If the device has a compact converter: The sensor extension is attached to the signal converter
- If the device has a remote converter: The sensor extension is attached to the probe housing

This option includes the process connection and the probe. The maximum length of the coaxial cable between the probe housing and the process connection is 100 m / 328 ft (tolerance: +3% / -1%). The coaxial cable has a protective flexible stainless steel jacket (refer to the illustration).

INFORMATION!
The coaxial cable and one length of the flexible stainless steel jacket are not attached to the process connection before delivery. For the assembly procedure, refer to How to prepare the sensor extension for installation on page 41.

For the wall bracket dimensions, refer to *How to prepare the sensor extension for installation* on page 41.

INFORMATION!
The length of the coaxial cable and the stainless steel jacket depends on the data given in the customer order.

Dimensions and weights in mm and kg

	Dimensions [mm]											Weights [kg]
	e	Øf	h	k	l	m	n	Øo	n	o	R	
Flexible jacket	79	68	193	150	150.4	49.7	55	35	86	58	250 ①	②

① Minimum radius of the flexible jacket
② Wall bracket (1.4 kg) + converter support (1.5 kg) + remote probe converter (2.7 kg) + coaxial cable (0.25 kg/m) + flexible jacket (6.9 kg)

Dimensions and weights in inches and lb

	Dimensions [inches]											Weights [lb]
	e	Øf	h	k	l	m	n	o	n	o	R	
Flexible jacket	3.11	2.68	7.60	5.91	5.92	1.96	2.17	1.38	3.39	2.28	17.72 ①	②

① Minimum radius of the flexible jacket
② Wall bracket (3.1 lb) + converter support (3.3 lb) + remote probe converter (6.0 lb) + coaxial cable (0.17 lb/ft) + flexible jacket (15.2 lb)

LOCA sensor extension (option): LOCA coaxial cable

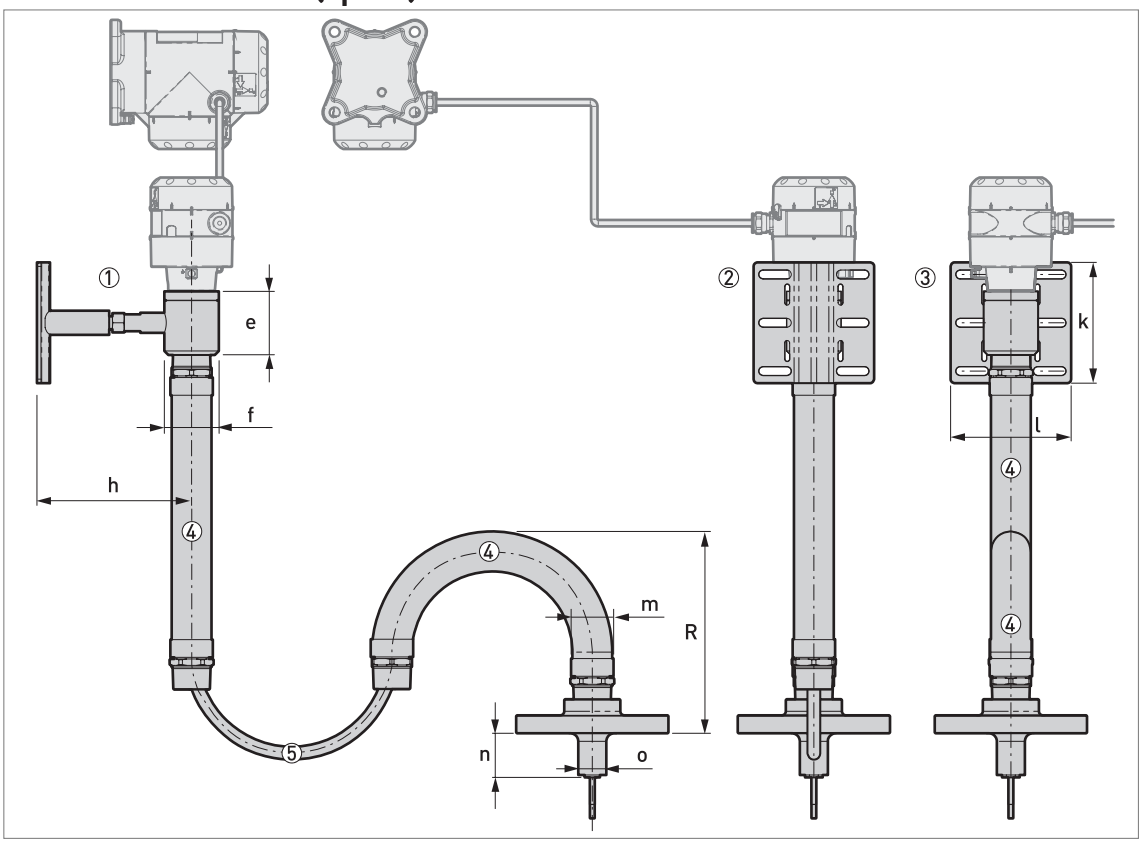


Figure 8-10: LOCA sensor extension (option): LOCA coaxial cable

① Left side
② Rear view
③ Front view
④ 1 or more lengths of flexible stainless steel jacket with male 1½ NPT threaded connection, maximum length 150 m / 492 ft (tolerance: +3% / -1%)
⑤ LOCA coaxial cable, maximum length 150 m / 492 ft (tolerance: +3% / -1%)

There are 2 alternatives for the position of this subassembly in the device:

- If the device has a compact converter: The sensor extension is attached to the signal converter
- If the device has a remote converter: The sensor extension is attached to the probe housing

This option includes the process connection and the probe. The maximum length of the LOCA coaxial cable between the probe housing and the process connection is 150 m / 492 ft (tolerance: +3% / -1%). If it is necessary to connect the LOCA coaxial cable to connectors on the containment system, then the LOCA coaxial cable is also available in 2 parts.

For the wall bracket dimensions, refer to *How to prepare the sensor extension for installation* on page 41.

INFORMATION!
The length of the coaxial cable and the stainless steel jacket depends on the data given in the customer order.

Dimensions and weights in mm and kg

	Dimensions [mm]											Weights [kg]
	e	Øf	h	k	l	m	n	Øo	n	o	R	
Flexible jacket	79	80	199	150	150.4	76	55	35	86	58	458	①

① Wall bracket (1.4 kg) + converter support (1.5 kg) + remote probe converter (2.7 kg) + coaxial cable (0.76 kg/m) + flexible jacket (6.9 kg)

Dimensions and weights in inches and lb

	Dimensions [inches]											Weights [lb]
	e	Øf	h	k	l	m	n	o	n	o	R	
Flexible jacket	3.1	3.14	7.83	5.91	5.92	2.99	2.17	1.38	3.39	2.28	18.03	①

① Wall bracket (3.1 lb) + converter support (3.3 lb) + remote probe converter (6.0 lb) + coaxial cable (0.51 lb/ft) + flexible jacket (15.2 lb)

Single probes

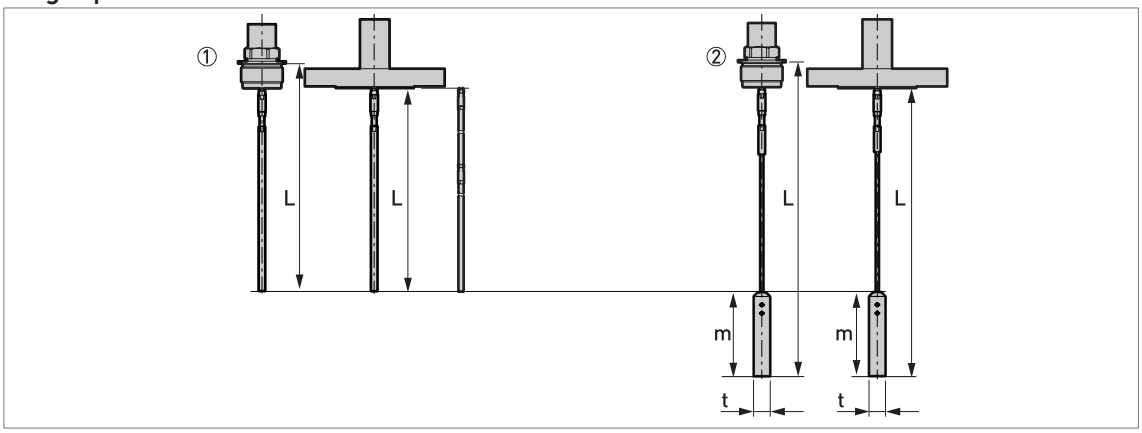


Figure 8-11: Single probe options

① Single rod Ø8 mm / Ø0.32¨ (thread and flange versions – segmented probe option shown on the right side)
② Single cable Ø4 mm / Ø0.16¨ (thread and flange versions)

Single probes: Dimensions in mm

Probes	Dimensions [mm]			
	L min.	L max.	m	t
Single rod Ø8 mm	1000 ①	4000	—	—
Single cable Ø4 mm	1000 ①	40000	100	Ø20

① A shorter probe length is available on request

Single probes: Dimensions in inches

Probes	Dimensions [inches]			
	L min.	L max.	m	t
Single rod Ø0.32¨	39 ①	158	—	—
Single cable Ø0.16¨	39 ①	1575	4.0	0.8

① A shorter probe length is available on request

Double and coaxial probes

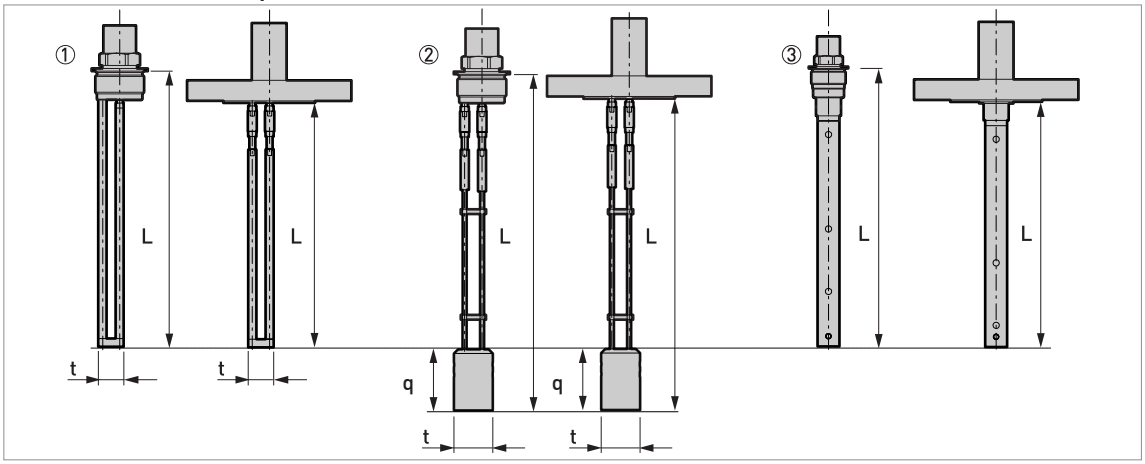


Figure 8-12: Double and coaxial probe options

① Double rod Ø8 mm / Ø0.32¨ (thread and flange versions)
② Double cable Ø4 mm / Ø0.16¨ (thread and flange versions)
③ Coaxial Ø22 mm / Ø0.87¨ (thread and flange versions)

Double probes: Dimensions in mm

Probes	Dimensions [mm]			
	L min.	L max.	q	t
Ø8 mm double rod	1000 ①	4000	—	25
Ø4 mm double cable	1000 ①	40000	60	Ø38
Ø22 mm coaxial	600 ①	6000	—	—

① A shorter probe length is available on request

Double probes: Dimensions in inches

Probes	Dimensions [inches]			
	L min.	L max.	q	t
Ø0.32¨ double rod	39 ①	158	—	1.0
Ø0.16¨ double cable	39 ①	1575	2.4	Ø1.5
Ø0.87¨ coaxial	24 ①	236	—	—

① A shorter probe length is available on request

Converter and probe housing weights

Type of housing	Weights	
	[kg]	[lb]
Compact	6.4	14.1
Remote converter ①	5.9	13.0
Probe housing ①	3.9	8.6

① The remote version of the device has a "remote converter" and a "probe housing". For more data, refer to "General dimensions" at the start of this section.

Probe weights

Probes	Min. process connection size		Weights	
	Thread	Flange	[kg/m]	[lb/ft]
Single cable Ø4 mm / 0.16¨	G 1½A; 1½ NPT	DN40 PN40; 1½¨ 150 lb; 1½¨ 300 lb	0.12 ①	0.08 ①
Double cable Ø4 mm / 0.16¨	G 1½A; 1½ NPT	DN50 PN40; 2¨ 150 lb; 2¨ 300 lb	0.24 ①	0.16 ①
Single rod Ø8 mm / 0.32¨	G 1½A; 1½ NPT	DN40 PN40; 1½¨ 150 lb; 1½¨ 300 lb	0.41 ②	0.28 ②
Double rod Ø8 mm / 0.32¨	G 1½A; 1½ NPT	DN50 PN40; 2¨ 150 lb; 2¨ 300 lb	0.82 ②	0.56 ②
Coaxial Ø22 mm / 0.87¨	G 1½A; 1½ NPT	DN40 PN40; 1½¨ 150 lb; 1½¨ 300 lb	0.79 ②	0.53 ②

① This value does not include the weights of the counterweight or the flange
② This value does not include the weight of the flange

9.1 General description

The HART® Protocol is an open digital communication protocol for industry. It is free to use by anyone. It is included in the software embedded in signal converters of HART-compatible devices.

There are 2 classes of devices which support the HART® Protocol: operating devices and field devices. There are 2 classes of operating devices (Master): PC-supported workstations (Primary Master) and manual control units (Secondary Master). These can be used in control centres and other locations. HART® field devices include sensors, converters and actuators. Field devices include 2-wire and 4-wire devices, and also intrinsically-safe versions for use in hazardous areas.

There are 2 primary operation modes for HART-compatible devices: point-to-point mode and multi-drop mode.

If the device is used in point-to-point mode, the HART® Protocol uses the Bell 202 Frequency Shift Keying (FSK) standard to put a digital signal on top of the 4...20 mA signal. The connected device sends and receives digital signals that agree with the HART® Protocol, and sends analog signals at the same time. Only 1 device can be connected to the signal cable.

If the device is used in multi-drop mode, the network only uses a digital signal that agrees with the HART® Protocol. The loop current is set to 4 mA. You can connect a maximum of 63 devices to the signal cable.

An FSK or HART® modem is included in field devices and manual control units. It is necessary to have an external modem for PC-supported workstations. The external modem is connected to the serial or USB interface.

9.2 Software description

HART® identification codes and revision numbers

Manufacturer ID:	0x45
Device:	0xD7
Device Revision:	1
DD Revision	1
HART® Universal Revision:	6
FC 375/475 system SW.Rev.:	≥ 2.0
AMS version:	≥ 7.0
PDM version:	≥ 6.0
FDT version:	1.2

9.3 Connection variants

The signal converter is a 2-wire device with 4...20 mA current output and HART® interface.

- **Multi-Drop Mode is supported**
  In a Multi-Drop communication system, more than 1 device is connected to a common transmission cable.
- **Burst Mode is not supported**

There are two ways of using the HART® communication:

- as Point-to-Point connection and
- as Multi-Drop connection with 2-wire connection.

9.3.1 Point-to-Point connection – analogue / digital mode

Point-to-Point connection between the signal converter and the HART® Master.

The current output of the device is passive.

Also refer to *Point-to-point networks* on page 56.

9.3.2 Multi-Drop connection (2-wire connection)

Up to 63 devices may be installed in parallel (this signal converter and other HART® devices).

For an illustration of multi-drop networks, refer to *Multi-drop networks* on page 57.

For data on communication in multi-drop mode, refer to *HART*® network configuration on page 84.

9.4 HART® device variables

HART® device variable	Code	Type
level	1	linear
distance	2	linear
conversion	3	linear
ullage conversion	4	linear

The HART® dynamic variables PV (Primary Variable), SV (Secondary Variable), TV (Third Variable) and QV (Fourth Variable) can be assigned to any of the device variables.

The HART® dynamic variable PV is always connected to the HART® current output which is, for example, assigned to level measurement.

9.5 Field Communicator 375/475 (FC 375/475)

The Field Communicator is a hand terminal from Emerson Process Management that is designed to configure HART® and Foundation Fieldbus devices. Device Descriptions (DDs) are used to integrate different devices into the Field Communicator.

9.5.1 Installation

CAUTION!
The Field Communicator cannot be used to correctly configure, operate or read data from the device unless the Device Description (DD) file is installed.

System and software requirements for the Field Communicator

- System card that includes the "Easy Upgrade Option"
- Field Communicator Easy Upgrade Programming Utility
- HART® Device Description file

For more data, refer to the Field Communicator User's Manual.

9.5.2 Operation

INFORMATION!
The Field Communicator will not give you access to the service menu. A simulation is only possible for current outputs.

The Field Communicator and the device's local display use almost the same procedures to operate the signal converter. The online help for each menu item refers to the function number given to each menu item on the local device display. Protection of settings is the same as on the device's local display.

The Field Communicator always saves a complete configuration for communication with AMS.

For more data, refer to *HART*® menu tree for Basic-DD on page 132.

9.6 Asset Management Solutions (AMS®)

The Asset Management Solutions Device Manager (AMS®) is a PC program from Emerson Process Management which is designed to configure and manage HART®, PROFIBUS and Foundation Fieldbus devices. Device Descriptions (DDs) are used to integrate different devices into the AMS®.

9.6.1 Installation

Please read the README.txt file in the Installation Kit.

If the Device Description has not been installed at this time, install the Installation Kit HART® AMS. You can download this .exe file from our website.

For installation data, refer to the "AMS Intelligent Device Manager Books Online" section "Basic AMS Functionality > Device Configurations > Installing Device Types > Procedures > Install device types from media".

9.6.2 Operation

INFORMATION!
For more data, refer to HART® menu tree for AMS on page 134.

9.6.3 Parameter for the basic configuration

Due to AMS requirements and conventions, there are differences when operating the signal converter with AMS and operating using the local keyboard. The service menu parameters are not supported and simulation is only possible for current outputs. The online help for each parameter contains its function number as a reference to the local device display.

9.7 Field Device Tool / Device Type Manager (FDT / DTM)

A Field Device Tool Container (FDT Container) is a PC program used to configure HART®, PROFIBUS and FOUNDATION™ fieldbus devices. To configure a device, an FDT container uses the applicable Device Type Manager (DTM).

9.7.1 Installation

Before you operate the device, the Device Type Manager (Device DTM) must be installed in the Field Device Tool Container. You can download this .msi file from our website. For installation and configuration data, refer to the documentation that is supplied with the Device DTM in the "Downloads" section of the website.

9.7.2 Operation

The DTM and the device's local display use almost the same procedures to operate the signal converter. For more data, refer to *Operation* on page 63.

9.8 Process Device Manager (PDM)

The Process Device Manager (PDM) is a Siemens PC program designed to configure HART® and PROFIBUS devices. Device Descriptions (DDs) are used to integrate different devices into the PDM.

9.8.1 Installation

Install Device Description files supplied in the Device Install HART® PDM folder. This is necessary for each type of field device that is used with SIMATIC PDM. This folder is available for download from the website.

If you use PDM version 5.2, refer to PDM manual, section 11.1 - Install device / Integrate device into SIMATIC PDM with Device Install.

If you use PDM version 6.0, refer to PDM manual, section 13 - Integrating devices.

For more data, refer to “readme.txt”. You can find this file in the Installation Kit.

9.8.2 Operation

INFORMATION!
For more data, refer to HART® menu tree for PDM on page 136.

There can be differences between the names of menus in the SIMATIC PDM software tool and menus shown on the device display screen. Refer to the online help in SIMATIC PDM to find the function number of each menu item. This function number agrees with the function number in the device menus.

Use the same procedure for the protection of parameters in the supervisor menu.

9.9 HART® menu tree for Basic-DD

Abbreviations of the following tables:

- Opt Optional, depending on device version and configuration
- Rd Read only

9.9.1 Overview Basic-DD menu tree (positions in menu tree)

1 Measurements	1 Measurements	
	2 Output	
2 Configuration and Test	1 Info.	1 Identification
		2 Output
	2 Supervisor	1 Test
		2 Basic Parameters
		3 Signal Out
		4 Application
		5 Display
		6 Conversion Table
		7 Reset
3 Diag/Service	1 Status	1 Standard Status
		2 Device-specific Status
4 Access Rights	1 Access level	
	2 Method Login	
	3 Method entry Code	
5 HART variables		

9.9.2 Basic-DD menu tree (details for settings)

1 Measurements

1 Measurements	1 Level value Rd / 2 Distance value Rd / 3 Volume value Rd / 4 Ullage value Rd
2 Inputs/Outputs	1 PV Rd / 2 PV Loop Current Rd / 3 PV % range Rd

2 Configuration and Test

1 Info.	1 Identification	1 Serial Number Rd / 2 Converter Firmware Version Rd / 3 Sensor Firmware Version Rd / 4 HMI Firmware Version Rd
	2 Output	1 Function I Rd / 2 Output Range Rd / 3 PV URV Rd / 4 PV LRV Rd / 5 Output Error Delay Rd

2 Supervisor	1 Test	1 Test I
	2 Basic Parameters	1 Tank height / 2 Time Constant / 3 Probe Length / 4 Block distance / 5 Length Unit (HART) / 6 Volume Unit (HART)
	3 Signal Out	1 Function I / 2 Output Range / 3 PV LRV / 4 PV URV / 5 Output Error Delay / 6 Current Output Calibration^{Cust}
	4 Application	1 Tracing Velocity / 2 Auto product epsilon R / 3 Epsilon R gas / 4 Epsilon R product / 5 Watch Pulses / 6 Measurement Threshold / 7 Probe End Threshold
	5 Display	1 Language / 2 Display Length Unit / 3 Display Volume Unit
	6 Conversion Table	1 Input table / 2 Delete table
	7 Reset	1 Warm start / 2 Factory reset / 3 Reset Configuration Changed flag

3 Diag/Service

1 Status	1 Standard status	1 Device statusRd / 2 Write protectRd	
	2 Device-specific status	1 Device failures	1 ErrorRd / 2 ErrorRd / 3 ErrorRd
		2 Device warning maintenance required	1 WarningRd
		3 Device warning out of specification	1 WarningRd
		4 Info	1 InfoRd

4 Access Rights

1 Access Level	(Access Not Granted)
2 Method Login	1 No Access (Log Out) / 2 Supervisor (Normal User) / 3 Service
3 Method Entry Code	

5 HART variables

	1 Poll addr / 2 Tag / 3 Hardware revRd / 4 Software revRd / 5 Descriptor / 6 Date / 7 Message / 8 ManufacturerRd / 9 ModelRd / Dev idRd / Universal idRd / Fld dev revRd / Num req preamsRd / Num resp preamsRd / Write protectRd / Production numberRd / Final asmbly numRd / PV is / SV is / TV is / QV is

9.10 HART® menu tree for AMS

Abbreviations of the following tables:

- Opt Optional, depending on device version and configuration
- Rd Read only

9.10.1 Overview AMS menu tree (positions in menu tree)

Process variables	Measurements	
	Analog Output	
Device Diagnostics	Overview	
	Fatal Errors	
	Warnings (Maintenance required)	
	Warnings (Out of specifications)	
	Warnings (Function check)	
Methods	Access Right	
	Tests	
	Calibrate	
	Threshold Settings	
	Conversion Table	
	Master reset	
Configure / Setup	Basic Setup	Basic Parameters
		Local Display
		Application
	Analog Output	Output Functions
		Output 1
	Units	
	Device	
	HART	ID
		-
	Conversion table	

9.10.2 AMS menu tree (details for settings)

Process Variables

Measurements	Level Rd / Distance Rd / Volume/Mass/Flow Rd / Ullage Volume/Mass/Flow Rd
Analog Output	Analog Output Value Rd / PV Percent of Range Rd

Device Diagnostics

Overview	Primary variable out of limits / Non-primary variable out of limits / Primary variable analog output saturated / Primary variable analog output fixed / Cold Start / Configuration changed / Field device malfunction

Fatal Errors	Converter EEPROM error / Converter RAM error / Converter ROM error / Sensor EEPROM error / Sensor RAM error / Sensor ROM error / Current output drift / Oscillator frequency fail. / Converter Voltage error / Sensor Voltage error / Measurement old/Communicat. Error / Temperature out of range / Sensor not compatible / Sensor processing failure / Reference pulse lost / Level pulse lost error / Overfill error / Tank empty error
Warnings (Maintenance required)	Flange lost / Reference position outside range / Audio signal offset outside range / Temperature below -35°C / Temperature above +75°C / Automatic probe length invalid
Warnings (Out of specifications)	Temperature out of range (warning) / Level lost (warning) / Overfill (warning) / Tank empty (warning)
Warnings (Function check)	Local operation on the device
Information	Epsilon R calcul frozen / Epsilon R value low / Epsilon R value high / Temperature out of range for HMI

Methods

Access right	Log In/Log Out / Password Yes/No
Tests	Test Output I
Calibrate	D/A Trim
Threshold Settings	Watch Pulses
Conversion Table	Input table / Delete table
Master reset	Restart Device / Reset Factory / Rst Conf. Chged flag

Configure / Setup

Basic Setup	Basic Parameters	Tank Height / Time Constant / Probe Length / Blocking Distance / Measuring mode [Rd] / Tag
	Local Display	Display length unit / Display volume unit / Language
	Application	Tracing velocity / Auto product epsilon R / Epsilon R gas / Epsilon R product / Level Threshold / Probe end Threshold
Analog Output	Output Functions	Function I / SV / TV / QV
	Output 1	Output Range / Output Error Delay / LRV / URV
Units	Length unit (HART) / Volume unit (HART) / Time constant	
Device	Model / Manufacturer / Fld dev rev / Software rev / Write protect / Descriptor / Message / Date / Serial number / Converter firmware number / Sensor Firmware number / HMI Firmware version	
HART	ID	Tag / Polling address / Device ID
		Universal revision / Fld dev rev Num / Num request preams
Conversion table	Number of points / Length unit[Rd] / Conversion unit[Rd] / Points (1...30 level-conversion pairs)	

9.11 HART® menu tree for PDM

Abbreviations of the following tables:

- Opt Optional, depending on device version and configuration
- Rd Read only
- Cust Custody lock protection
- Loc Local PDM, affects only PDM views

9.11.1 Overview PDM menu tree (positions in menu tree)

Overview: Menu Device

Communication Path
Download To Device...
Upload To PG/PC...
Update Diagnosis Status
Configuration and Test
Access Rights
watch status

Overview: Menu View

Measurements	Level Value
	Distance Value
Yt diagram	
Diag / Service	
Toolbar	
Status Bar	
Update	

Overview: PDM parameters

Configuration and Test	Info.	Identification
		Output
	Supervisor	Test
		Basic Parameters
		Signal Output
		Application
		Display
		Conversion Table
		Reset
Access rights		
HART variables		

9.11.2 PDM menu tree (details for settings)

Device Menu

Communication Path

Download To Device...

Upload To PG/PC...

Update Diagnosis Status

Configuration and Test

Info.	Identification	Serial Number[Rd] / Converter Firmware version[Rd] / Sensor Firmware version[Rd] / HMI Firmware version[Rd]
	Output	Function I[Rd] / Output Range[Rd] / PV URV[Rd] / PV LRV[Rd] / Output Error Delay[Rd]
Supervisor	Test	Test I
	Basic Parameters	Tank Height / Time Constant / Probe Length / Blocking Distance / Length Unit (HART) / Volume Unit (HART)
	Signal Output	Function I / Output Range / PV URV / PV LRV / Output Error Delay / Current Output Calibration ①
	Application	Tracing Velocity / Auto product epsilon R / Epsilon R gas / Epsilon R product / Watch Pulses / Level Threshold / Probe End Threshold ②
	Display	Language / Display Length Unit / Display Volume Unit
	Conversion Table	Input Table / Delete Table
	Reset	Warm start (function to restart the device) / Factory Reset / Reset Configuration Changed Flag

Access rights

Access level[Rd]
Method Login
Method Entry Code

HART Variables

1 Poll addr / 2 Tag / 3 Hardware rev[Rd] / 4 Software rev[Rd] / 5 Descriptor / 6 Date / 7 Message / 8 Manufacturer[Rd] / 9 Model[Rd] / Dev id[Rd] / Universal id[Rd] / Fld dev rev[Rd] / Num req preams[Rd] / Num resp preams[Rd] / Write protect[Rd] / Production number[Rd] / Final asmbly num[Rd] / PV is / SV is / TV is / QV is

① Current Output Calibration is available only if the service password is used

② Use "Watch Pulses" to monitor the amplitude of the measured pulses

View Menu

Measurements

Measurements	Level Value / Distance Value
Output	Level value / Loop current / % Range

Yt diagram

Diag / Service

Standard Status	Device status	PV Analog Channel Saturated / Configuration changed
Device-specific status	Device failures	Oscillator Frequency Failure / Current Output Drift / Sensor ROM error / Sensor RAM error / Sensor EEPROM error / Converter ROM error / Converter RAM error / Converter EEPROM error Sensor No Signal / Sensor Not Compatible / Temperature Out of Range / Measurement Old / Sensor Voltage Error / Converter Voltage Error Reference Pulse Lost / Level Pulse Lost Error / Overfill Error / No Probe Detected
	Device Warning (Out of Specification)	Flange Lost / Level Lost Warning / Overfill Warning
	Info	First Start / EpsilonR Calcul Frozen / EpsilonR Value Low / EpsilonR Value High / Temperature out of range for HMI

Toolbar

Status Bar

Update

10.1 Glossary

C

Cable This is a wire rope. It is used as a measurement pulse guide.

D

Dielectric constant An electrical property of the product to be measured used in TDR measurement. Also known as εr, DK and relative permittivity. This gives the strength of the measurement pulse reflected back to the device's signal converter.

Direct mode The device sends a signal along the probe. It receives the reflection of the signal from the surface of the tank contents. The device uses an algorithm to convert the time it takes to receive the signal into a distance. Use of this measurement mode depends on the minimum dielectric constant limit of the probe type. For more data, refer to *Technical data* on page 103.

Discontinuities These are objects or parts of objects (including the tank) that are in the tank, are possibly in the probe's empty space and can potentially influence the electromagnetic field around the probe. This can cause a measurement error. Also refer to *General requirements* on page 27.

Distance This is a display option. It is the distance from the face of flange to the level (1 product) or the surface of the top product (2 or more products). Refer to the diagrams at the end of this section.

E

Electromagnetic compatibility Defines how much a device influences or is influenced by other devices that generate electromagnetic fields during operation. Refer to European standard EN 61326-1 and EN 61326-2-3 for further details.

Electromagnetic field This is a physical field that is produced by electrically-charged objects and which may affect the behaviour of other objects near to the field.

Empty space A minimum diameter around a probe that should have no objects in it for the device to work correctly. This depends on the probe type. Refer to **Installation** for more details.

L

Level This is a display option. It is the height from the bottom of the tank (user-defined) to the surface of the top product (Tank height – distance). Refer to the diagrams at the end of this section.

M

Mass This is a display option. It shows the total mass of tank contents. Use a mass table or a volume table to display measurement data with mass units.

Measurement pulse The device transmits a short, low-powered electrical pulse or wave transmitted down a guide to the process. The process reflects the pulse back to the device.

O

Operators Users who can choose how to display measurements. They cannot configure the device in supervisor mode.

P

Probe This is either a metallic cable or rod used to guide the measurement pulse to the process.

Probe length Ordered length of probe, L, from the face of the flange to end of the guide. If you ordered a cable probe, this includes the counterweight. Refer to the diagrams at the end of this section.

S

Supervisors Users who can configure the device in supervisor mode. They cannot configure the device in service mode.

T

TDR Time domain reflectometry (TDR). The principle used by the device to measure level. For more data, refer to *Measuring principle* on page 103.

Threshold A number of limits set either manually or automatically by the signal converter to identify the reflected measurement pulses from the level. For configuration data, refer to *Function description* on page 70.

Top dead zone The distance from the flange to the top limit of the measuring range. Also refer to *Measurement limits* on page 110.

U

Ullage mass This is a display option. It shows empty mass or mass of the product that can be put into the tank. Refer to the diagrams at the end of this section.

Ullage volume This is a display option. It shows the unfilled volume. Refer to the diagrams at the end of this section.

V

Volume Total volume of tank contents. Calculated with a volume table.

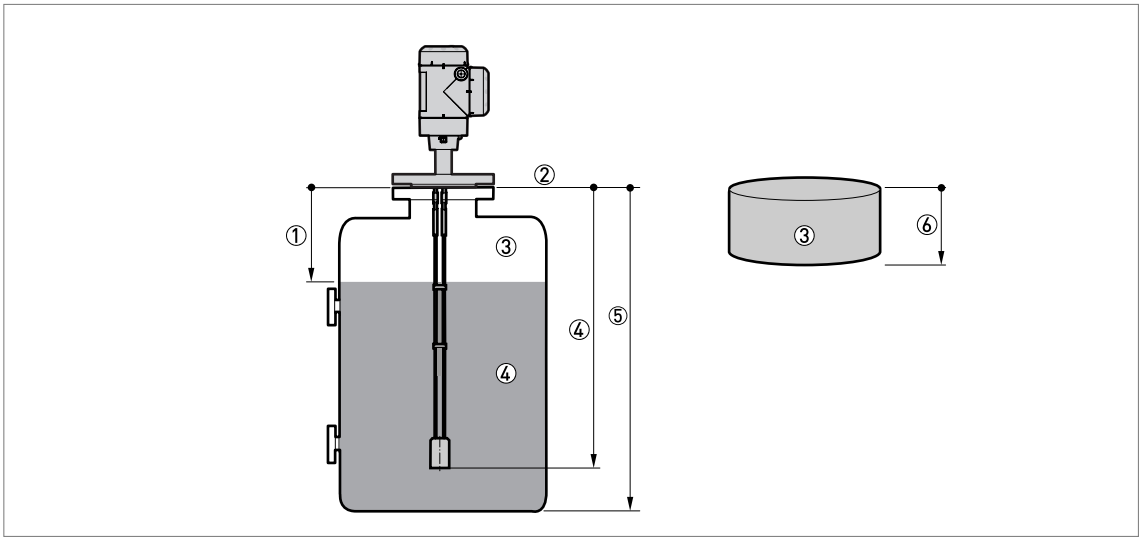


Figure 10-1: Measurement definitions 1

① Distance
② Flange facing
③ Gas (Air)
④ Probe length, L
⑤ Tank height
⑥ Ullage volume or mass

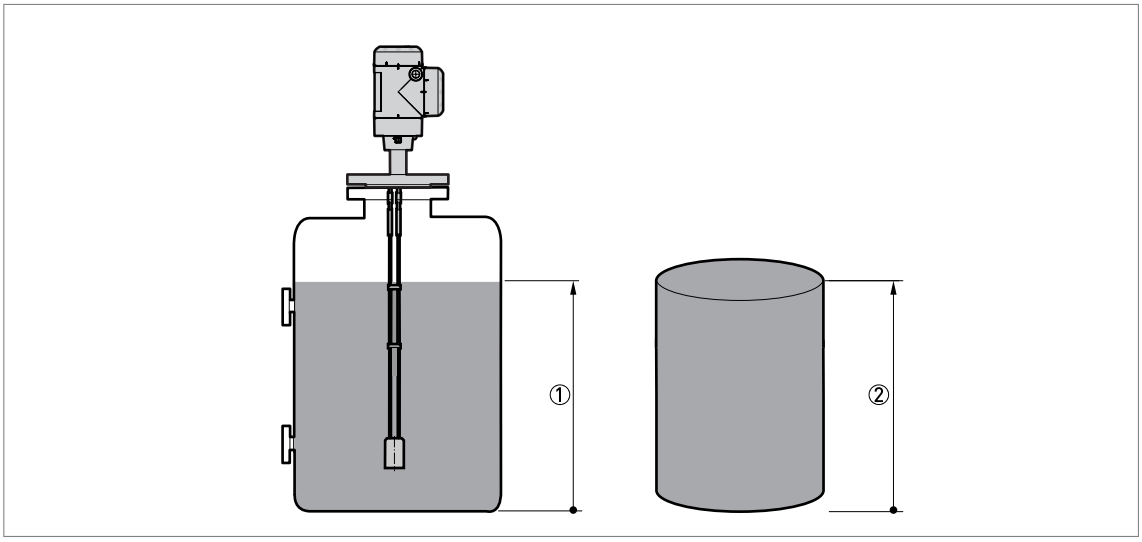


Figure 10-2: Measurement definitions 2

① Level
② Volume or mass

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