

LR01 Free-Space Radar Level Meter



The LevelWave LR01 is designed to perform continuous level measurement in a wide range of industries and applications. We are known for more than 50 years of experience in level measurement as a leading supplier of extremely robust, durable and reliable level measurements. Unaffected by changes in temperature, specific gravity, pressure and with no need to recalibrate, offering a highly available measurement at low maintenance cost. With the LevelWave LR01 you achieve a highly modular system which is designed for the requirements of the modern industry.

FEATURES

- 2-wire Loop powered 10 GHz FMCW technology
- Wave Horn Antenna in PP or PTFE for corrosive media
- 360° rotatable housing with snap solution
- Housing and cover with bayonet connectors
- Horizontal or vertical housing position
- Remote electronics (up to 100 m / 328 ft)
- Weather protection cap
- Measuring range up to 30 m / 98.4 ft
- Empty Tank Spectrum (ETS) function
- HART Communication, 4 to 20 mA
- Configuration via FDT-DTM
- Continuous self-diagnostics, Status and diagnostic messages, acc. to NE 107
- Process temperature from -60 to $+250$ °C
- Process pressure from -1 to 40 bar
- SIL2-compliant acc. to IEC 61508 for safety related systems
- Local multilingual full graphic LCD, configurable in %, mA or physical units
- Display with external keypad

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1 Safety instructions

Warnings and symbols used



DANGER!

This information refers to the immediate danger when working with electricity.



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.



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.

Safety instructions for the operator



CAUTION!

Installation, assembly, start-up and maintenance may only be performed by appropriately trained personnel. The regional occupational health and safety directives must always be observed.



LEGAL NOTICE!

The responsibility as to the suitability and intended use of this device rests solely with the user. The supplier assumes no responsibility in the event of improper use by the customer. Improper installation and operation may lead to loss of warranty. In addition, the "Terms and Conditions of Sale" apply which form the basis of the purchase contract.



INFORMATION!

- Further information can be found in the handbook and on the data sheet. These documents can be downloaded from the website.
- If you need to return the device to the manufacturer or supplier, please fill out the device return form and send it with the device. Unfortunately, the manufacturer cannot repair or inspect the device without the completed form.

2 Installation

2.1 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 level meter with Radar (FMCW) measures distance, level, mass, volume, flow rate (in open channels) and reflectivity of liquids, pastes and slurries. It does not touch the measured product.

2.2 Scope of delivery



INFORMATION!

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

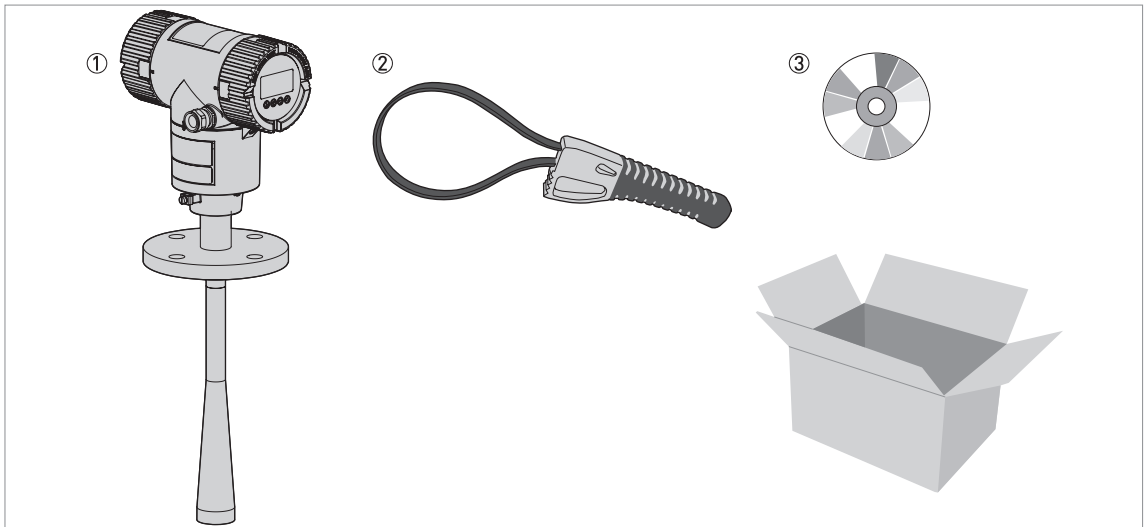


Figure 2-1: Scope of delivery

- ① Signal converter and antenna (compact version)
- ② Strap wrench
- ③ DVD-ROM (including Handbook, Quick Guide, Product Specifications and related software)



INFORMATION!

METALLIC HORN AND WAVE GUIDE ANTENNAS

If the device has an antenna extension option, this part is attached to the device if the antenna extension length, $L_{ext} \leq 300 \text{ mm} / 11.8''$. If $L_{ext} > 300 \text{ mm} / 11.8''$, then the antenna extension is not attached to the device. Obey the assembly procedure on page 23.

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.

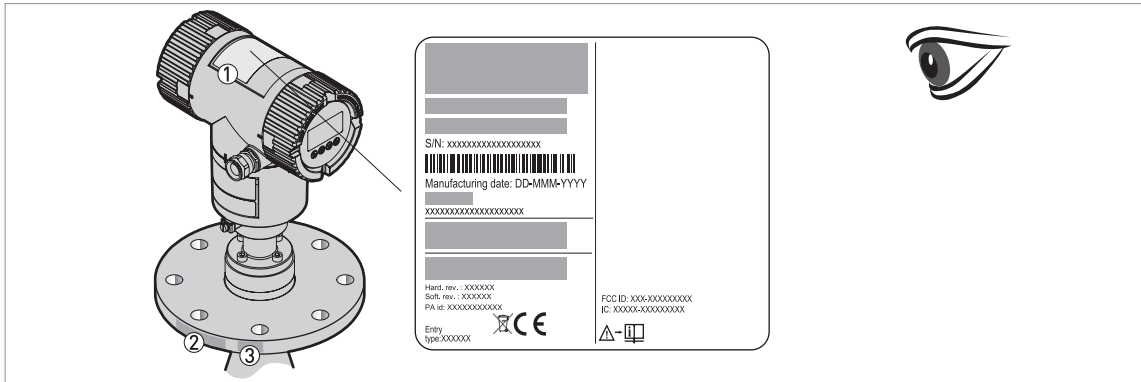


Figure 2-2: Visual check

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



Figure 2-3: Symbols for the supplied gasket material (on the side of the process connection)

- ① EPDM
- ② Kalrez® 6375

If the device is supplied with an FKM/FPM gasket, there is no symbol on the side of the process connection.



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 Storage

**WARNING!**

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

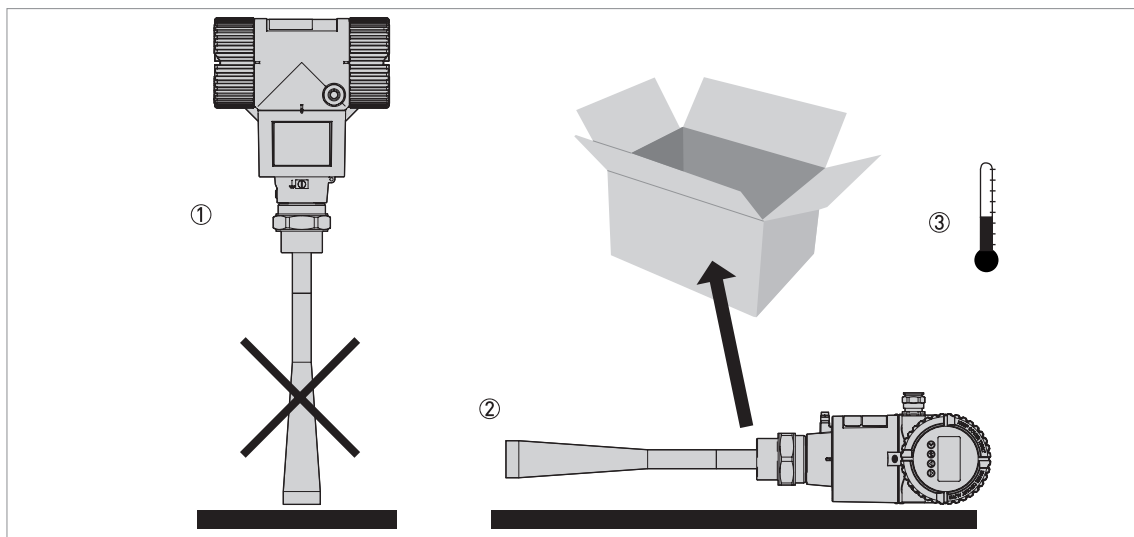


Figure 2-4: Storage conditions

- ① When you put the device into storage, do not keep it in a vertical position
- ② Put the device on its side. We recommend that you use the packaging in which it was delivered.
- ③ Storage temperature range: -50...+85°C / -58...+185°F (min. -40°C / -40°F for devices with the integrated LCD display option)

- Store the device in a dry and dust-free location.
- Store the device in its original packing.

2.5 How to assemble the PTFE Wave Horn antenna

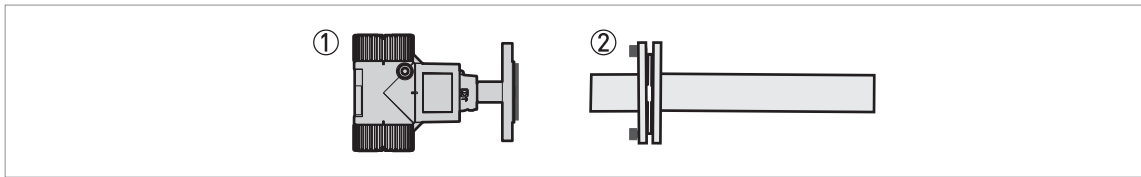


Figure 2-5: Equipment needed to assemble the device

- ① Signal converter and process connection (compact version) or antenna housing and process connection (remote version)
- ② PTFE Wave Horn antenna in cardboard packaging. The cardboard packaging is attached with 4 screws and wingnuts.

Part 1: Remove the protective cover from the process connection

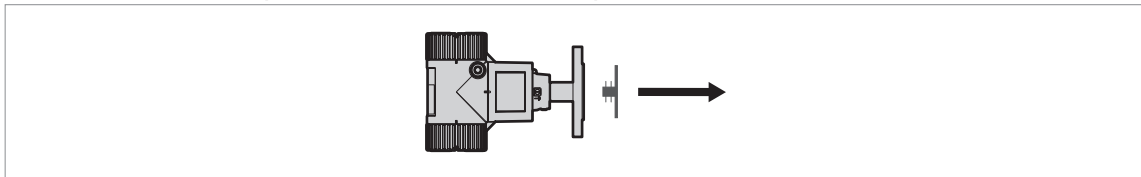


Figure 2-6: Part 1: Remove the protective cover from the process connection



- Remove the plastic cover from the process connection.

Part2: Remove the cardboard packaging from the PTFE Wave Horn antenna

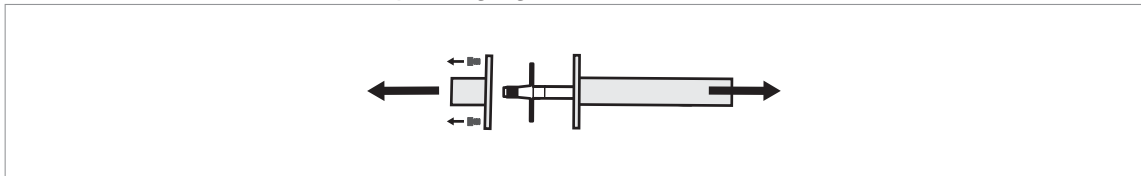


Figure 2-7: Part2: Remove the cardboard packaging from the PTFE Wave Horn antenna



- Remove the 4 wingnuts and screws that attach cardboard packaging.
- Remove the top and the bottom of the cardboard packaging from the PTFE Wave Horn antenna.

Part3A: Attach the PTFE Wave Horn antenna to the process connection

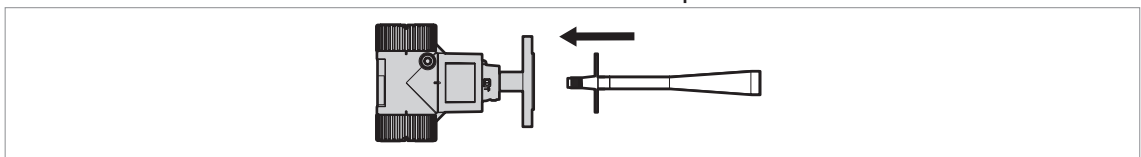


Figure 2-8: Part3A: Attach the PTFE Wave Horn antenna to the process connection



CAUTION!

Do not use tools to attach the antenna to the process connection.



- Attach the Wave Horn antenna to the process connection. Put the end of the antenna that has a thread in the fitting on the process connection.

Part3B: Attach the PTFE Wave Horn antenna to the process connection

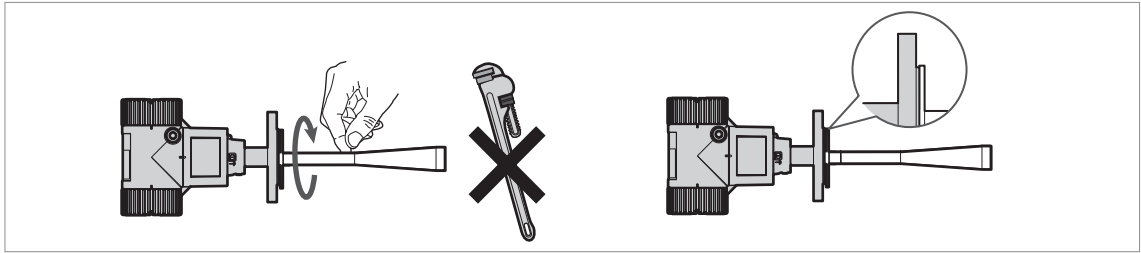


Figure 2-9: Part3B: Attach the PTFE Wave Horn antenna to the process connection



CAUTION!

Do not use tools to attach the antenna to the process connection.



- Turn the PTFE Wave Horn antenna. Tighten with your fingers.
- Make sure that the thread is engaged fully.
- ➔ End of the procedure.

2.6 Transport



WARNING!

- Depending on the version, the device will weight approx. 5...30 kg / 11...66 lb. To carry, use both hands to lift the device carefully by the converter housing. If necessary, lift the device with a hoist.
- When handling the device, avoid hard blows, jolts, impact, etc. to prevent damage.

2.7 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.

2.8 Installation

2.8.1 Pressure and temperature ranges



DANGER!

If the ambient temperature is more than $+70^{\circ}\text{C}$ / $+158^{\circ}\text{F}$, there is a risk of injury if you touch the device. Use a protective cover or metallic grid to prevent injury.

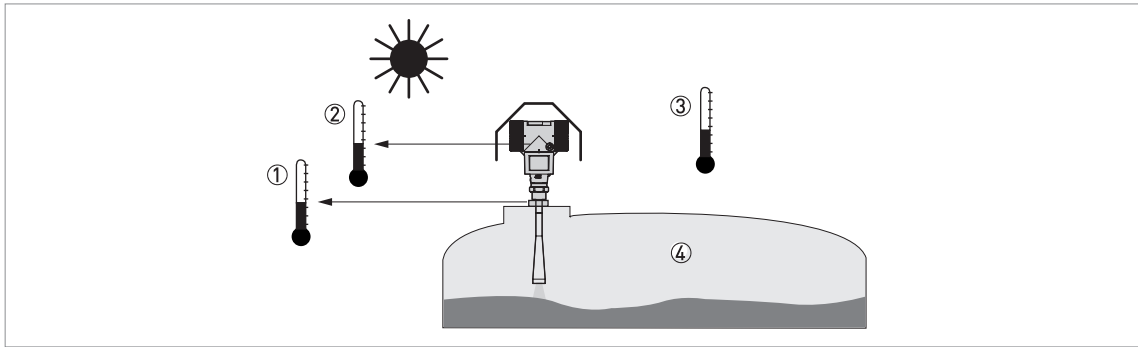


Figure 2-10: Pressure and temperature ranges

- ① Temperature at the process connection
Non-Ex devices: The temperature range depends on the type of antenna, process connection and the seal material. Refer to the table that follows.
Devices with Hazardous Location approvals: see supplementary instructions
- ② 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. The device continues to operate.
- ③ Ambient temperature
Non-Ex devices: refer to the ambient temperature / flange temperature graphs in this section
Devices with Hazardous Location approvals: see supplementary instructions
- ④ Process pressure
Depends on the type of antenna and process connection. Refer to the table that follows.

**WARNING!**

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

Antenna type	Process connection	Seal	Process connection temperature		Process pressure	
			[°C]	[°F]	[barg]	[psig]
PP Wave Horn	G 1½...2; 1½...2 NPT	—	-20...+100	-4...+212	-1...16	-14.5...232
PTFE Wave Horn	Flange with PTFE plate	—	-50...+150	-58...+302	-1...40	-14.5...580
Metallic Horn Wave Guide	Flange	Metaglas® with FKM/FPM	-40...+200 ①	-40...+392 ①	-1...40 ②	-14.5...580 ②
		Metaglas® with Kalrez® 6375	-20...+250 ①	-4...+482 ①	-1...40 ②	-14.5...580 ②
		Metaglas® with PFA	-60...+130 ①	-76...+266 ①	-1...40 ②	-14.5...580 ②
		Metaglas® with EPDM	-50...+130 ①	-58...+266 ①	-1...40 ②	-14.5...580 ②

① Higher temperature on request

② Higher pressure on request

For more data on pressure ratings, refer to the "Technical Data" chapter in the handbook.

PP Wave Horn: compact and remote versions

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

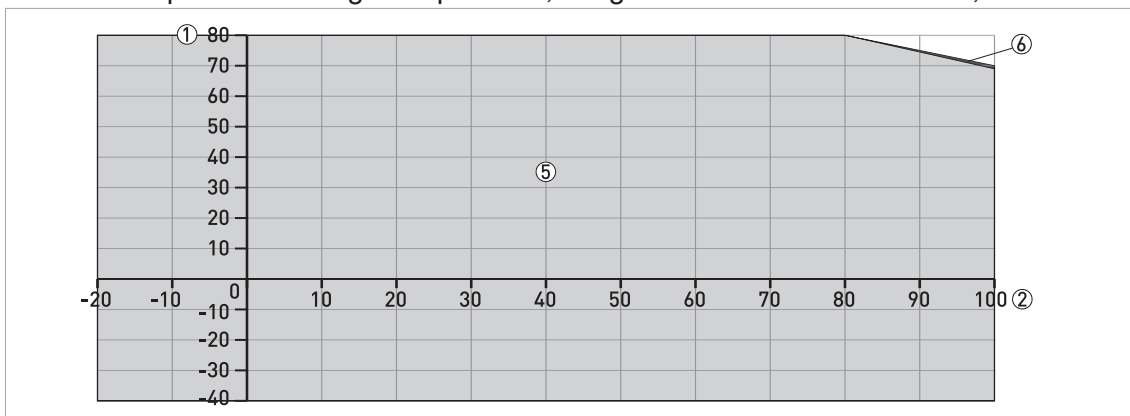


Figure 2-11: Ambient temperature / flange temperature, flange and threaded connection, in °C

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

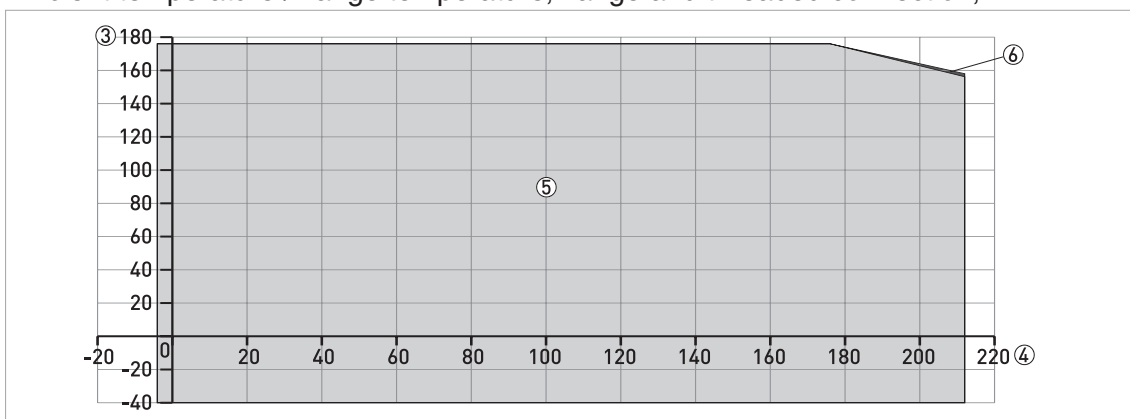


Figure 2-12: Ambient temperature / flange temperature, flange and threaded connection, in °F

- ① Maximum ambient temperature, °C
- ② Maximum flange temperature, °C
- ③ Maximum ambient temperature, °F
- ④ Maximum flange temperature, °F
- ⑤ Compact and remote versions of the device with the PP Wave Horn antenna
- ⑥ Remote version of the device with the PP Wave Horn antenna

PTFE Wave Horn: compact and remote versions

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

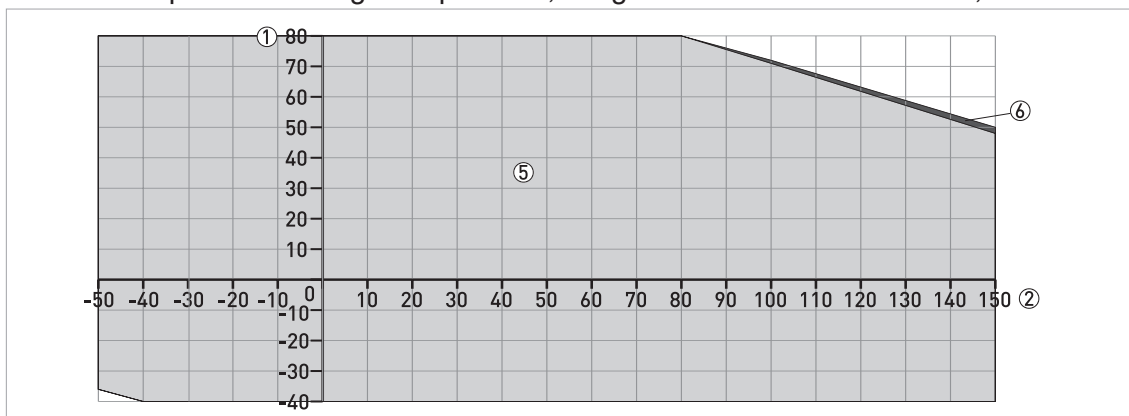


Figure 2-13: Ambient temperature / flange temperature, flange and threaded connection, in °C

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

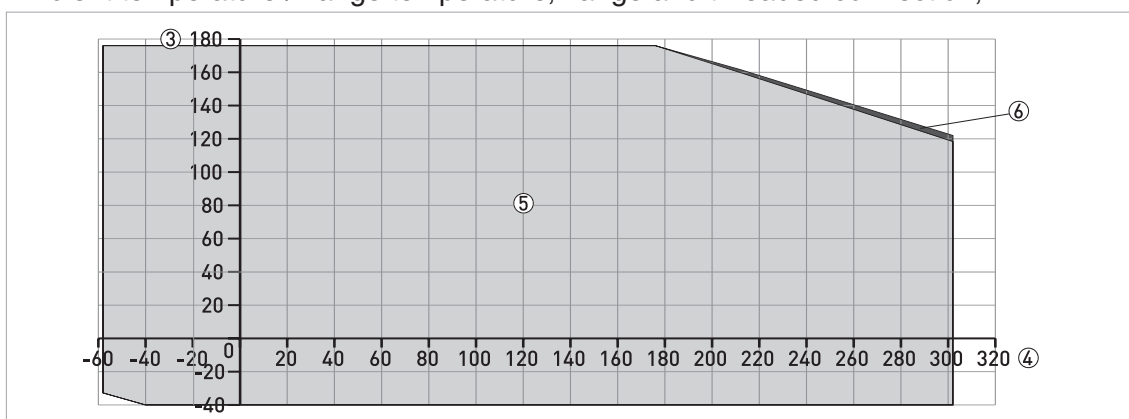


Figure 2-14: Ambient temperature / flange temperature, flange and threaded connection, in °F

- ① Maximum ambient temperature, °C
- ② Maximum flange temperature, °C
- ③ Maximum ambient temperature, °F
- ④ Maximum flange temperature, °F
- ⑤ Compact and remote versions of the device with the PTFE Wave Horn antenna
- ⑥ Compact version of the device with the PTFE Wave Horn antenna

**INFORMATION!**

When the process temperature is -50°C / -58°F , there is a de-rating for the ambient temperature. The minimum ambient temperature is -36°C / -32.8°F .

Metallic Horn and Wave Guide: compact and remote versions
 Ambient temperature / flange temperature, flange and threaded connection, in °C

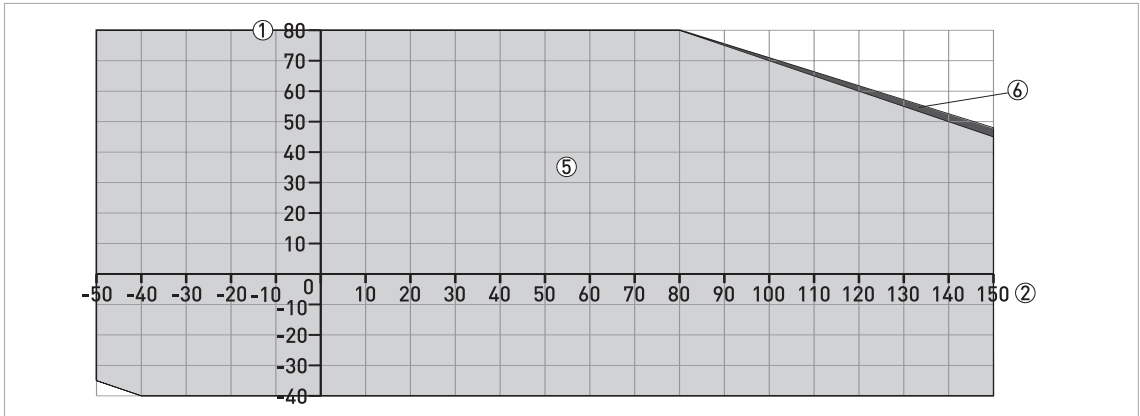


Figure 2-15: Ambient temperature / flange temperature, flange and threaded connection, in °C

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

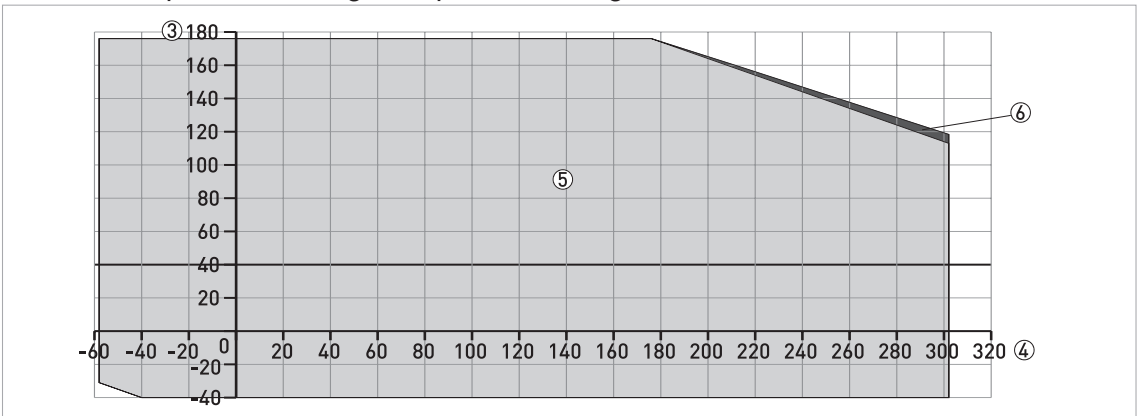


Figure 2-16: Ambient temperature / flange temperature, flange and threaded connection, in °F

- ① Maximum ambient temperature, °C
- ② Maximum flange temperature, °C
- ③ Maximum ambient temperature, °F
- ④ Maximum flange temperature, °F
- ⑤ Compact and remote versions of the device with the Metallic Horn or Wave Guide antenna
- ⑥ Compact version of the device with the Metallic Horn or Wave Guide antenna



INFORMATION!

When the process temperature is $-50^{\circ}\text{C} / -58^{\circ}\text{F}$ and the device has an EPDM gasket, there is a de-rating for the ambient temperature. The minimum ambient temperature is $-35^{\circ}\text{C} / -31^{\circ}\text{F}$.

Metallic Horn and Wave Guide: compact and remote versions with the high-temperature (HT) extension

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

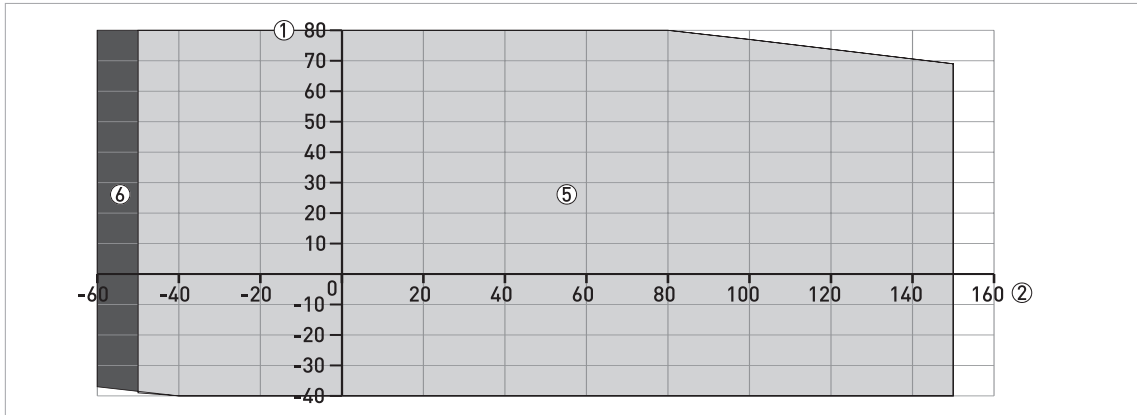


Figure 2-17: Ambient temperature / flange temperature, flange and threaded connection, in °C

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

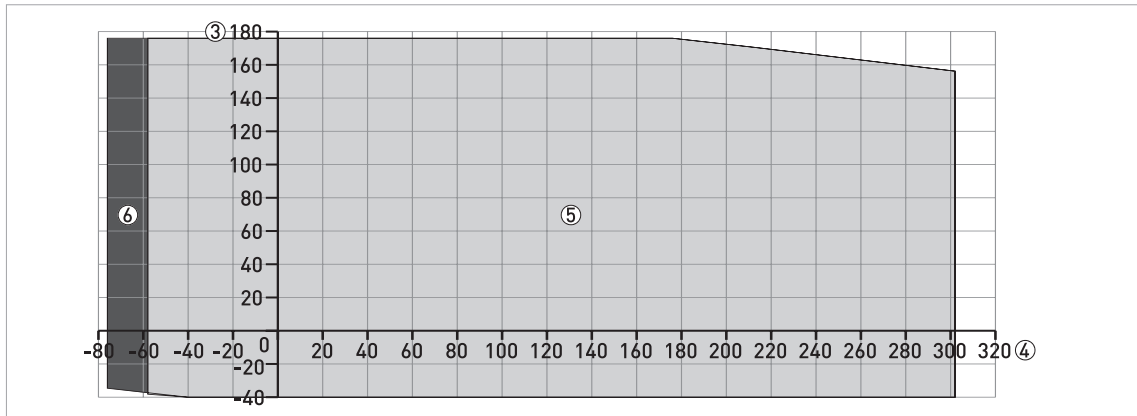


Figure 2-18: Ambient temperature / flange temperature, flange and threaded connection, in °F

- ① Maximum ambient temperature, °C
- ② Maximum flange temperature, °C
- ③ Maximum ambient temperature, °F
- ④ Maximum flange temperature, °F
- ⑤ Compact and remote versions of the device with the Metallic Horn or Wave Guide antenna, the HT extension and EPDM and PFA gaskets
- ⑥ Compact and remote versions of the device with the Metallic Horn or Wave Guide antenna, the HT extension and a PFA gasket



INFORMATION!

When the process temperature is -50°C / -58°F and the device has an EPDM gasket, there is a de-rating for the ambient temperature. The minimum ambient temperature is -39°C / -38.2°F .

When the process temperature is -60°C / -76°F and the device has a PFA gasket, there is a de-rating for the ambient temperature. The minimum ambient temperature is -37°C / -34.6°F .

2.8.2 Recommended mounting position



CAUTION!

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

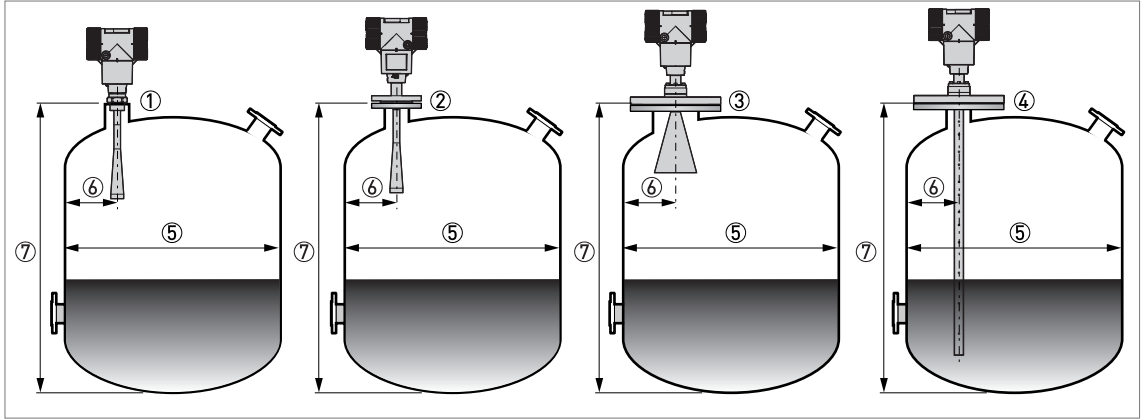


Figure 2-19: Recommended mounting position for liquids, pastes and slurries

- ① Sockets for the PP Wave Horn antenna
- ② Nozzles for the PTFE Wave Horn antenna
- ③ Nozzles for DN150 or DN200 Metallic Horn antennas
- ④ Nozzles for Wave Guide antennas
- ⑤ Tank diameter
- ⑥ Minimum distance of the nozzle or socket from the tank wall (depends on the antenna type and size - refer to items ①, ②, ③ and ④ in this list):
 - PP/PTFE Wave Horn (① and ②): $1/7 \times$ tank height
 - Metallic Horn (③): $1/10 \times$ tank height
 - Wave Guide (④): There is no minimum distance from the Wave Guide antenna to metallic walls and other metal objects
- Maximum distance of nozzle from the tank wall (depends on the antenna type and size - refer to items ①, ② and ③ in this list):
 - PP/PTFE Wave Horn (① and ②): $1/3 \times$ tank diameter
 - Metallic Horn (③): $1/3 \times$ tank diameter
 - Wave Guide (④): There is no maximum distance from the Wave Guide antenna to metallic walls and other metal objects
- ⑦ Tank height



INFORMATION!

If there is a nozzle on the tank before installation, the nozzle must be a minimum of 200 mm / 7.9" from the tank wall. The tank wall must be flat and there must not be obstacles adjacent to the nozzle or on the tank wall.

Point the device in the correct direction

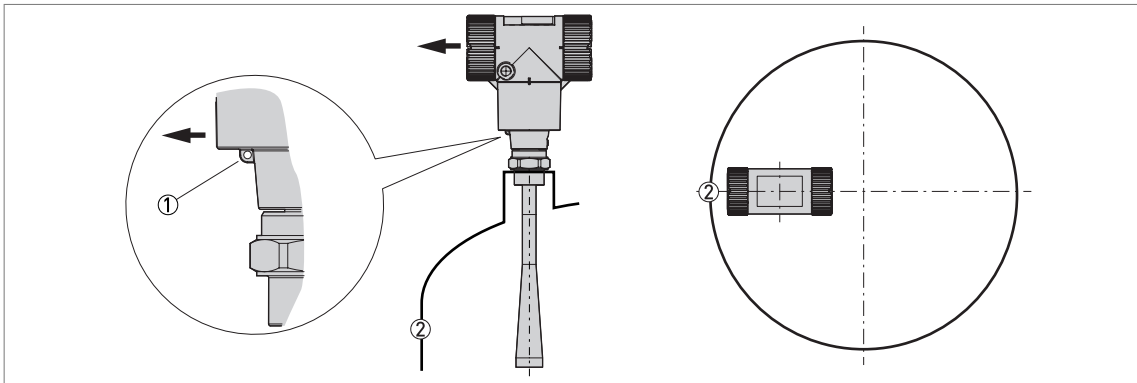


Figure 2-20: Point the device in the correct direction to get the best performance

Point the tag hole on the housing in the direction of the nearest tank wall.

- ① Tag hole
- ② Nearest tank wall

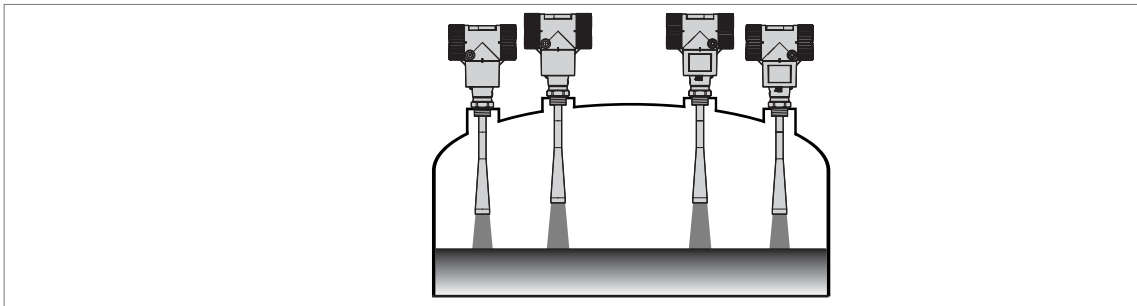


Figure 2-21: A maximum of 4 FMCW radar level meters can be operated in a tank

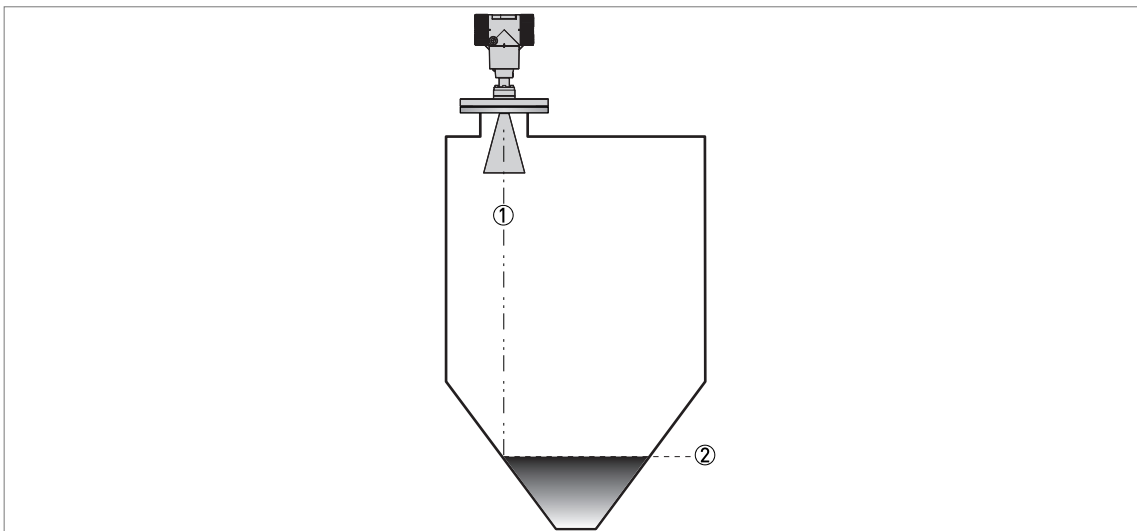


Figure 2-22: Tanks with dish-shaped or conical bottoms

Dish-shaped or conical bottoms have an effect on the measuring range. The device cannot measure to the bottom of the tank.

- ① Axis of radar beam
- ② Minimum level reading

2.8.3 Mounting restrictions



CAUTION!

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

We recommend that you prepare the installation when the tank is empty.

Mounting restrictions: General data

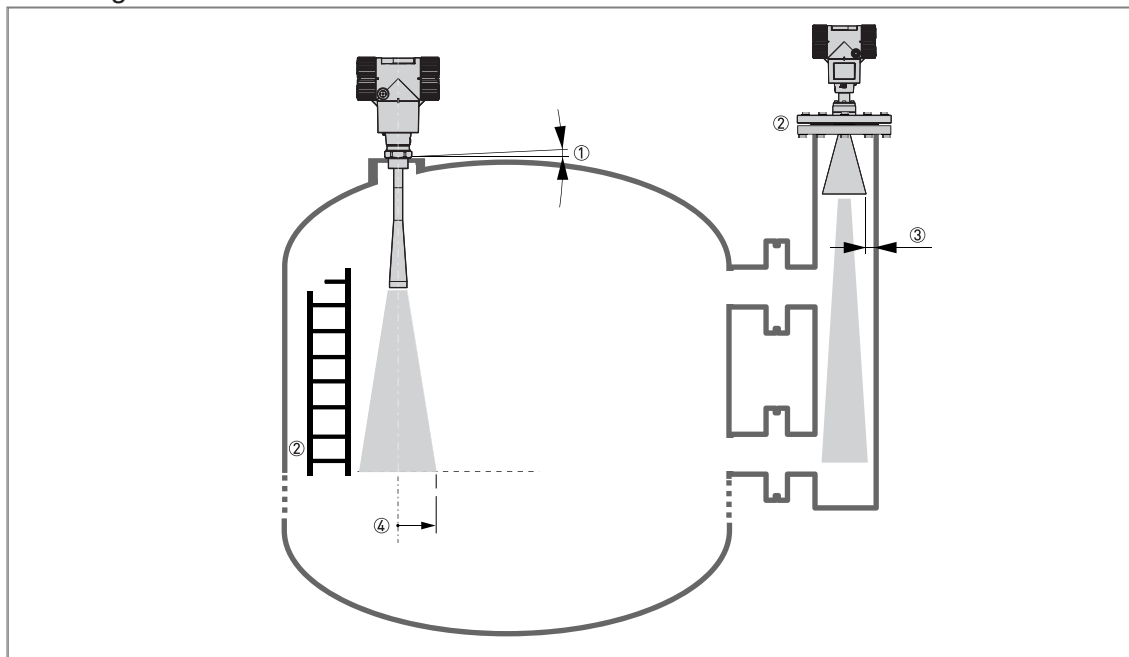


Figure 2-23: Mounting restrictions: General data

- ① Do not tilt the device more than 2°
- ② We recommend that you do an empty spectrum recording if there are obstacles in the radar beam (refer to **Operation**). If necessary, install a bypass chamber or stilling well or use an S-bend antenna extension or an L-bend antenna extension (the device must be installed on the side of the tank) to move the device away from obstacles.
- ③ 2.5 mm / 0.1" max. for high-dielectric constant liquids
- ④ Beam radius (DN80 (3") Metallic Horn antenna): increments of 290 mm/m or 3.4"/ft (16°)
 Beam radius (DN100 (4") Metallic Horn antenna): increments of 210 mm/m or 2.6"/ft (12°)
 Beam radius (DN150 (6") Metallic Horn antenna): increments of 140 mm/m or 1.7"/ft (8°)
 Beam radius (DN200 (8") Metallic Horn antenna): increments of 100 mm/m or 1.3"/ft (6°)
 Beam radius (PP Wave Horn and PTFE Wave Horn antenna): increments of 176 mm/m or 2.1"/ft (10°)

Obstacles in the tank

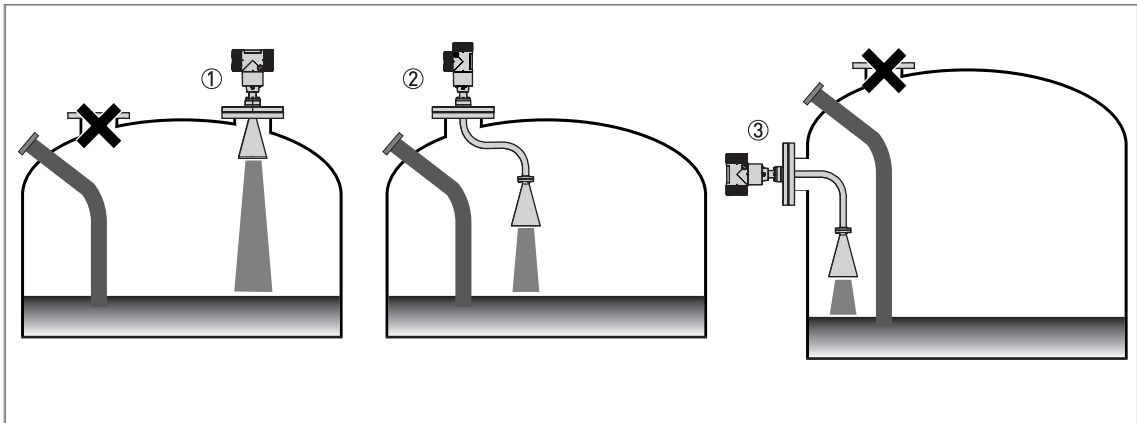


Figure 2-24: Obstacles in the tank

Do not put the device directly above obstacles (agitator, support beams, heating tubes etc.). Parasitic signals from obstacles will cause the device to measure incorrectly.

- ① Solution 1: Put the device on another process connection away from obstacles
- ② Solution 2: Use the same process connection, but also use an S-bend extension
- ③ Solution 3: Attach the device to the side of the tank and use an L-bend (right angle) extension

**CAUTION!**

Do not put the device near to the product inlet. If the product that enters the tank touches the antenna, the device will measure incorrectly. If the product fills the tank directly below the antenna, the device will also measure incorrectly.

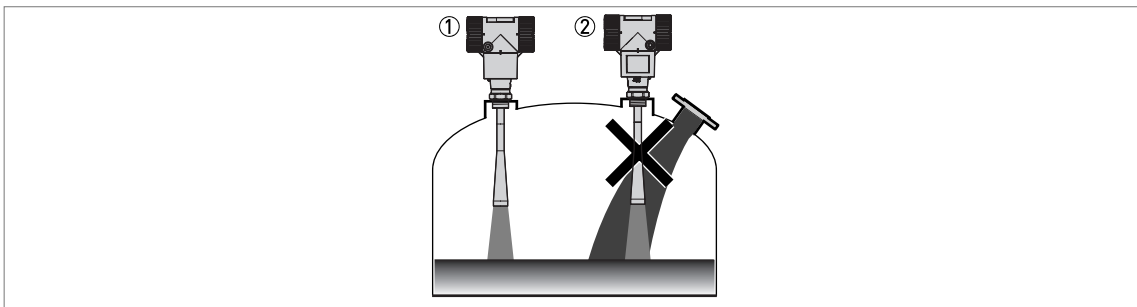


Figure 2-25: Product inlets

- ① The device is in the correct position.
- ② The device is too near to the product inlet.

Devices with Metallic Horn antenna

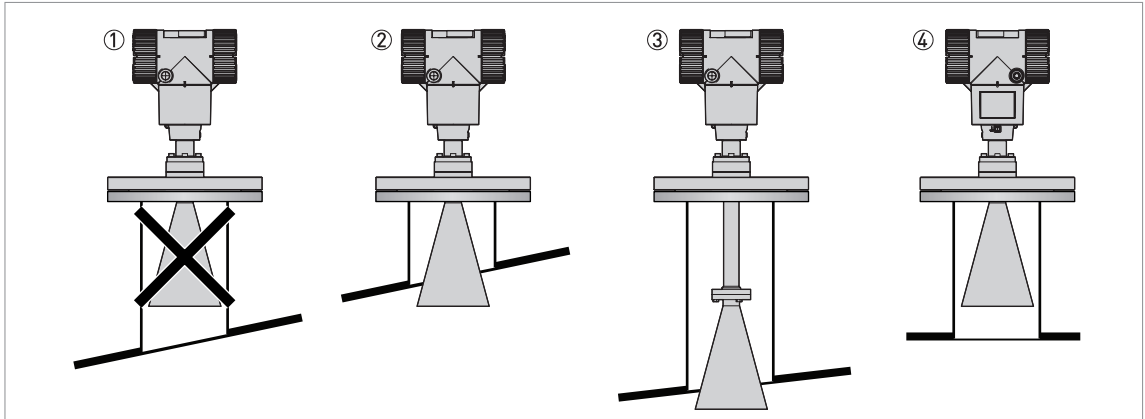


Figure 2-26: Devices with Metallic Horn antenna

- ① If the roof is not flat, the antenna must project out of the nozzle
- ② Short tank nozzle
- ③ Long tank nozzle (device with an antenna extension)
- ④ If the roof is flat and the tank fitting is symmetrical, it is not necessary for the antenna to project out of the nozzle. Thus, the device can have a larger measuring range.

The antenna must project out of the nozzle. If necessary, use an antenna extension. But if the tank roof is flat and the tank fitting is symmetrical, it is not necessary for the antenna to project out of the nozzle. Thus, the device can have a larger measuring range.

Devices with PTFE or PP Wave Horn antenna

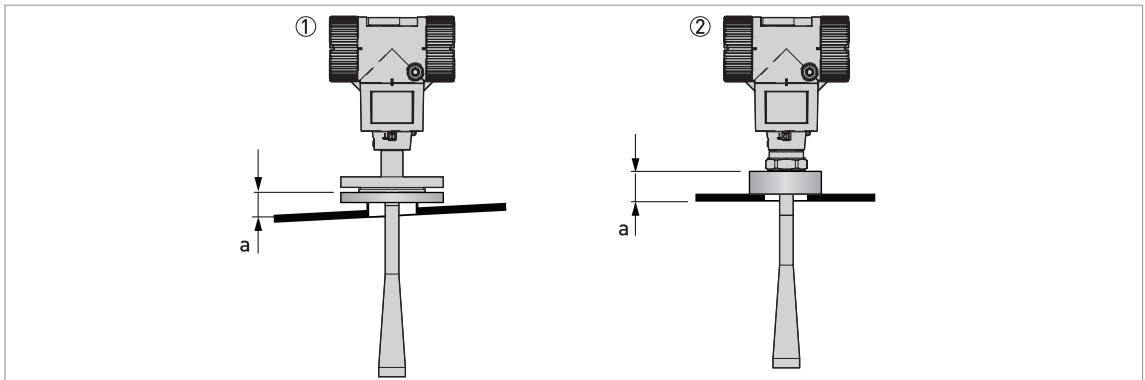


Figure 2-27: Devices with PTFE or PP Wave Horn antenna

Recommended height of tank process connection, $a = 44...200 \text{ mm} / 1.7...7.87''$

- ① Device with a PTFE Wave Horn antenna and a flange connection. There are antenna extension options available (100 mm / 4", 200 mm / 8" and 300 mm / 12") for long nozzles.
- ② Device with a PP Wave Horn antenna and a thread connection



CAUTION!

Do not install devices with Wave Horn antennas on plastic nozzles that have a diameter of 50 mm / 2".



CAUTION!

If there are parasitic signals, the device will not measure correctly. Parasitic signals are caused by:

- Objects in the tank.
- Sharp corners that are perpendicular to the path of the radar beam.

Do an Empty Spectrum recording (refer to **Operation**) to remove parasitic signals with a filter.

Requirements for flange connections

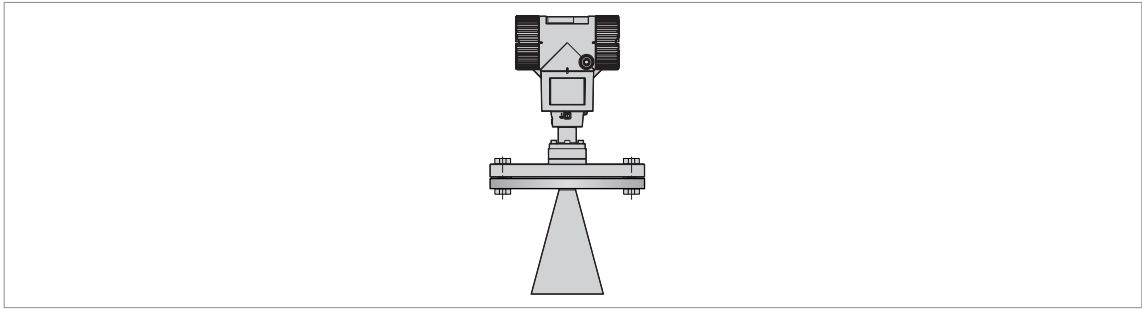


Figure 2-28: Flange connection

Equipment needed:

- Device
- Flange gasket (not supplied)
- Wrench (not supplied)



- Make sure the flange on the nozzle is level.
- Make sure that you use the applicable gasket for the flange dimensions and the process.
- Align the gasket correctly on the flange facing of the nozzle.
- Lower the antenna carefully into the tank.
- Make sure that you point the device in the correct direction. Refer to "Point the device in the correct direction" in this section.
- Tighten the flange bolts.
- ➡ Refer to local rules and regulations for the correct torque to apply to the bolts.

Requirements for threaded connections

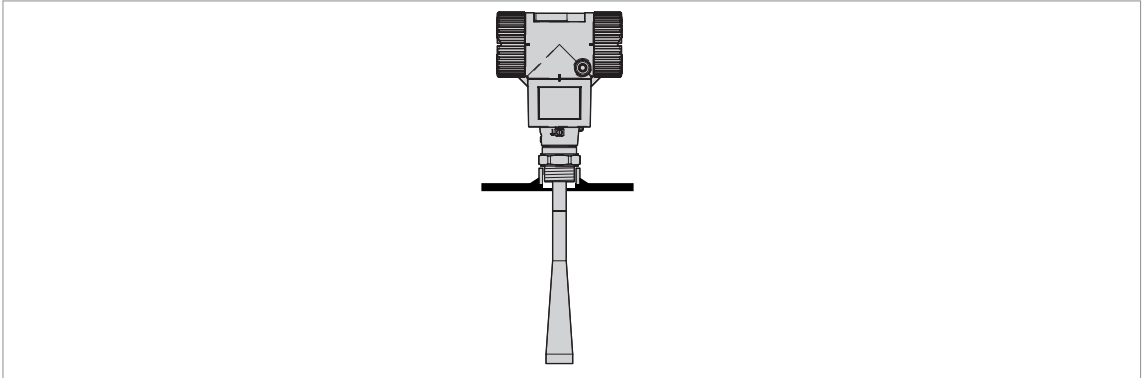


Figure 2-29: Threaded connection

Equipment needed:

- Device
- Gasket for G 1½A or G 2A connection (not supplied)
- Thread seal tape (PTFE) for 1½ NPT or 2 NPT connection (not supplied)
- 50 mm / 2" wrench (not supplied)



WARNING!

Do not tighten the connection to a torque more than 40 N·m / 29.5 lb·ft. If the connection is too tight, this will damage the thread.

To prevent damage to the antenna, make sure that the minimum diameter of the hole for a 1½ NPT or 2 NPT thread connection is not less than 43.4 mm / 1.71".



- Make sure the tank connection is level.
- **ISO 228-1 (G) connection:** Make sure that you use the applicable gasket for the connection dimensions and the process.
- **ISO 228-1 (G) connection:** Align the gasket correctly.
- **NPT connection:** Wind the thread seal tape around the process connection in agreement with good engineering practice.
- Lower the antenna carefully into the tank.
- Turn the threaded connection on the antenna to attach the device to the process connection.
- Make sure that you point the device in the correct direction. Refer to "Point the device in the correct direction" in this section.
- Tighten the connection to the correct torque (not more than 40 Nm).

2.8.4 Standpipes (stilling wells and bypass chambers)

Use a standpipe if:

- There is highly conductive foam in the tank.
- The liquid is very turbulent or agitated.
- There are too many other objects in the tank.
- The device is measuring a liquid (petro-chemicals) in a tank with a floating roof.
- The device is installed in a horizontal cylindrical tank.

For more data, refer to the Handbook.

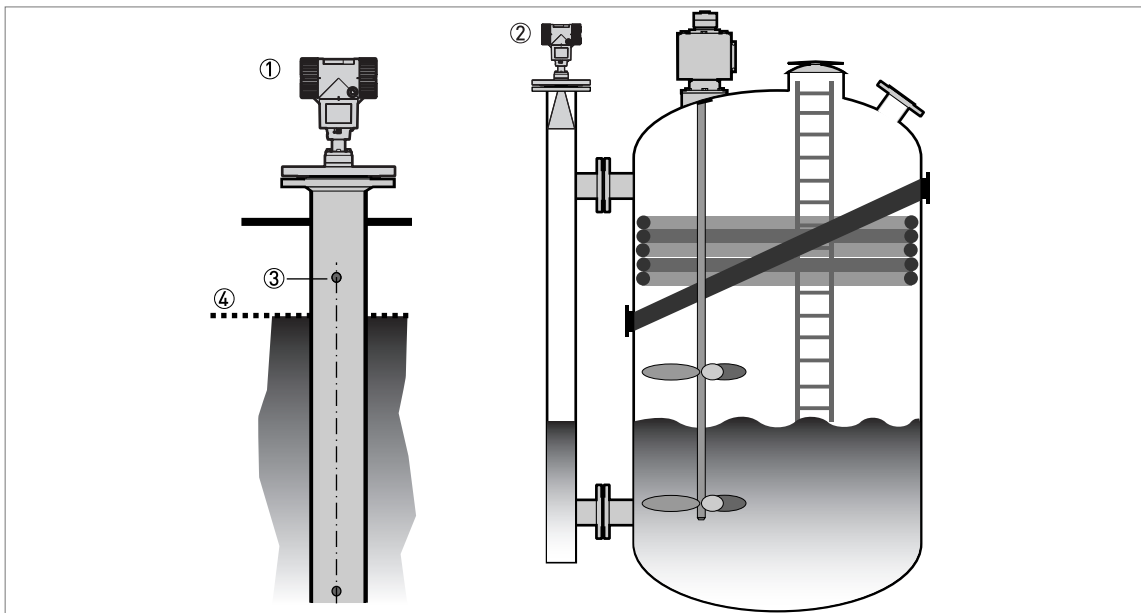


Figure 2-30: Installation recommendations for standpipes (stilling wells and bypass chambers)

- ① A stilling well solution
- ② A bypass chamber solution
- ③ Air circulation hole
- ④ Level of the liquid



CAUTION!

You can drill an air circulation hole if the stilling well is in a closed space (a metallic container). This condition is necessary to obey TLPR standards. For more data, refer to the handbook.

2.8.5 Wall support for the remote version

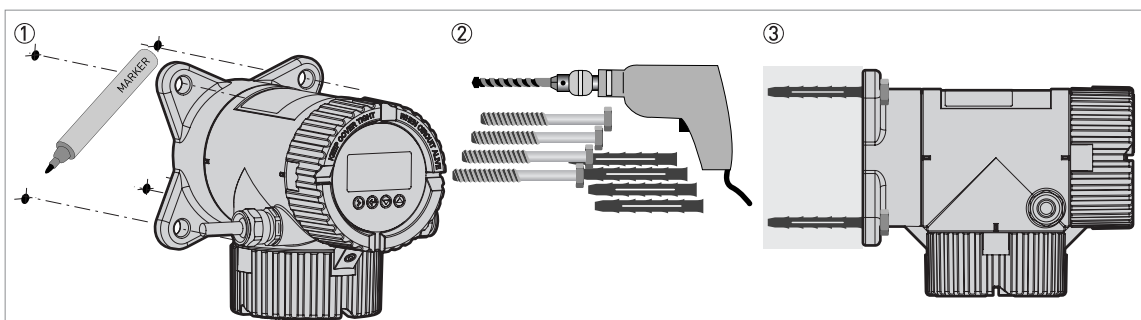


Figure 2-31: Wall support for the remote version (attached to the remote converter)



- 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" in the handbook.
- ② Use equipment and tools that agree with health and safety regulations and good engineering practice.
- ③ Make sure the wall support is correctly attached to the wall.

2.8.6 How to attach an antenna extension (Metallic Horn or Wave Guide antennas)



CAUTION!

IF THE ANTENNA EXTENSION IS SUPPLIED WITH THE DEVICE AS AN OPTION:

If the antenna extension is attached to the device, no more work is necessary.

If the antenna extension is not attached to the device, refer to Procedure 1 in this section. It is not necessary to change the device settings. The manufacturer sets the related menu items to the correct values in the factory.

IF THE ANTENNA EXTENSION IS SUPPLIED AFTER DELIVERY OF THE DEVICE (SPARE PART):

You must attach the antenna extension to the device and change the device settings in the SUPERVISOR menu. If you have a straight antenna extension, refer to Procedures 1 and 2A. If you have an S-bend or L-bend (right-angle) antenna extension, refer to Procedures 1 and 2B.



DANGER!

If you installed the device on the tank before the procedure, make the device safe (de-energize the circuit, clean the device etc.) before you continue the work.

Equipment needed

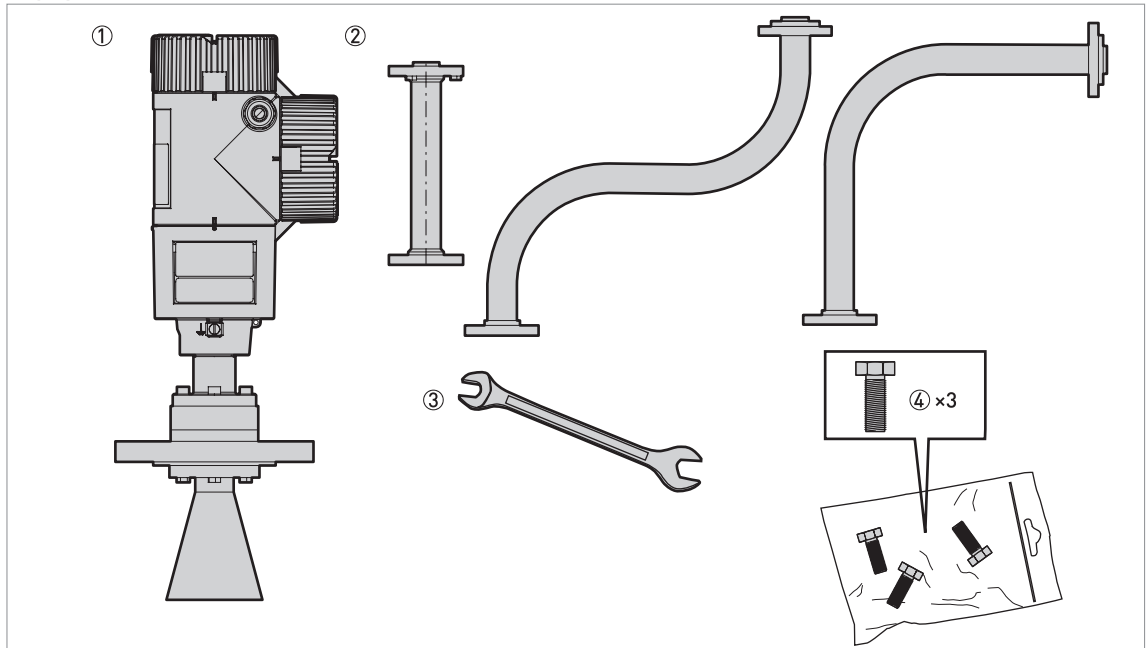


Figure 2-32: Equipment needed

- ① Device (with a Metallic Horn or Wave Guide antenna option only)
- ② Antenna extension. From left to right: straight, S-bend and L-bend (right-angle) extension.
- ③ 10 mm open-end or box-end wrench (not supplied)
- ④ 3 hex head screws M6x25-A4-70 (supplied in a plastic sachet)

Obey the assembly procedure that follows:

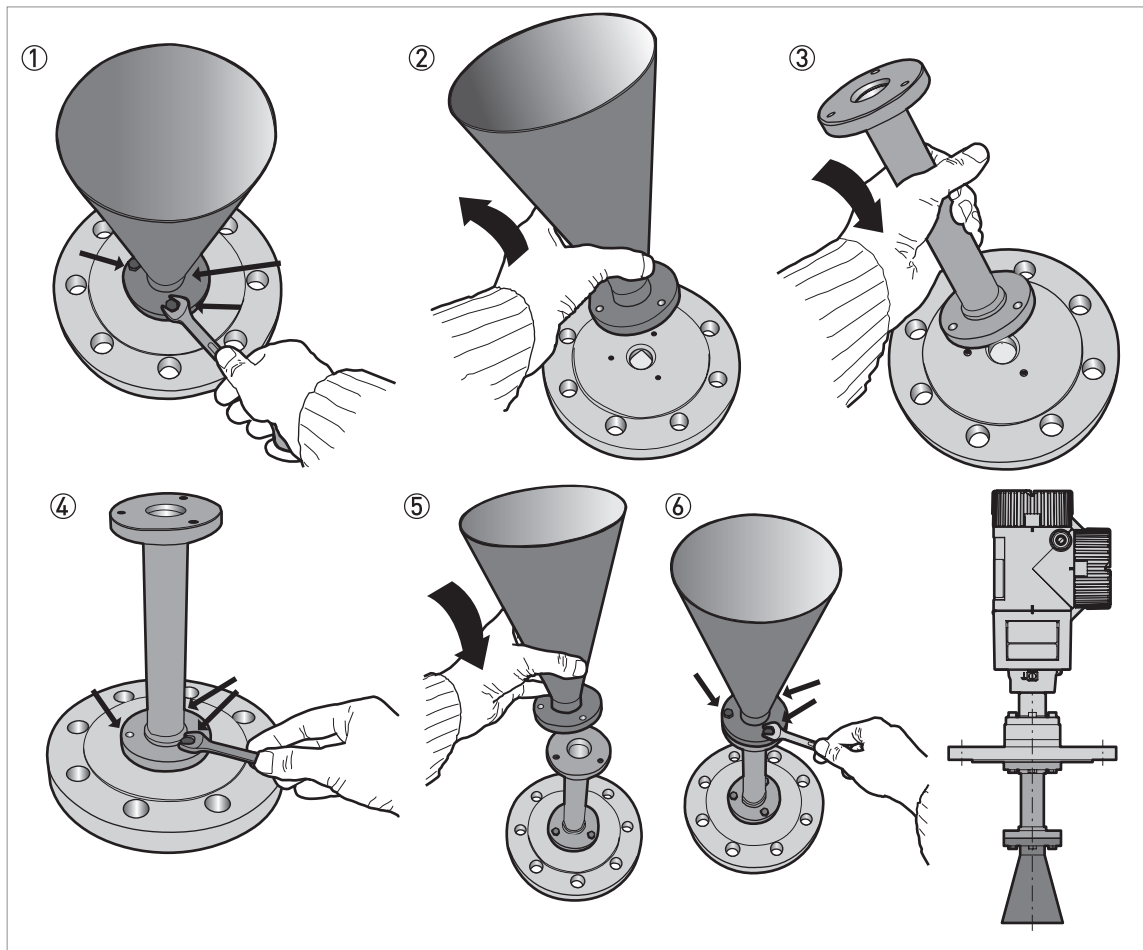


Figure 2-33: Procedure: How to attach an antenna extension



WARNING!

Make sure that you do not damage the PTFE cone when you remove or install the antenna.



Procedure 1: How to attach an antenna extension

- ① Remove the 3 hex head screws from the antenna with the 10 mm wrench.
- ② Remove the antenna. Make sure that you do not damage the PTFE cone when you remove the antenna.
- ③ Attach the antenna extension below the flange. Make sure that the antenna extension is fully engaged. Make sure that you do not damage the PTFE cone when you attach the antenna extension.
- ④ Attach 3 hex head screws to the antenna extension with a 10 mm wrench. Tighten the screws to a torque of 8 Nm.
- ⑤ Attach the antenna below the antenna extension.
- ⑥ Attach 3 hex head screws to the antenna with a 10 mm wrench. Tighten the screws to a torque of 8 Nm.
- ➡ If the antenna extension is supplied with the device, it is not necessary to change the device settings. End of the procedure.
- ⑦ If the antenna extension is supplied after delivery of the device, it is necessary to change the device settings. Make a selection from one of the procedures (2A or 2B) that follow: straight antenna extension, S-bend antenna extension or L-bend (right angle) antenna extension.



Procedure 2A: Device settings for a device with a straight antenna extension

- Enter the SUPERVISOR menu (2.0.0).
- Push [>], 2 x [▲], [>] and 6 x [▲] to go to menu item ANTENNA EXTENSION (2.3.7).
- Push [>] to change the value. Push [>] to change the position of the cursor. Push [▼] to decrease the value or [▲] to increase the value.
- ➡ If the antenna extension has a length of 500 mm, enter the value "500" (if units for this menu item are in mm).
- Push 3 x [←] to go back to the "STORE" screen.
- Push [▲] or [▼] to set the screen to **STORE YES** and push [←].
- ➡ End of the procedure.



Procedure 2B: Device settings for a device with an S-bend or L-bend (right angle) antenna extension

- Enter the SUPERVISOR menu (2.0.0).
- Push [>], 2 x [▲], [>] and 6 x [▲] to go to menu item ANTENNA EXTENSION (2.3.7).
- Push [>] to change the value. Push [>] to change the position of the cursor. Push [▼] to decrease the value or [▲] to increase the value.
- ➡ If units are in mm, enter the value "221" (for an S-bend extension) or "236" (for an L-bend extension).
- Push [←] to go back to the menu. Push 2 x [▲] to go to menu item DIST.PIECE (2.3.9).
- Push [>] to change the value. Push [>] to change the position of the cursor. Push [▼] to decrease the value or [▲] to increase the value.
- ➡ If units are in mm, enter the value "243" (for an S-bend extension) or "236" (for an L-bend extension).
- Push 3 x [←] to go back to the "STORE" screen.
- Push [▲] or [▼] to set the screen to **STORE YES** and push [←].
- ➡ End of the procedure.

Settings for devices with antenna extensions in mm

Antenna extension type	Device settings	
	ANTENNA EXTENSION (2.3.7)	DIST.PIECE (2.3.9)
Straight	①	0 ②
S-bend	221	243 ②
L-bend (right angle)	236	236 ②

① This value depends on the length of the antenna extension. Enter the length of the antenna extension: 100, 200, 300, 400, 500 or 1000 mm
 ② If the device has a high temperature extension, add 120 mm to this value

For more data about the dimensions of devices with antenna extensionsFor more data about the dimensions of devices with antenna extensions, refer to "Dimensions and weights" in the handbook.

2.8.7 How to turn or remove the signal converter

The converter turns 360°, but we recommend that the tag hole on the housing points to the nearest tank wall. For more data, refer to *Recommended mounting position* on page 15. The converter can be removed from the process connection assembly under process conditions.

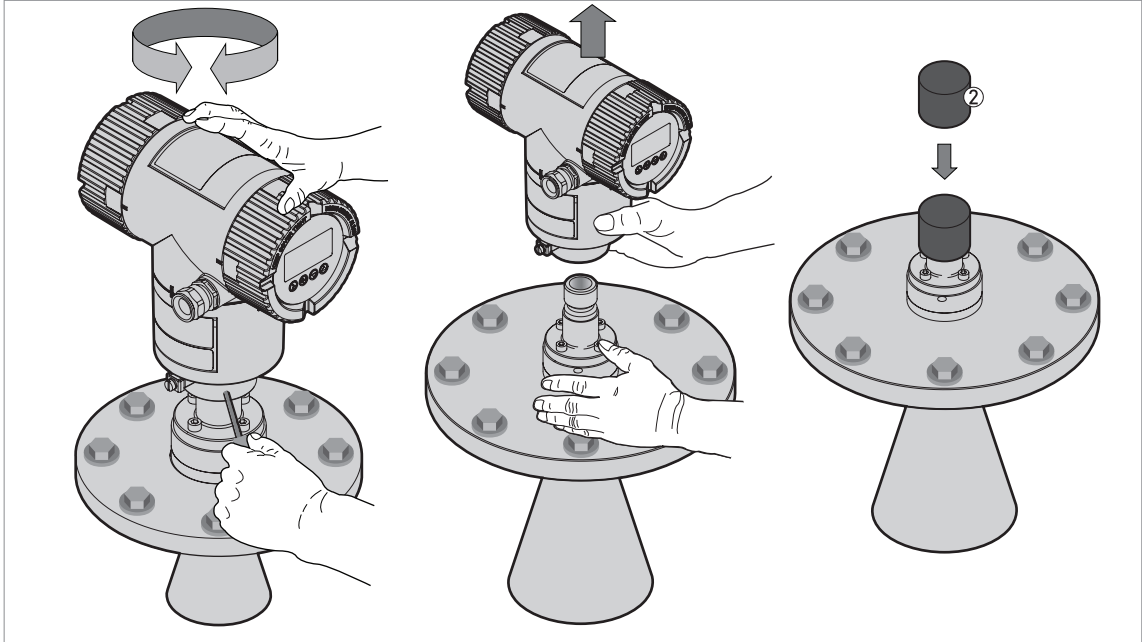


Figure 2-34: How to turn or remove the signal converter

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



CAUTION!

Do not loosen the 4 socket head screws on the process connection assembly. If you remove the housing, put a cover on the wave guide hole on top of the process connection assembly. Make sure that the wave guide hole is clean and dry. When the housing is attached to the process connection assembly, tighten the lock screw with the 5 mm Allen wrench ①.

2.8.8 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.

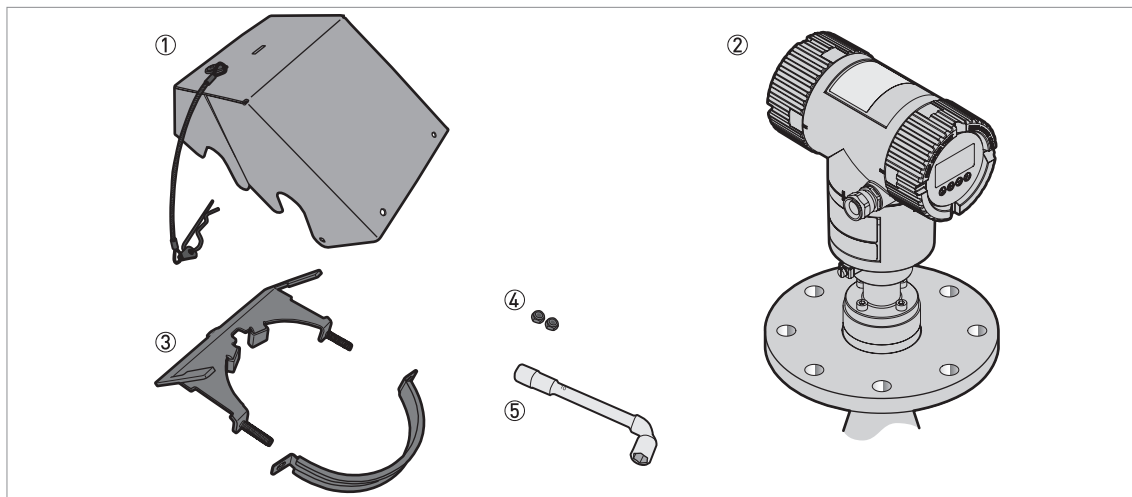


Figure 2-35: Equipment needed

- ① Weather protection cover (with an R-clip to hold the cover on the clamp)
- ② Device
- ③ Weather protection clamp (2 parts)
- ④ 10 mm socket wrench (not supplied)
- ⑤ 2 locking nuts

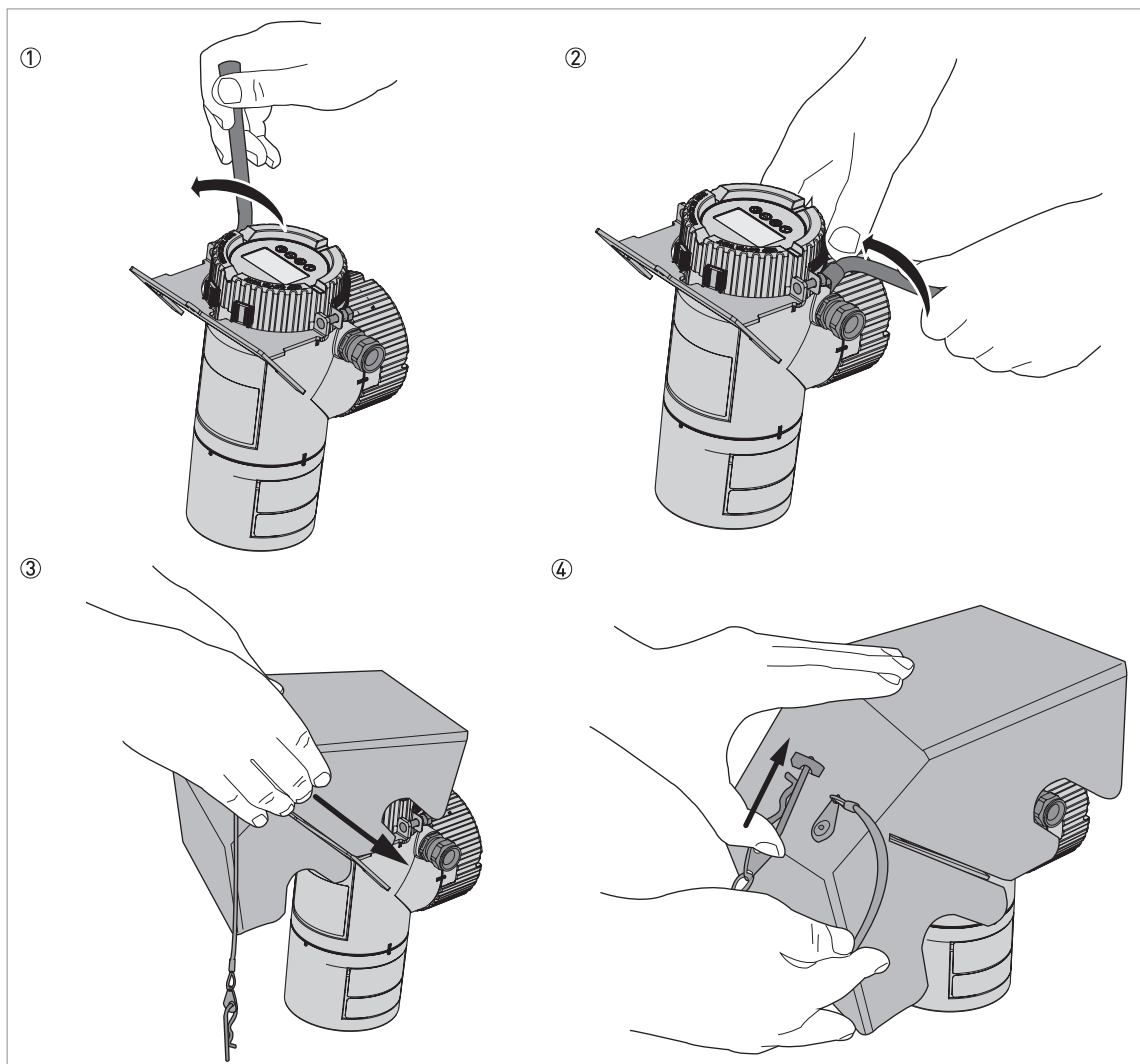


Figure 2-36: Installation of the weather protection on a vertical signal converter



- 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.

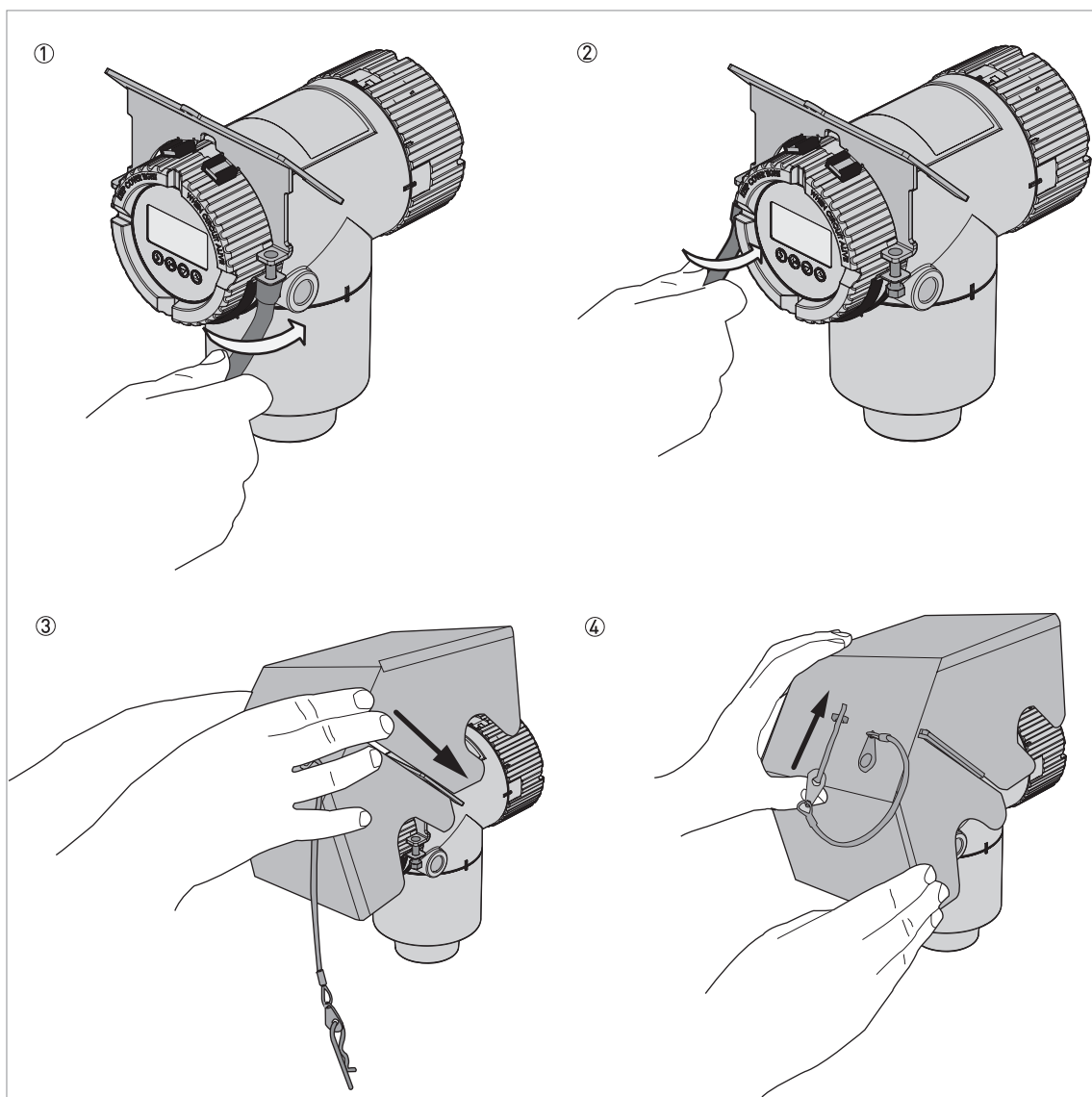


Figure 2-37: Installation of the weather protection on a horizontal signal converter



- 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 in "Dimensions and weights" in the handbook.

2.8.9 How to open the weather protection

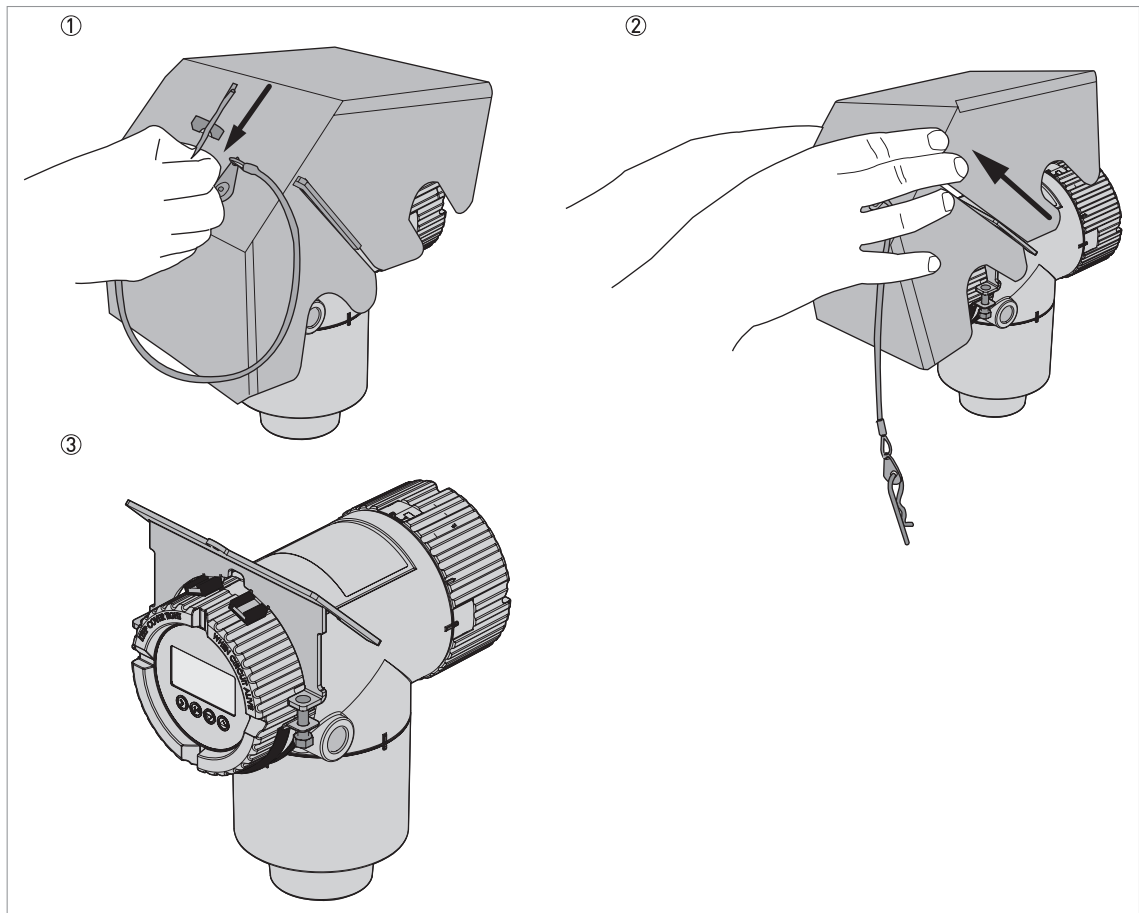


Figure 2-38: How to open the weather protection



- 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 Electrical connections

3.1 Electrical installation: 2-wire, loop-powered

3.1.1 Compact version

Terminals for electrical installation

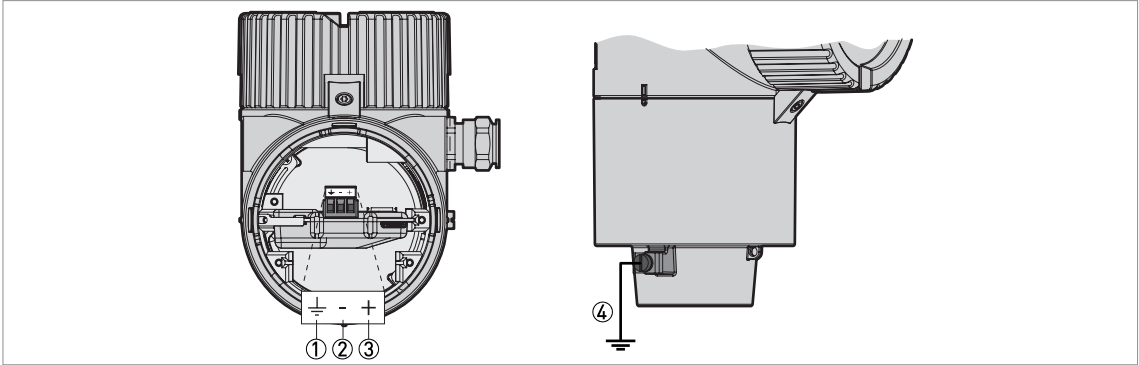


Figure 3-1: Terminals for electrical installation

- 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.
- Make sure that the polarity of the power supply is correct. If the polarity is incorrect, you will not cause damage to the device but the device will not operate.

Open the terminal compartment cover

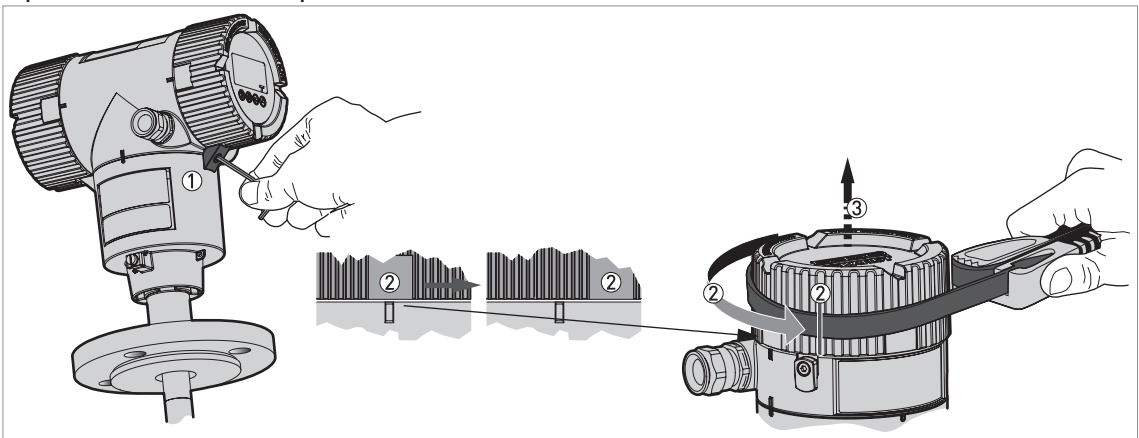


Figure 3-2: How to open the terminal compartment cover



- 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.

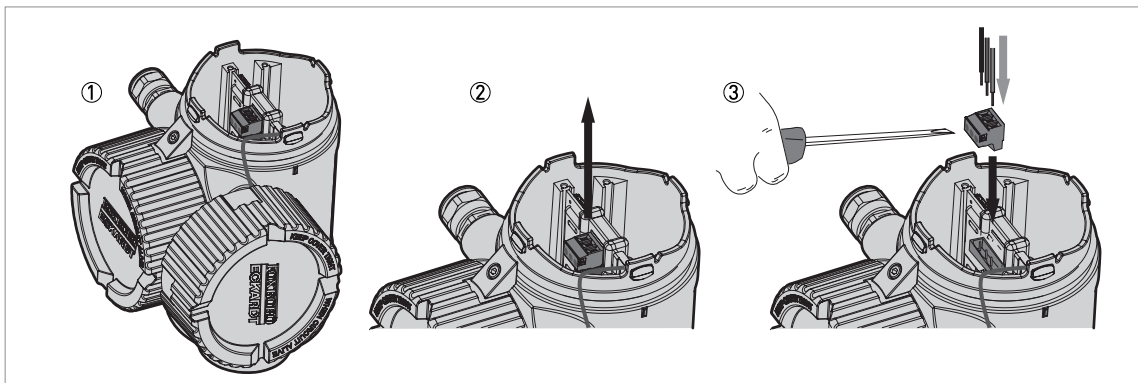


Figure 3-3: Procedure for electrical installation

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

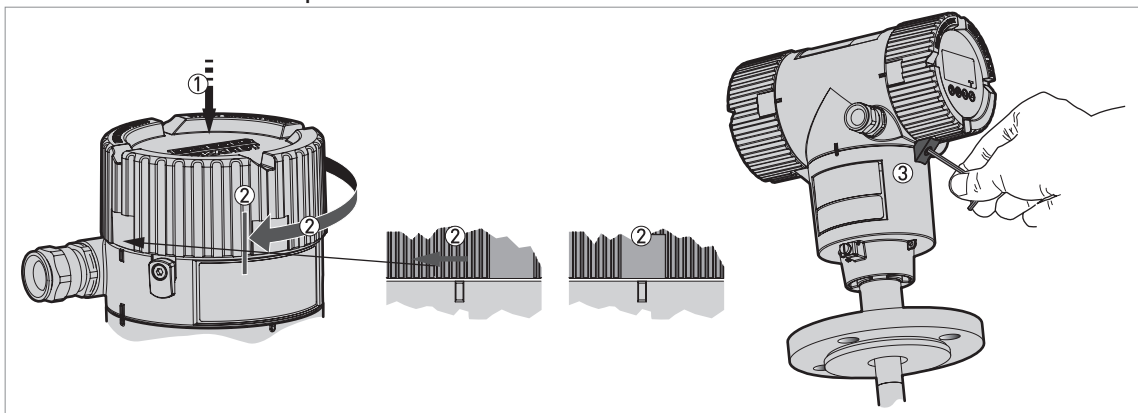


Figure 3-4: How to close the terminal compartment cover



- ① Put the cover on the housing and push it down.
- ② Turn the cover clockwise until it is fully engaged.
- ③ Tighten the lock screw.

3.1.2 Remote version

Terminals for electrical installation

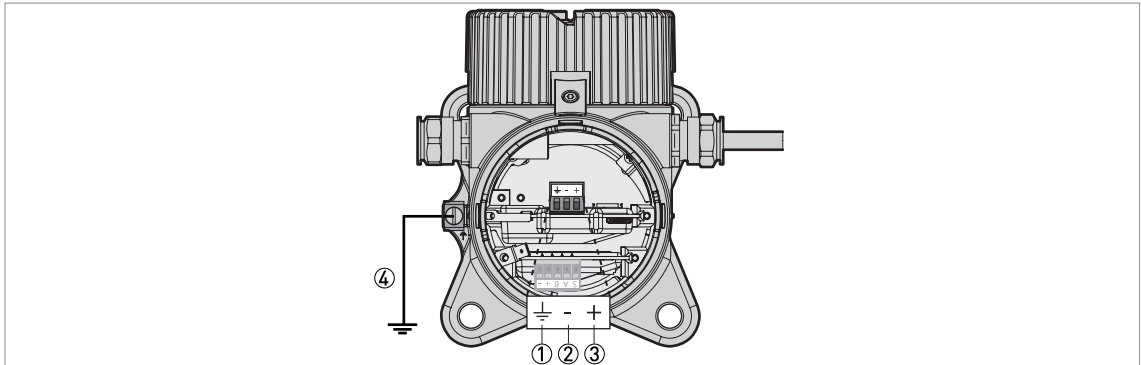


Figure 3-5: Terminals for electrical installation

- 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.



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.
- Make sure that the polarity of the power supply is correct. If the polarity is incorrect, you will not cause damage to the device but the device will not operate.

Connections between the remote converter and the antenna housing

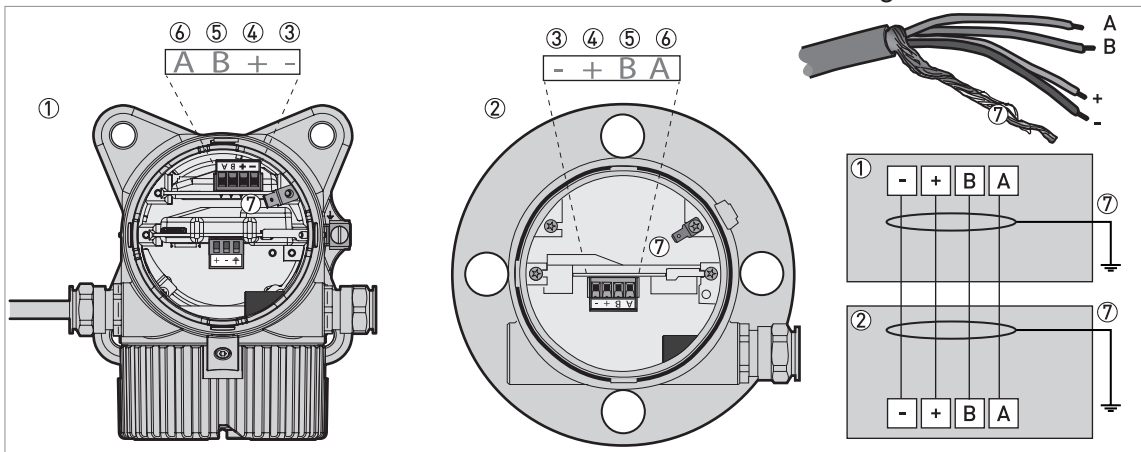


Figure 3-6: Connections between the remote converter and the antenna housing

- ① Remote converter
- ② Antenna 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 antenna housing)

For more electrical installation data, refer to *Compact version* on page 31.

For more data about the signal cable between the remote converter and the antenna housing, refer to the handbook.

3.2 Non-Ex devices

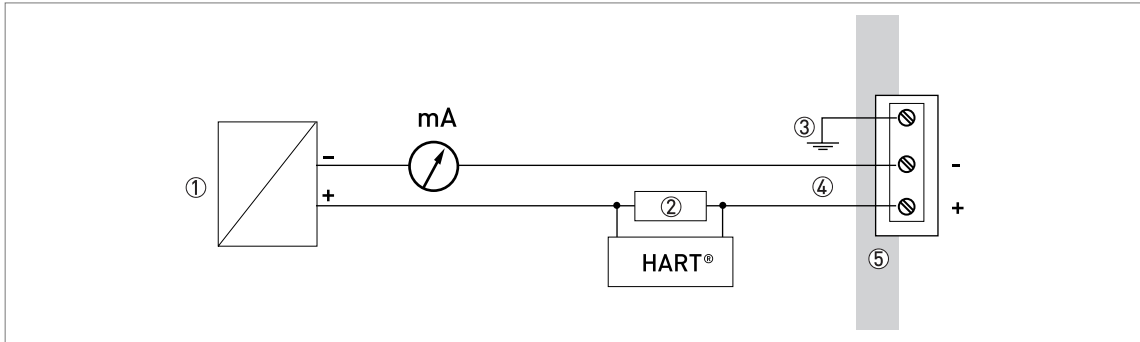


Figure 3-7: Electrical connections for non-Ex devices

- ① Power supply
- ② Resistor for HART® communication
- ③ Optional connection to the grounding terminal
- ④ Output: 11.5...30 VDC for an output of 22 mA at the terminal
- ⑤ Device

3.3 Devices for hazardous locations



DANGER!

For electrical data for device operation in hazardous locations, refer to the related certificates of compliance and supplementary instructions (ATEX, IECEx, etc.). This documentation can be downloaded from our website.

3.4 Minimum power supply voltage

Use these graphs to find the minimum power supply voltage for a given current output load.

Non-Ex and Hazardous Location approved (Ex i / IS) devices



Figure 3-8: Minimum power supply voltage for an output of 22 mA at the terminal (Non-Ex and Hazardous Location approval (Ex i / IS))

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

Hazardous Location (Ex d / XP/NI) approved devices

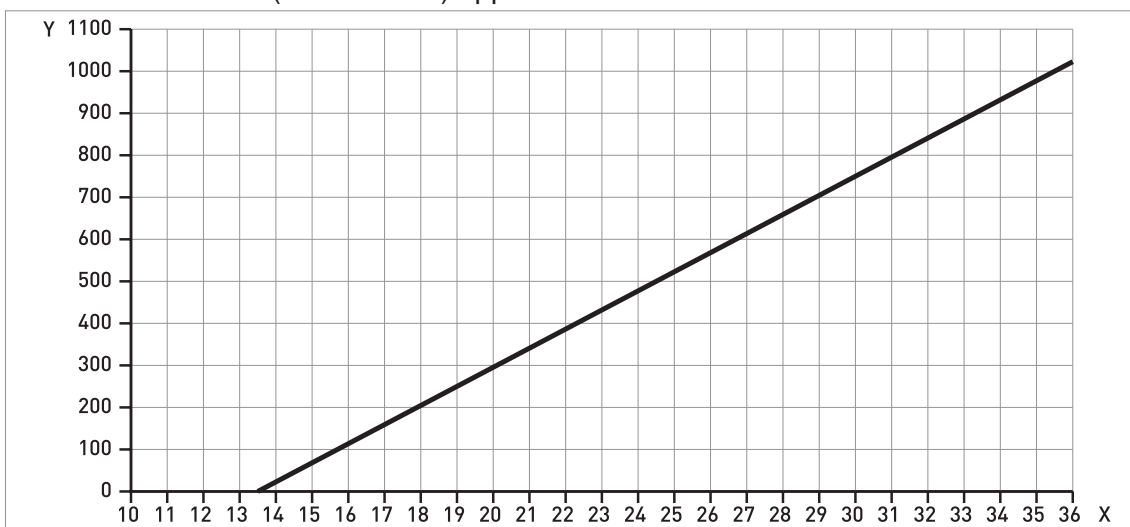


Figure 3-9: Minimum power supply voltage for an output of 22 mA at the terminal (Hazardous Location approval (Ex d / XP/NI))

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

3.5 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 (antenna).



DANGER!

Make sure that the cable gland is watertight.

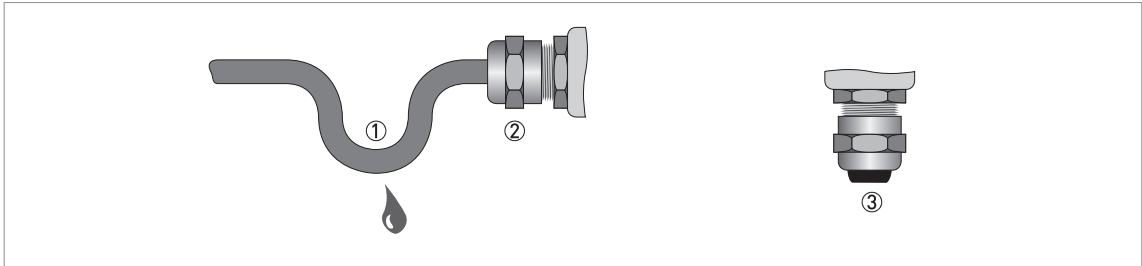


Figure 3-10: How to make the installation agree with protection category IP67



- 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	Approval	Min. / Max. diameter of the electrical cable	
		[mm]	[inches]
Power supply / output	non-Ex / Ex i	6...7.5	0.24...0.3
Power supply / output	Exd	6...10	0.24...0.39
Signal cable (for the remote version) ①	non-Ex / Ex i / Ex d	6...10	0.24...0.39

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

3.6 Networks

3.6.1 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 "Network configuration" in the handbook.

3.6.2 Point-to-point connection

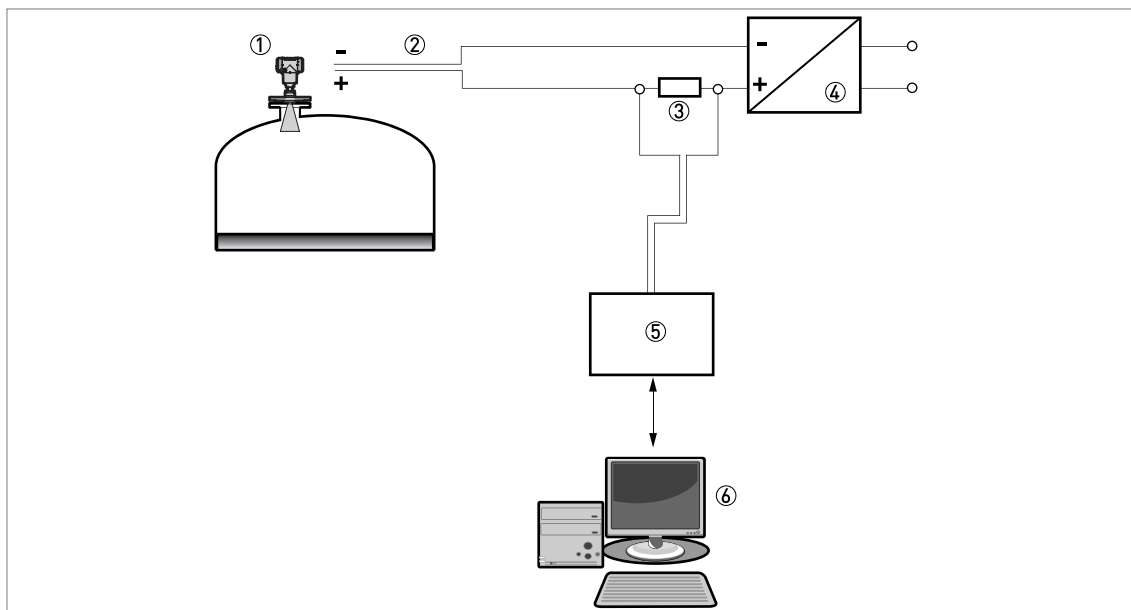


Figure 3-11: Point-to-point connection (non-Ex)

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

3.6.3 Multi-drop networks

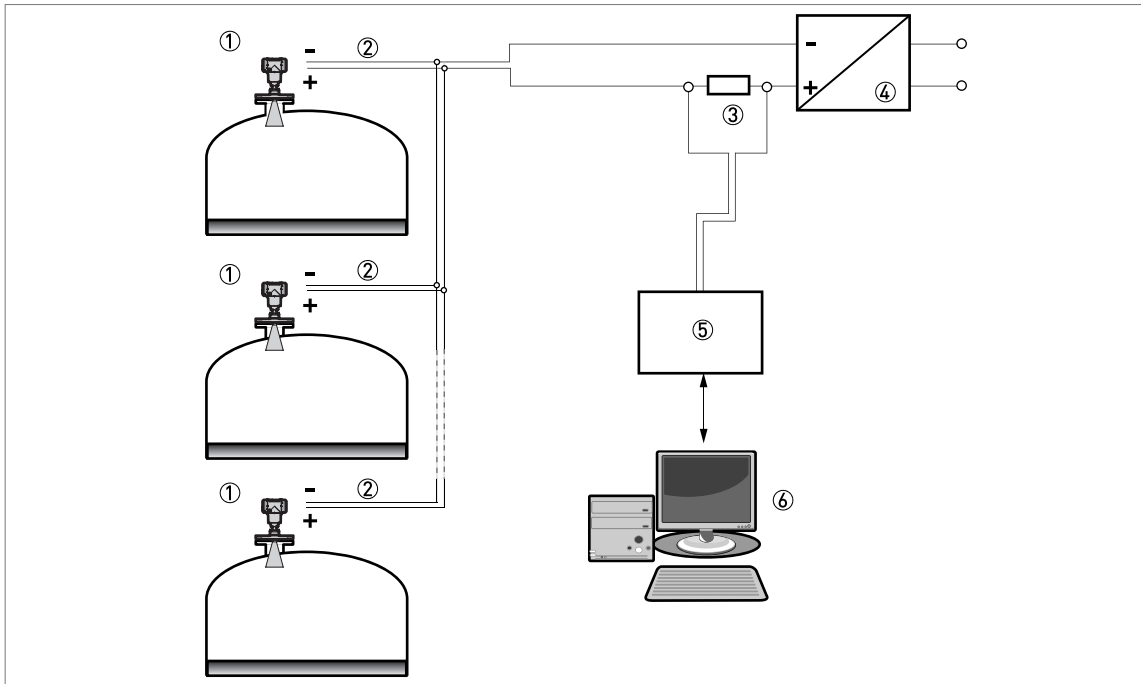


Figure 3-12: Multi-drop network (non-Ex)

- ① Address of the device (each device must have a different address in multidrop networks)
- ② 4 mA + HART®
- ③ Resistor for HART® communication
- ④ Power supply
- ⑤ HART® converter
- ⑥ HART® communication software

3.6.4 Fieldbus networks

For more data, refer to the supplementary instructions for FOUNDATION™ fieldbus and PROFIBUS PA.

FOUNDATION™ fieldbus network (non-Ex)

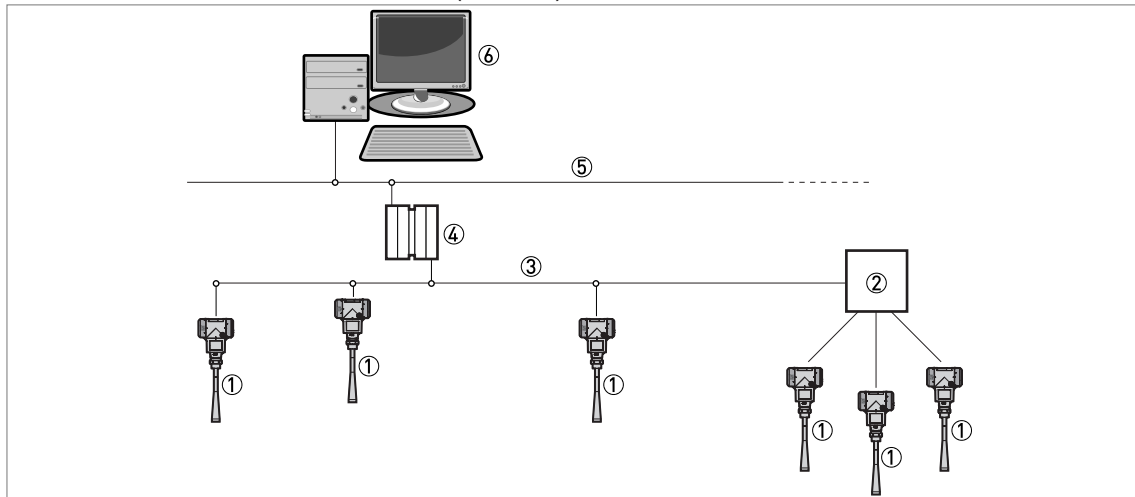


Figure 3-13: FOUNDATION™ fieldbus network (non-Ex)

- ① Field device
- ② Junction box
- ③ H1 network
- ④ H1/HSE converter
- ⑤ High Speed Ethernet (HSE)
- ⑥ Workstation

PROFIBUS PA/DP network (non-Ex)

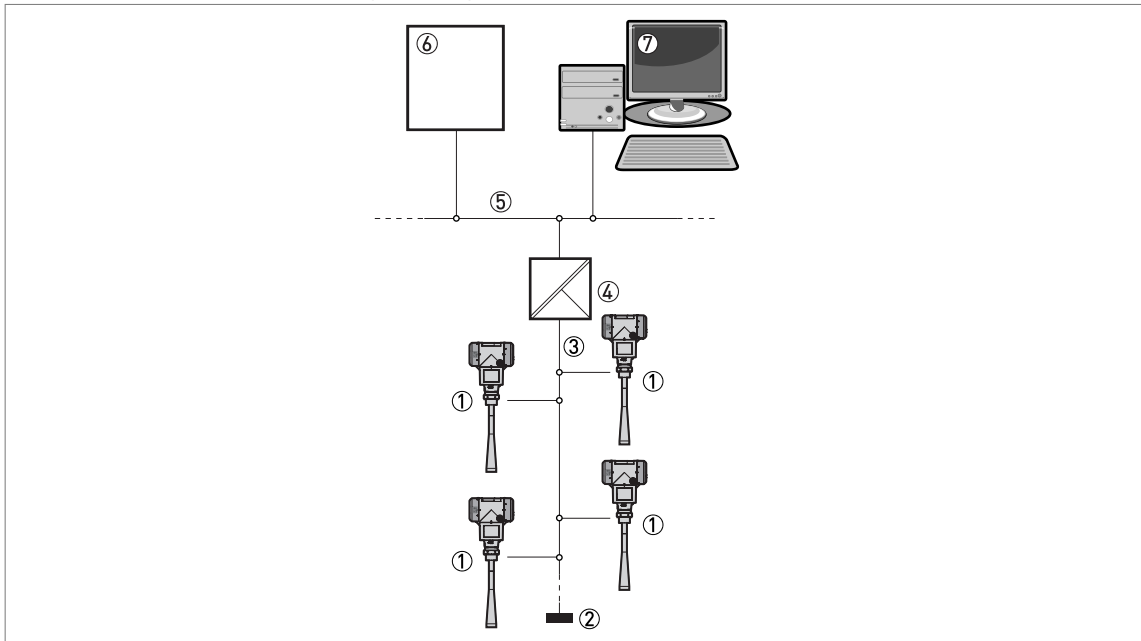


Figure 3-14: PROFIBUS PA/DP network (non-Ex)

- ① Field device
- ② Bus termination
- ③ PROFIBUS PA bus segment
- ④ Segment coupler (PA/DP link)
- ⑤ PROFIBUS DP bus line
- ⑥ Control system (PLC / Class 1 master device)
- ⑦ Engineering or operator workstation (Control tool / Class 2 master device)

4 Operation

4.1 General notes

For more data about device configuration, refer to the handbook.

4.2 Digital display screen

4.2.1 Local display screen layout

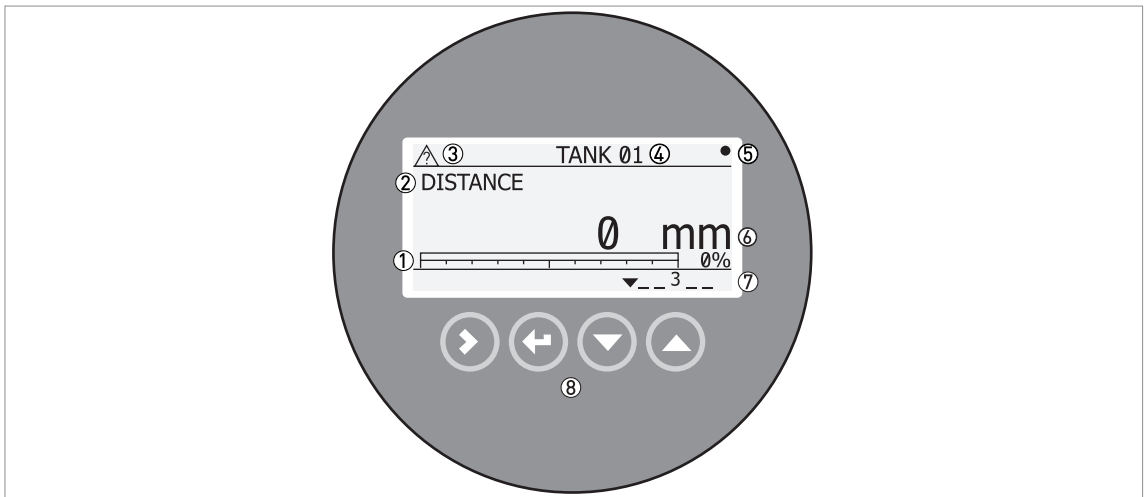


Figure 4-1: Local display screen layout in Normal mode

- 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)

4.2.2 Functions of keypad buttons

Keypad button	Function
[Right]	Normal mode: Enter Information 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, reflection) ① Configuration mode: Decrease value or change parameter
[Up]	Normal mode: Change measurement type (distance, level , output (%), output (mA), conversion, ullage conversion, reflection) 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 the **Operation** section in the Handbook.

4.3 Quick Setup (Parameters)

Use this procedure to change the tank height, tank type, output function, output range and give the top and bottom measuring limits. 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:

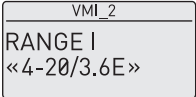
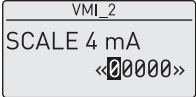
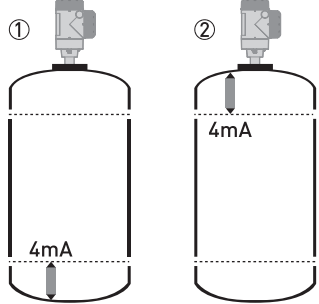
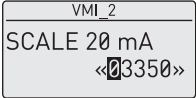
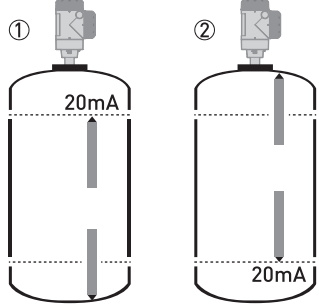
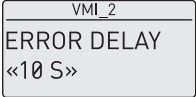

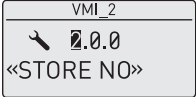


CAUTION!

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
	<ul style="list-style-type: none"> [>], [▲] and [>]. 	Default screen. Enter configuration mode (2.0.0 SUPERVISOR).
	<ul style="list-style-type: none"> [>], [←], [▼], [▲], [>] and [←]. 	Enter the password (the default password is shown). If it is necessary to change the password, refer to the handbook.
	<ul style="list-style-type: none"> 2 × [>] 	Push this button to start the quick set-up procedure.
	<ul style="list-style-type: none"> [>] to change the tank height (H). [>] to change the position of the cursor. [▼] to decrease the value or [▲] to increase the value. [←] to confirm. 	The distance from the flange face / thread stop of the tank connection down to the tank bottom. If the tank has a dish-shaped or conical bottom, the tank height is measured to a point on the tank bottom directly below the antenna.
	<ul style="list-style-type: none"> [▲] or [▼] for the selection of the conditions in which the device is used (Storage, Process, Agitator). [←] to confirm. 	If the surface of the product is flat, select "Storage". If the surface of the product is disturbed, select "Process". If the surface of the product is agitated with vortexes and foam, select "Agitator".
	<ul style="list-style-type: none"> [▲] or [▼] for the selection of the measurement name (Distance, Level, Conversion, Ullage Conv. or Reflection). [←] 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 the handbook.

Screen	Steps	Description
	<ul style="list-style-type: none"> [▲] 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. 	
	<ul style="list-style-type: none"> [>] to change Scale 4 mA. [>] to change the position of the cursor. [▼] to decrease the value or [▲] to increase the value. [←] to confirm. 	<p>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.</p> 
	<ul style="list-style-type: none"> [>] to change Scale 20 mA. [>] to change the position of the cursor. [▼] to decrease the value or [▲] to increase the value. [←] to confirm. 	<p>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.</p> 
	<ul style="list-style-type: none"> [▲] 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. 	<p>The time after which the current output changes to an error value. The error value shows that there is a measurement error.</p>
	<ul style="list-style-type: none"> [>] to change the tag name. [>] to change the position of the cursor. [▼] to decrease the alphanumeric value (A, B, ..., 1, 2, ...) or [▲] to increase the alphanumeric value. [←] to confirm. 	<p>The device has an identification code (tag name). The supervisor can enter a maximum of 8 numbers or letters.</p>
	<ul style="list-style-type: none"> 2 x [←] to confirm. [▲] or [▼] for the selection of the save option (STORE NO or STORE YES). [←] to confirm. 	<p>Set to STORE YES to save and use the data. Set to STORE NO to cancel the changes to the device settings.</p>

4.4 Empty spectrum recording

The empty spectrum recording procedure is important for the performance of the device. We recommend 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 EMP.SPEC.REC.) if there are fixed and moving objects in the tank 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 (empty spectrum).

When the empty spectrum filter is on (when menu item 2.3.12 EMP.SPEC.EN. is set to "on"), it will ignore the parasitic signals. Because the device records the data from the procedure, it is also not necessary to do the procedure again if you de-energize the device.



CAUTION!

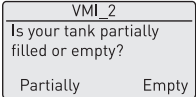

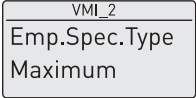


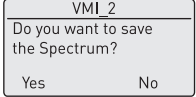
Make sure that the tank is empty or only filled to the minimum level.

Before you do the empty spectrum recording procedure, install the device on the tank. For more data about how to install the device, refer to the handbook.

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
	<ul style="list-style-type: none"> [>], [▲] and [>]. 	Default screen. Enter configuration mode (2.0.0 SUPERVISOR).
	<ul style="list-style-type: none"> [>], [←], [▼], [▲], [>] and [←]. 	Enter the password (the default password is shown). If it is necessary to change the password, refer to the handbook.
	<ul style="list-style-type: none"> [>], [▲] and [>] 	Push these buttons to start the empty spectrum recording procedure.
	<ul style="list-style-type: none"> [>] for the selection of YES or [▲] for the selection of NO. 	Have you completely filled the tank? If the tank is full, it is not possible to complete this procedure. The tank must be partially filled or empty. Push [>] to go back to the start of the empty spectrum recording procedure.
	<ul style="list-style-type: none"> Push [>] after you start equipment in the tank with parts that move. 	Please activate moving parts! If you installed the device on a tank that has equipment with parts that move (e.g. agitators), start the equipment. CAUTION! Make sure that you start all of the equipment in the tank with parts that move, before you continue to the subsequent step.

Screen	Steps	Description
	<ul style="list-style-type: none"> [>] for the selection of "Partially filled" or [▲] for the selection of "Empty". 	<p>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 subsequent step.</p>
	<ul style="list-style-type: none"> [>] to change the measuring distance. [>] to change the position of the cursor. [▼] to decrease the value or [▲] to increase the value. [←] to confirm. 	<p>Measuring Distance If the tank is partially filled, type in a distance shorter than that between the flange and the tank contents.</p>
	<ul style="list-style-type: none"> [▼] or [▲] to change the parameter ("Maximum" or "Average"). [←] to confirm. 	<p>Type of empty spectrum Use the average value for tanks which contain fixed objects only. Use the maximum value for tanks which contain many objects or moving objects.</p>
		<p>Recording in progress Reading in progress 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.</p>
	<ul style="list-style-type: none"> Push [>] to make a selection from the available spectra. [←] to confirm. 	<p>This shows a set of spectra (signals found in the tank). It also gives the amplitude and location of each signal.</p>
	<ul style="list-style-type: none"> [>] to set to "Yes". [▲] to set to "No". 	<p>Do you want to save the spectrum? Set to "Yes" to use the data. Set to "No" to erase the data.</p>

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