



## OPTIFLEX 1300 C Technical Datasheet

### Guided Radar (TDR) Level Meter

- Universal device that can measure level of liquids, pastes, granulates, powders, and liquid interface
- Easy to install: onsite calibration is not needed
- Operates up to 300 bar / 4350 psi



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## 1.1 The superior TDR solution

This device is a Guided Radar (TDR) Level Meter for measuring distance, level, interface, level and interface, volume and mass. It has higher signal dynamics and a sharper pulse than conventional TDR devices and therefore better reproducibility and accuracy. A variant with a remote converter can be mounted up to 14.5 m / 47.6 ft from the probe. The device can operate at very low and very high process temperatures as long as the process connection temperature limits are observed.



- ① Touch screen with 4-button operation
- ② 2-wire level meter
- ③ Converter is rotatable and removable under process conditions
- ④ 5 different types of probes suitable for a wide range of media
- ⑤ Optional ESD protection (30 kV) or Metaglas® dual process sealing system for dangerous products
- ⑥ Same converter for Ex and non-Ex
- ⑦ Large graphical display

### Highlights

- Displays level and interface
- PACTware and DTMs included as standard
- Optional FOUNDATION™ Fieldbus and PROFIBUS PA outputs
- Optional second current output - used for displaying interface measurements, for example
- High-pressure and high-temperature versions
- Optimal process safety (with Metaglas® dual process sealing system for dangerous products)
- Display in 9 languages: even in Chinese, Japanese and Russian
- Available in stainless steel and Hastelloy® C-22. Other materials are available on request: monel, tantalum, titanium, duplex, ...
- Angled single cable and rod probes are available on request for installation in tanks which contain obstructions

### Industries

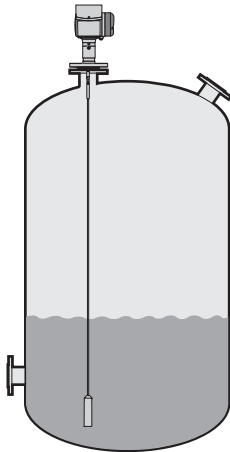
- Chemicals & Petrochemicals
- Oil & Gas
- Minerals & Mining
- Wastewater
- Pulp & Paper
- Food & Beverages
- Pharmaceutical
- Energy

### Applications

- Blending tanks
- Distillation tanks
- Process tanks
- Separator
- Solid silos (inventory)
- Storage tanks

## 1.2 Applications

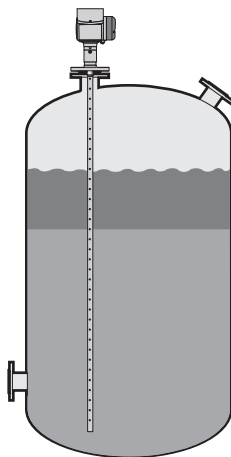
### 1. Level measurement of liquids



The level meter can measure the level of a wide range of liquid products on a large variety of installations within the stated pressure and temperature range, including LPG and LNG. It does not require calibration or commissioning when installed. A Metaglas® option is also available for dangerous products and ensures that no leakage is possible.

A number of probe end attachments are available. For example, the user can fix the end of cable probes to heating coils: the heat prevents deposits building up on the probe.

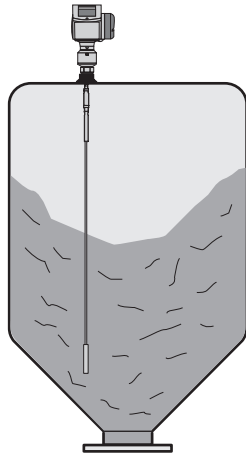
### 2. Interface measurement of liquids



The level meter can measure interface with or without an air gap. It can also measure level and interface simultaneously. It has an optional second analogue output.

The coaxial probe of the level meter has a top dead zone of only 10 mm / 0.4": this makes it ideal for tracking full tank or ballast interface.

### 3. Level measurement of solids

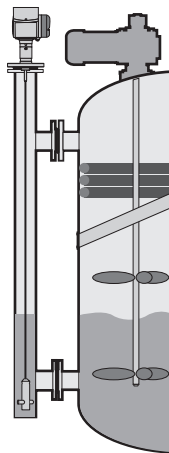


The level meter has a strengthened  $\varnothing 8$  mm / 0.3" single cable probe for measuring powders and granulates in silos up to 35 m / 115 ft high.

The  $\varnothing 4$  mm / 0.15" single cable probe is used for small silos. An ESD protection (30 kV) option is also available.

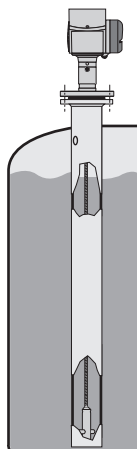
If a product has a very low dielectric constant ( $\epsilon_r < 1.6$ ), the level meter automatically switches to TBF (Tank Bottom Following) mode and keeps operating.

### 4. Measurement of liquids in a bypass chamber



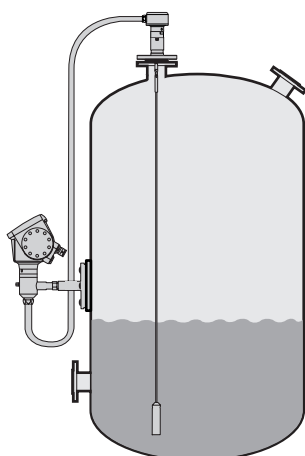
The level meter can measure accurately in agitated conditions and in the presence of foam. If the tank is full of obstructions such as agitators and reinforcements, we recommend installing the level meter in a bypass chamber. This solution is available from KROHNE under the name BM 26 F. Please refer to the BM 26 F documentation for further information.

## 5. Measurement of liquids in a still well



You can also install the level meter in a still well if there are vortices, agitators or other obstructions in the tank. It is also suitable for tanks with floating roofs. The level meter's setup wizard allows you to quickly configure your device to suit specific types of installations and get the best possible performance from it.

## 6. Remote display on high or inaccessible tanks



If it is difficult or impossible to read the level meter's integrated display at the top of the tank, we recommend the remote display variant. It is provided with a cable up to 14.5 m / 47.6 ft long and a bracket for mounting in an accessible position. If there is vibration in the installation, we also recommend that you attach the remote converter to a wall or another safe object that is not attached to the installation.

## 1.3 Measuring principle

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

The device transmits low-intensity electromagnetic pulses of approximately half a 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 with an intensity that depends on the dielectric constant,  $\epsilon_r$ , of the product (for example, water has a high dielectric constant and reflects the pulse back to the meter converter at 80% of its original intensity).

The device measures the time from when the pulse is transmitted to when it is received: half of this time is equivalent to the distance from the reference point of the device (the flange facing) to the surface of the product. The time value is converted into an output current of 4...20 mA and/or a digital signal.



Dust, foam, vapor, agitated surfaces, boiling surfaces, changes in pressure, changes in temperature 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.

### Level measurement principle (direct measurement)

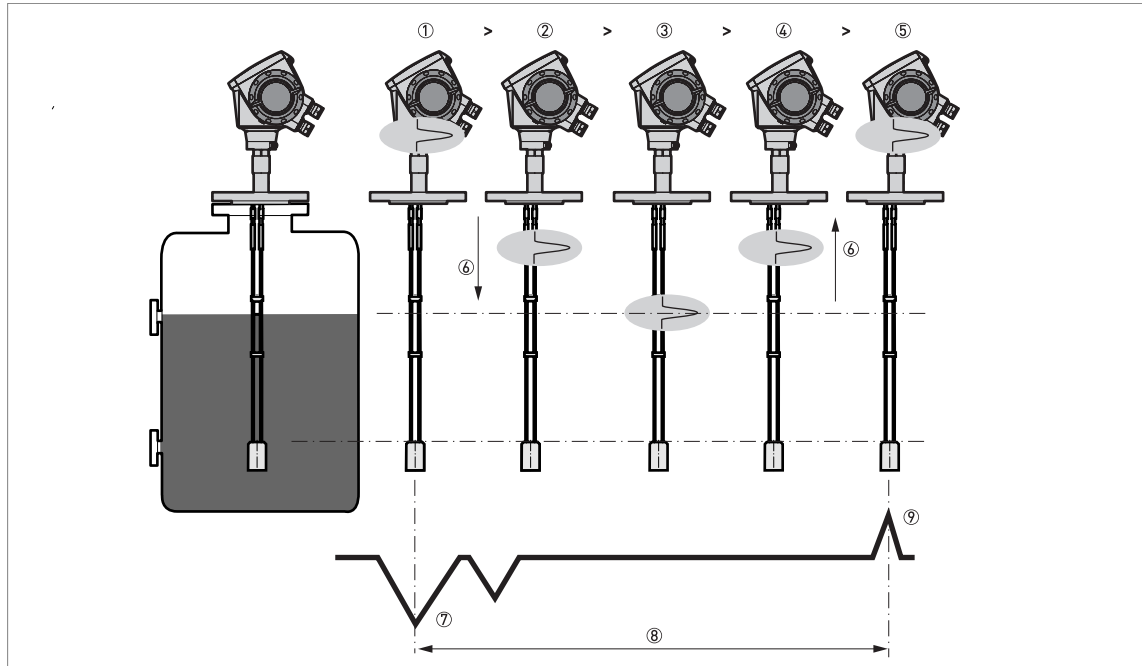


Figure 1-1: Level measurement principle

- ① Time 0: The electromagnetic (EM) pulse is transmitted by the converter
- ② Time 1: The pulse goes down the probe at the speed of light in air,  $V1$
- ③ Time 2: The pulse is reflected
- ④ Time 3: The pulse goes up the probe at speed,  $V1$
- ⑤ Time 4: The converter receives the pulse and records the signal
- ⑥ The EM pulse moves at speed,  $V1$
- ⑦ Transmitted EM pulse
- ⑧ Half of this time is equivalent to the distance from the reference point of the device (the flange facing) to the surface of the product
- ⑨ Received EM pulse

The illustration that follows shows a snapshot of what a user would see on an oscilloscope, if the level and/or interface of products are measured.

**Interface measurement:** *The dielectric constant of the top liquid must be less than the dielectric constant of the bottom liquid. If not, or if there is too small a difference, the device may not measure correctly.*

## Level and interface measurement principle (direct measurement)

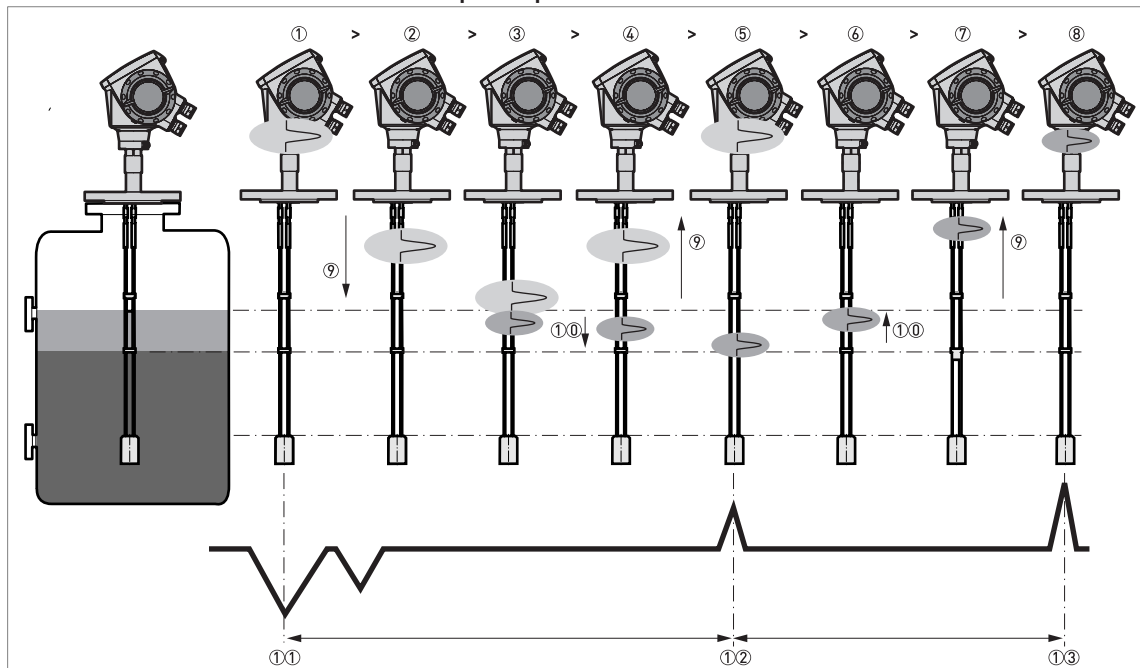


Figure 1-2: Level and interface measurement principle (2 liquids in the tank)

- ① Time 0: The electromagnetic (EM) pulse is transmitted by the converter
- ② Time 1: The pulse goes down the probe at the speed of light in air,  $V_1$
- ③ Time 2: Part of the pulse is reflected at the surface of the top liquid, the remaining pulse goes down the probe
- ④ Time 3: Part of the pulse goes up the probe at speed,  $V_1$ . The remaining pulse goes down the probe at the speed of light in the top product,  $V_2$
- ⑤ Time 4: The converter receives part of the pulse and records the signal. The remaining pulse is reflected at the interface of the 2 liquids
- ⑥ Time 5: The remaining pulse goes up the probe at speed,  $V_2$
- ⑦ Time 6: The remaining pulse goes up the probe at speed,  $V_1$
- ⑧ Time 7: The converter receives the remaining pulse and records the signal
- ⑨ The EM pulse moves at speed,  $V_1$
- ⑩ The EM pulse moves at speed,  $V_2$
- ①① Transmitted EM pulse
- ①② Received EM pulse (distance to the top liquid)
- ①③ Received EM pulse (distance to the interface of 2 liquids)

If products have a very low dielectric constant ( $\epsilon_r < 1.6$ ), only a small part of the EM pulse is reflected at the surface of the product. Most of the pulse is reflected at the probe end. TBF (tank bottom following) mode is used to measure the distance to the product surface.

TBF mode (indirect measurement) compares:

- The time for the pulse to go to the probe end and go back to the converter when the tank is empty.
- The time for the pulse to go to the probe end and go back to the converter when the tank is full or partially filled.

The level of the product in the tank can be calculated from the time difference.

## 2.1 Technical data

- *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 representative.*
- *Additional information (certificates, special tools, software,...) and complete product documentation can be downloaded free of charge from the website (Download Center).*

### Measuring system

Measuring principle	2-wire loop-powered level transmitter; Time Domain Reflectometry (TDR)
Application range	Level measurement of liquids, pastes, slurries, powders and granulates
Primary measured value	Time between the emitted and received signal
Secondary measured value	Distance, level, volume, mass and/or interface

### Design

Construction	The measurement system consists of a measuring sensor (probe) and a signal converter which is available in a compact or remote version
Options	Integrated LCD display with sun cover (-20...+60°C / -4...+140°F); if the ambient temperature is not in these limits, the display switches off
	2nd current output
	ESD protection (max. 30 kV)
	Metaglas® (dual process sealing system for dangerous products (ammonia, chlorine, ...)) ①
	Remote housing connected to the probe via a flexible conduit Standard lengths: 2 m / 6.6 ft, 4.5 m / 14.8 ft, 9.5 m / 31.2 ft and 14.5 m / 47.6 ft
	<b>Probe end types (not for rod and coaxial probes)</b> Standard: Counterweights (refer to counterweight dimensions in "Technical data: Dimensions and weights".) Options: Turnbuckle, chuck, threaded end, crimped end, open end
Accessories	Weather protection
Max. measuring range	Double rod Ø8 mm / 0.3": 4 m / 13 ft
	Single rod Ø8 mm / 0.3": 4 m / 13 ft
	Single rod Ø8 mm / 0.3" (segmented): 6 m / 20 ft
	Coaxial Ø22 mm / 0.9": 6 m / 20 ft
	Coaxial Ø22 mm / 0.9" (segmented): 6 m / 20 ft
	Double cable Ø4 mm / 0.15": 8 m / 26 ft
	Single cable Ø2 mm / 0.08": 35 m / 115 ft (for liquids only)
	Single cable Ø4 mm / 0.15": 35 m / 115 ft (For liquids only. An angled probe is available on request for installations with very low ceilings or objects in the tank that prevent installation on top of the tank.)
	Single cable Ø8 mm / 0.3": 35 m / 115 ft (For solids only. Tolerance, probe length: -1%/+0%.)
Dead zone	This depends on the type of probe. For more data, refer to <i>Measurement limits</i> on page 19.
<b>Display and User interface</b>	
Display	LCD display
	9 lines, 160×160 pixels in 8-step grayscale with 4-button keypad
Interface languages	English, German, French, Italian, Spanish, Portuguese, Japanese, Chinese (Mandarin) and Russian

## Accuracy

Resolution	1 mm / 0.04"
Repeatability	±1 mm / ±0.04"
Accuracy (in direct mode)	<p><b>Liquids:</b> ±3 mm / ±0.12", when distance &lt; 10 m / 33 ft; ±0.03% of measured distance, when distance &gt; 10 m / 33 ft</p> <p><b>Powders:</b> ±20 mm / ±0.8"</p> <p><b>Interface:</b> ±10 mm / ±0.4" (<math>\epsilon_r</math> constant)</p>
Accuracy (in TBF mode)	±20 mm / ±0.8" ( $\epsilon_r$ constant)
Minimum layer (interface)	50 mm / 2"
<b>Reference conditions acc. to EN 60770</b>	
Temperature	+20°C ±5°C / +68°F ±10°F
Pressure	1013 mbara ±20 mbar / 14.69 psia ±0.29 psi
Relative air humidity	60% ±15%

## Operating conditions

<b>Temperature</b>	
Ambient temperature	-40...+80°C / -40...+175°F (Ex: see supplementary operating instructions or approval certificates)
Storage temperature	-40...+85°C / -40...+185°F
Process connection temperature	<p><b>Standard</b> -40...+200°C / -40...+390°F (according to the temperature limits of the gasket material. Refer to "Material" in this table.) (Ex: see supplementary operating instructions or approval certificates) ②</p> <p><b>High-Temperature (HT) and High-Temperature / High-Pressure (HT/HP) versions with FKM/FPM and Kalrez® 6375 gaskets</b> +300°C / +570°F (single cable Ø2 mm / 0.08" probe only) (Ex: see supplementary operating instructions or approval certificates) ②</p> <p><b>HT and HT/HP versions with EPDM gaskets</b> +250°C / +480°F (single cable Ø2 mm / 0.08" probe only) (Ex: see supplementary operating instructions or approval certificates) ②</p>
Thermal shock resistance	100°C/min
<b>Pressure</b>	
Operating pressure	<p><b>Single cable Ø8 mm / 0.3" probe</b> -1...40 barg / -14.5...580 psig subject to process connection temperature and probe type used ②</p> <p><b>High-Pressure (HP) version</b> max. 300 barg / 4350 psig (single cable Ø2 mm / 0.08" probe only) subject to process connection temperature and probe type used ②</p> <p><b>All other probe types</b> -1...100 barg / -14.5...1450 psig subject to process connection temperature and probe type used ②</p>

Other conditions	
Dielectric constant ( $\epsilon_r$ )	<b>Level in direct mode:</b> $\geq 1.4$ for coaxial probe; $\geq 1.6$ for single and double probes
	<b>Interface in direct mode:</b> $\epsilon_r(\text{interface}) \gg \epsilon_r(\text{level})^2$
	<b>Level in TBF mode:</b> $\geq 1.1$
Vibration resistance	IEC 60068-2-6 and EN 50178 (10...57 Hz: 0.075 mm / 57...150 Hz:1g)
Protection category	IP 66/67 equivalent to NEMA 6-6X

### Installation conditions

Process connection size	Refer to "Installation: How to prepare the tank before you install the device" and "Technical data: Measurement limits"
Process connection position	Make sure that there are not any obstructions directly below the process connection for the device.
Dimensions and weights	Refer to "Technical data: Dimensions and weights"

### Material

Housing	Standard: Aluminium
	Option: Stainless steel (1.4404 / 316L)
Single rod (single-piece)	Standard: Stainless steel (1.4404 / 316L)
	Option: Hastelloy <sup>®</sup> C-22 (2.4602) ③
	On request: Stainless steel (1.4404 / 316L) in a PVC, PVDF or PP protective sheath
	On request: Monel; Tantalum; Titanium; Duplex
Single rod (segmented)	Standard: Stainless steel (1.4404 / 316L)
Double rod	Standard: Stainless steel (1.4404 / 316L)
	Option: Hastelloy <sup>®</sup> C-22 (2.4602)
	On request: Monel; Tantalum; Titanium; Duplex
Coaxial (single-piece)	Standard: Stainless steel (1.4404 / 316L)
	Option: Hastelloy <sup>®</sup> C-22 (2.4602)
Coaxial (segmented)	Standard: Stainless steel (1.4404 / 316L)
Single cable	Standard: Stainless steel (1.4401 / 316)
	Option: Hastelloy <sup>®</sup> C-22 (2.4602) - only for the $\varnothing 2$ mm / 0.08" or $\varnothing 4$ mm / 0.15" single cable probes
	On request: FEP-coated stainless steel (-20...+150°C / -4...+300°F) - only for the $\varnothing 4$ mm / 0.15" single cable probe
Double cable	Stainless steel (1.4401 / 316)
Process fitting	Standard: Stainless steel (1.4404 / 316 L)
	Option: Hastelloy <sup>®</sup> C-22 (2.4602)
	On request: Monel; Tantalum; Titanium; Duplex
Gaskets	FKM/FPM (-40...+200°C / -40...+390°F); Kalrez <sup>®</sup> 6375 (-20...+200°C / -4...+390°F); EPDM (-50...+150°C / -58...+300°F) - all probes except single cable $\varnothing 8$ mm / 0.3" ④
Weather protection (Option)	Stainless steel (1.4301 / 304)
Protective sheath (On request for single rod only)	PP (-40...+90°C / -40...+194°F); PVC (-15...+80°C / +5...+176°F); PVDF (-40...+150°C / -40...+300°F)
Conduit for remote housing (Option)	Zinc-coated steel in a PVC sheath (-40...+105°C / -40...+220°F)

## Process connections

Thread	
Single cable Ø2 mm / 0.08"	G ½; ½ NPT; ½ NPTF (for the HT/HP version)
Single cable Ø8 mm / 0.3"	G 1½; 1½ NPT
All other probes	G ¾...1½; ¾...1½ NPT
Flange versions for single cable Ø8 mm / 0.3", double rod and double cable probes	
EN	DN40...150 in PN16, PN40, PN63 or PN100; others on request
ASME	1½"...8" in 150 lb, 1½"...6" in 300 lb, 1½"...4" in 600 lb or 900 lb; 1½"...2" in 1500 lb; others on request
JIS	40...100A in 10K; others on request
Flange versions for single cable Ø2 mm / 0.08" probe	
EN	DN25...150 in PN16, PN40, PN63 or PN100; others on request
ASME	1"...8" in 150 lb, 1½"...6" in 300 lb, 1"...4" in 600 lb or 900 lb, 1"...2" in 1500 lb, 1" in 2500 lb; others on request
JIS	40...100A in 10K; others on request
Flange versions for all other probes	
EN	DN25...150 in PN16, PN40, PN63 or PN100; others on request
ASME	1"...8" in 150 lb, 1½"...6" in 300 lb, 1"...4" in 600 lb or 900 lb, 1"...2" in 1500 lb; others on request
JIS	40...100A in 10K; others on request
Other options for single and double rod probes	
SMS	Available on request
Tri-clamp	Available on request
Others	Others on request

## Electrical connections

Power supply	<b>Terminals output 1 - Non-Ex / Ex i:</b> 14...30 VDC; min./max. value for an output of 22 mA at the terminal
	<b>Terminals output 1 - Ex d:</b> 20...36 VDC; min./max. value for an output of 22 mA at the terminal
	<b>Terminals output 2 - Non-Ex / Ex i / Ex d:</b> 10...30 VDC; min./max. value for an output of 22 mA at the terminal (additional power supply needed - output only)
Cable entry	M20×1.5; ½ NPT
	G ½ (not for FM- and CSA-approved devices. Not for stainless steel housings.)
	M25×1.5 (for stainless steel housings only)
Cable gland	Standard: none
	Options: M20×1.5 (for non-Ex and Ex-approved devices with M20×1.5 and M25×1.5 cable entries); others are available on request
Cable entry capacity (terminal)	0.5...1.5 mm <sup>2</sup>

## Input and output

Current output	
Output signal (Output 1)	4...20 mA HART® or 3.8...20.5 mA acc. to NAMUR NE 43 ⑤
Output signal (Output 2 - optional)	4...20 mA (no HART® signal) or 3.8...20.5 mA acc. to NAMUR NE 43 (optional)

Resolution	±3 µA
Temperature drift	Typically 50 ppm/K
Error signal	High: 22 mA; Low: 3.6 mA acc. to NAMUR NE 43
<b>PROFIBUS PA</b>	
Type	4-wire (+ local HART) level transmitter; Time Domain Reflectometry (TDR)
Function blocks	11 (level, distance, interface level, interface distance, layer, interface conversion, ullage conversion, layer conversion, level conversion, level mass and distance mass)
Protocol / Communication standard	PROFIBUS PA protocol that agrees with IEC 61158-2, galvanically isolated
Physical layer types	Standard power signaling, bus powered, non I.S.
Other features	Bus interface with integrated reverse polarity protection
Device power supply (24 V input)	18...30 VDC
Current consumption on PROFIBUS network	20 mA
Output data	Level, distance, interface level, interface distance, layer, interface conversion, ullage conversion, layer conversion, level conversion, level mass and distance mass
Input data	None
Error current FDE	Typically 0 mA (FDE =Fault Disconnection Electronic)
Address range	0...125. Default address: 126.
<b>FOUNDATION Fieldbus</b>	
Type	4-wire (+ local HART) level transmitter; Time Domain Reflectometry (TDR)
Function blocks	1 × Resource Block (RB), 4 × Analog Input Blocks (AI), 1 × Transducer Block (TB) Analog Input Block: 50 ms
Protocol / Communication standard	Foundation Fieldbus protocol that agrees with IEC 61158-2, galvanically isolated
ITK version	5.1
Physical layer types	Standard power signaling, bus powered, non I.S.
Other features	Bus interface with integrated reverse polarity protection
Device power supply (24 V input)	18...30 VDC
Bus power supply	9...32 VDC (non-Ex); 9...17.5 VDC (intrinsically-safe)
Basic current	20 mA
Maximum error current	20 mA
Start current after 10 ms	20 mA
Polar sensitivity	Yes
Minimum cycle time	100 ms
Output data	Level, distance, level conversion, interface level, interface distance, layer, interface conversion, ullage conversion, layer conversion, level conversion, level mass or distance mass
Input data	None
Error current FDE	Typically 0 mA (FDE =Fault Disconnection Electronic)
Link Master function	Not supported

## Approvals and certification

CE	This device fulfills the statutory requirements of the EC directives. The manufacturer certifies successful testing of the product by applying the CE mark.
<b>Explosion protection</b>	
ATEX (approval for fieldbus outputs pending)	ATEX II 1 G, 1/2 G, 2 G Ex ia IIC T6...T2;
	ATEX II 1 D, 1/2 D, 2 D Ex iaD 20 or Ex iaD 20/21 IP6X T70°C...T95°C;
	ATEX II 1/2 G, 2 G Ex d[ia] IIC T6...T2 ;
	ATEX II 1/2 D, 2 D Ex tD[iaD] A21/20 IP6X T70°C...T95°C;
	ATEX II 3 G Ex nA IIC T6...T2
IECEx (approval for fieldbus outputs options pending)	Ex ia IIC T6...T3 Ga; Ex iaD 20 IP6X T70°C...T95°C;
	Ex d[ia] IIC T6...T3 Ga/Gb; Ex tD[iaD] A21/20 IP6X T70°C...T95°C
FM - Dual Seal-approved (approval for fieldbus output options pending)	<b>NEC 500</b>
	XP-IS, Cl. I, Div. 1, Gr. ABCD T6...T2;
	DIP, Cl. II/III, Div. 1, Gr. EFG T6...T2;
	IS, Cl. I/II/III, Div. 1, Gr. ABCDEFG T6...T2;
	NI, Cl. I, Div. 2, Gr. ABCD T6...T2
	<b>NEC 505</b>
	Cl. I, Zone 0, AEx d[ia] IIC T6...T2;
	Cl. I, Zone 0, AEx ia IIC T6...T2;
	Cl. I, Zone 2, AEx nA[ia] IIC T6...T2
Hazardous (Classified) Locations, indoor/outdoor Type 4X and 6P, IP66, Dual Seal	
CSA - Dual Seal-approved (approval for Drop antenna, hygienic antenna and fieldbus output options pending)	<b>CEC Section 18 (Zone ratings)</b>
	Cl. I, Zone 1, Ex d, IIC (Probe: Zone 0) T6...T2;
	Cl. I, Zone 0, Ex ia, IIC T6...T2;
	Cl. I, Zone 2, Ex nA, IIC T6...T2
	<b>CEC Section 18 and Annex J (Division ratings)</b>
	XP-IS, Cl. I, Div. 2, Gr. ABCD; Cl. II, Div. 2, Gr. FG; Cl. III, Div. 2 T6...T2;
IS, Cl. I, Div. 1, Gr. ABCD; Cl. II, Gr. FG; Cl. III T6...T2	
NEPSI	Ex dia IIC T2~T6; Ex ia IIC T2~T6
CEPEL / INMETRO	BR-Ex ia IIC T2...T6; BR-Ex d[ia] IIC T2...T6
<b>Other standards and approvals</b>	
EMC	Electromagnetic Compatibility Directive 2004/108/EC in conjunction with EN 61326-1 (2006) and EN 61326-2-3 (2006). 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.
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
WHG (pending)	In conformity with the German Federal Water Act, §9
Construction code	On request: NACE MR0175 / ISO 15156

① Metaglas® is a registered trademark of Herberts Industrieglas, GMBH & Co., KG

② Refer to the Pressure/Temperature table for probe selection

③ Hastelloy® is a registered trademark of Haynes International, Inc.

④ Kalrez® is a registered trademark of DuPont Performance Elastomers L.L.C.

⑤ HART® is a registered trademark of the HART Communication Foundation



## 2.2 Application table for probe selection

	Double rod	Single rod	Single rod (segmented)	Coaxial	Coaxial (segmented)	Double cable	Single cable Ø8 mm / 0.3"	Single cable Ø4 mm / 0.15"	Single cable Ø2 mm / 0.08"
--	------------	------------	------------------------	---------	---------------------	--------------	---------------------------	----------------------------	----------------------------

### Maximum probe length, L

	Double rod	Single rod	Single rod (segmented)	Coaxial	Coaxial (segmented)	Double cable	Single cable Ø8 mm / 0.3"	Single cable Ø4 mm / 0.15"	Single cable Ø2 mm / 0.08"
4 m / 13 ft	■	■							
6 m / 20 ft			■	■	■				
8 m / 26 ft						■			
35 m / 115 ft							■	■	■

### Liquids

Liquid application	Double rod	Single rod	Single rod (segmented)	Coaxial	Coaxial (segmented)	Double cable	Single cable Ø8 mm / 0.3"	Single cable Ø4 mm / 0.15"	Single cable Ø2 mm / 0.08"
LPG, LNG	■			■	■			①	①
Highly viscous liquids		■	■					■	■
Highly crystallising liquids		■	■					■	■
Highly corrosive liquids	■	■	■	■	■			■	■
Foam		■	■					■	■
Agitated liquids	■	②	②	■	■	②		②	②
High-pressure applications	③	③	③	③	③	③		③	④
High-temperature applications									⑤
Spray in tank		①	①	■				①	①
Storage tanks	■	■	■	■	■			■	■
Installation in bypass chamber	■	■		■		■		■	■
Small diameter nozzles	■			■	■				
Long nozzles	■			■	■				
Stilling wells	■	■	■	■	■			■	■
Interface measurement	■			■	■			⑥	⑥

### Solids

	Double rod	Single rod	Single rod (segmented)	Coaxial	Coaxial (segmented)	Double cable	Single cable Ø8 mm / 0.3"	Single cable Ø4 mm / 0.15"	Single cable Ø2 mm / 0.08"
Powders		■						⑦	
Granules, <5 mm / 0.1"								⑦	

■ standard ■ optional □ on request

- ① Install the device in a stilling well or a bypass chamber
- ② Use this probe with an anchor fitting. For more data, refer to the handbook.
- ③ Max. pressure is 100 bar / 1450 psig. Refer to the pressure-temperature table for probe selection.
- ④ Optional. Max. pressure is 300 bar / 4350 psig. Refer to the pressure-temperature table for probe selection.
- ⑤ Optional. Max. temperature is 300°C / 570°F. Refer to the pressure-temperature table for probe selection.
- ⑥ Max. length is 20 m / 65.5 ft, more on request
- ⑦ Max. length is 10 m / 33 ft, more on request

### 2.3 Pressure/temperature table for probe selection

Make sure that the transmitters are used within their operating limits.

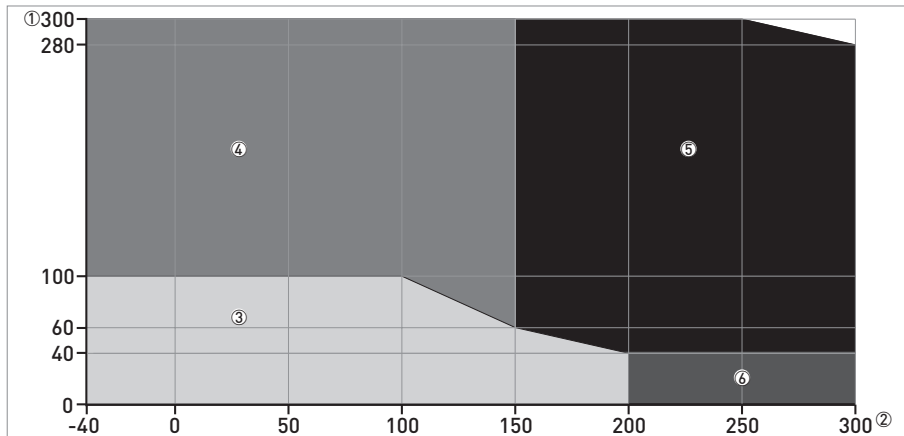


Figure 2-1: Pressure/temperature table for probe selection

- ① Process pressure,  $P_s$  [barg]
- ② Process connection temperature,  $T$  [°C]
- ③ All probes
- ④ High-Pressure (HP) version of the Ø2 mm single cable probe
- ⑤ High-Temperature/High-Pressure (HT/HP) version of the Ø2 mm single cable probe
- ⑥ High-Temperature (HT) version of the Ø2 mm single cable probe

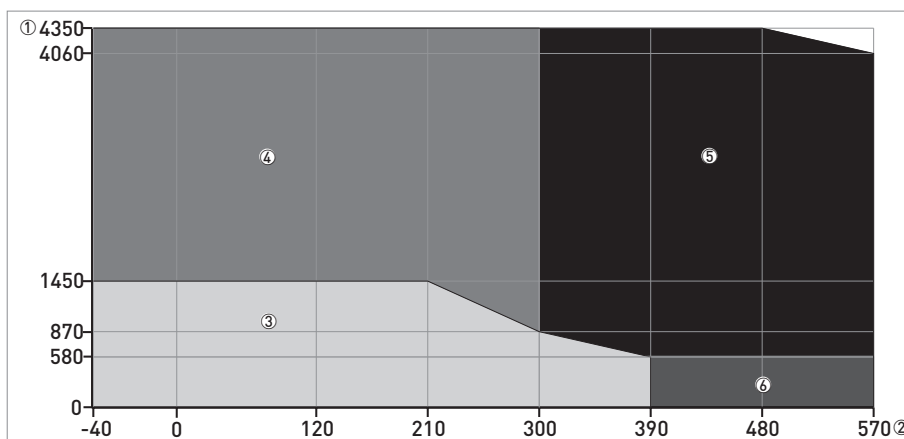


Figure 2-2: Pressure/temperature table for probe selection

- ① Process pressure,  $P_s$  [psig]
- ② Process connection temperature,  $T$  [°F]
- ③ All probes
- ④ High-Pressure (HP) version of the Ø0.08" single cable probe
- ⑤ High-Temperature/High-Pressure (HT/HP) version of the Ø0.08" single cable probe
- ⑥ High-Temperature (HT) version of the Ø0.08" single cable probe

*The minimum and maximum process connection temperature and the minimum and maximum process pressure also depends on the gasket material selected. Refer to "Technical data" on page 11.*

## 2.4 Measurement limits

### Double cable and double rod probes

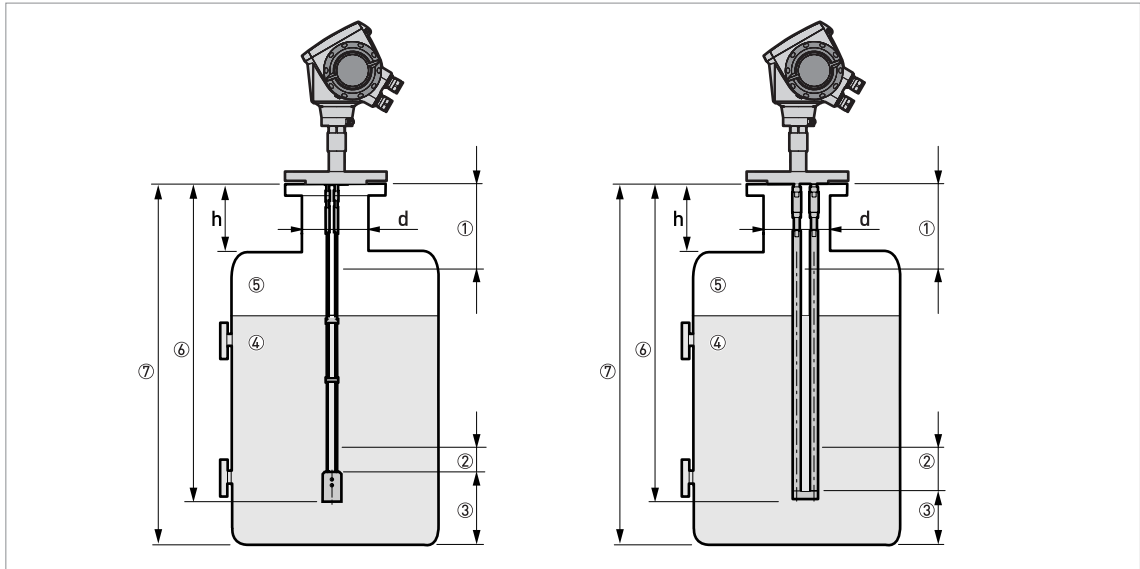


Figure 2-3: Measurement limits of the double cable probes (on the left side) and double rod probes (on the right side)

- ① **A1, Top dead zone:** Distance from the flange to the top limit of the measuring range. Refer to the notes and table that follow.
- ② **A2, Bottom dead zone:** Length at the end of the probe, where measurement is not linear.
- ③ **D, non measurement zone:** Zone where measurement cannot be taken.
- ④ **Product 1**
- ⑤ **Gas (Air)**
- ⑥ **L, Probe length:** Length specified by the customer in the order. This is also the maximum measuring length for some probe types in direct mode and all devices that operate in TBF mode.
- ⑦ **Tank Height**

*h* is the height of the nozzle. *d* is the diameter of the tank nozzle.

- If  $h < d$ , then the top dead zone (A1) is equal to the top dead zone for the probe only. Refer to the table that follows.
- If  $h \geq d$ , then the top dead zone (A1) is equal to the tank nozzle height plus the top dead zone for the probe.

### Measurement limits in mm and inches

Probes	Top dead zone, A1 $\epsilon_r = 80$		Bottom dead zone, A2 $\epsilon_r = 80$		Top dead zone, A1 $\epsilon_r = 2.3$		Bottom dead zone, A2 $\epsilon_r = 2.3$	
	[mm]	[inches]	[mm]	[inches]	[mm]	[inches]	[mm]	[inches]
Double rod Double cable	125	4.9	10	0.4	165	6.5	50	1.95

80 is  $\epsilon_r$  of water; 2.3 is  $\epsilon_r$  of oil

Single cable and single rod probes

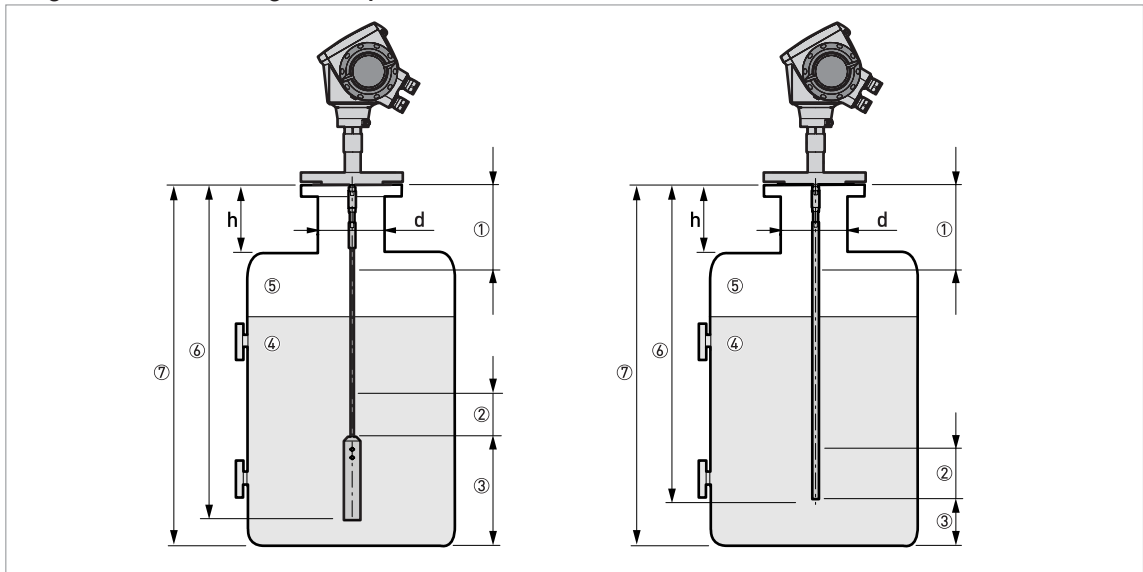


Figure 2-4: Measurement limits of the single cable probes (on the left side) and single rod probes (on the right side)

- ① **A1, Top dead zone:** Distance from the flange to the top limit of the measuring range. Refer to the notes and table that follow.
- ② **A2, Bottom dead zone:** Length at the end of the probe, where measurement is not linear.
- ③ **D, non measurement zone:** Zone where measurement cannot be taken.
- ④ **Product 1**
- ⑤ **Gas (Air)**
- ⑥ **L, Probe length:** Length specified by the customer in the order. This is also the maximum measuring length for some probe types in direct mode and all devices that operate in TBF mode.
- ⑦ **Tank Height**

*h* is the height of the nozzle. *d* is the diameter of the tank nozzle.

- If  $h < d$ , then the top dead zone (A1) is equal to the top dead zone for the probe only. Refer to the table that follows.
- If  $h \geq d$ , then the top dead zone (A1) is equal to the tank nozzle height plus the top dead zone for the probe.

Measurement limits in mm and inches

Probes	Top dead zone, A1 $\epsilon_r = 80$		Bottom dead zone, A2 $\epsilon_r = 80$		Top dead zone, A1 $\epsilon_r = 2.3$		Bottom dead zone, A2 $\epsilon_r = 2.3$	
	[mm]	[inches]	[mm]	[inches]	[mm]	[inches]	[mm]	[inches]
Single rod Single cable	200	7.9	10	0.4	250	9.9	50	1.95

## Coaxial probe

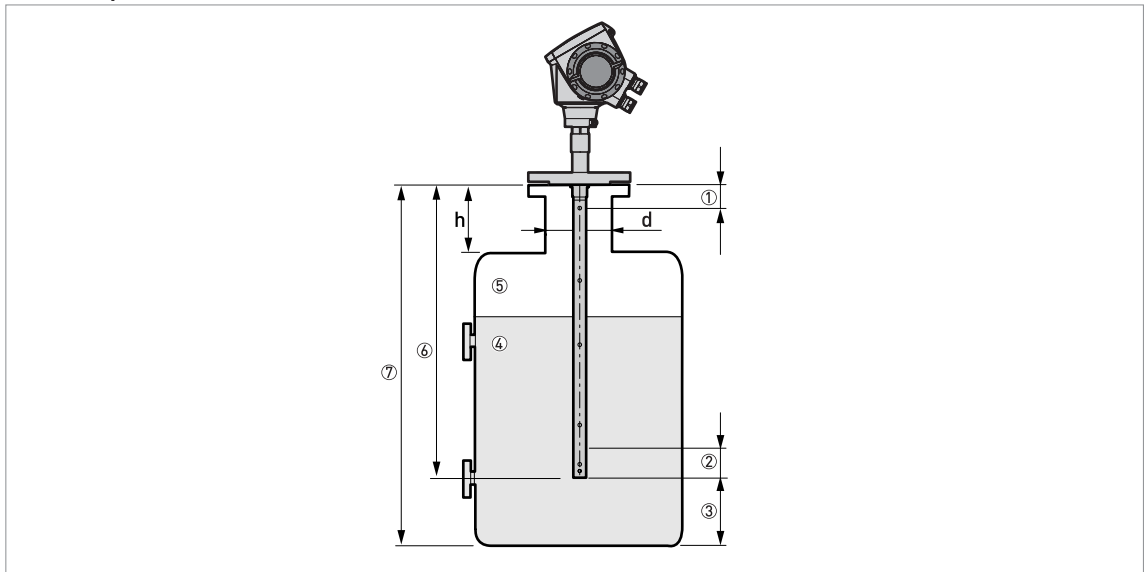


Figure 2-5: Measurement limits of the coaxial probe

- ① **A1, Top dead zone:** Distance from the flange to the top limit of the measuring range. Refer to the notes and table that follow.
- ② **A2, Bottom dead zone:** Length at the end of the probe, where measurement is not linear.
- ③ **D, non measurement zone:** Zone where measurement cannot be taken.
- ④ **Product 1**
- ⑤ **Gas (Air)**
- ⑥ **L, Probe length:** Length specified by the customer in the order. This is also the maximum measuring length for some probe types in direct mode and all devices that operate in TBF mode.
- ⑦ **Tank Height**

*h* is the height of the nozzle. *d* is the diameter of the tank nozzle.

*The dimensions of the tank nozzle have no effect on the top dead zone of the coaxial probe.*

## Measurement limits in mm and inches

Probes	Top dead zone, A1 $\epsilon_r = 80$		Bottom dead zone, A2 $\epsilon_r = 80$		Top dead zone, A1 $\epsilon_r = 2.3$		Bottom dead zone, A2 $\epsilon_r = 2.3$	
	[mm]	[inches]	[mm]	[inches]	[mm]	[inches]	[mm]	[inches]
Coaxial	10	0.4	10	0.4	10	0.4	50	1.95

## 2.5 Dimensions and weights

## Standard converter

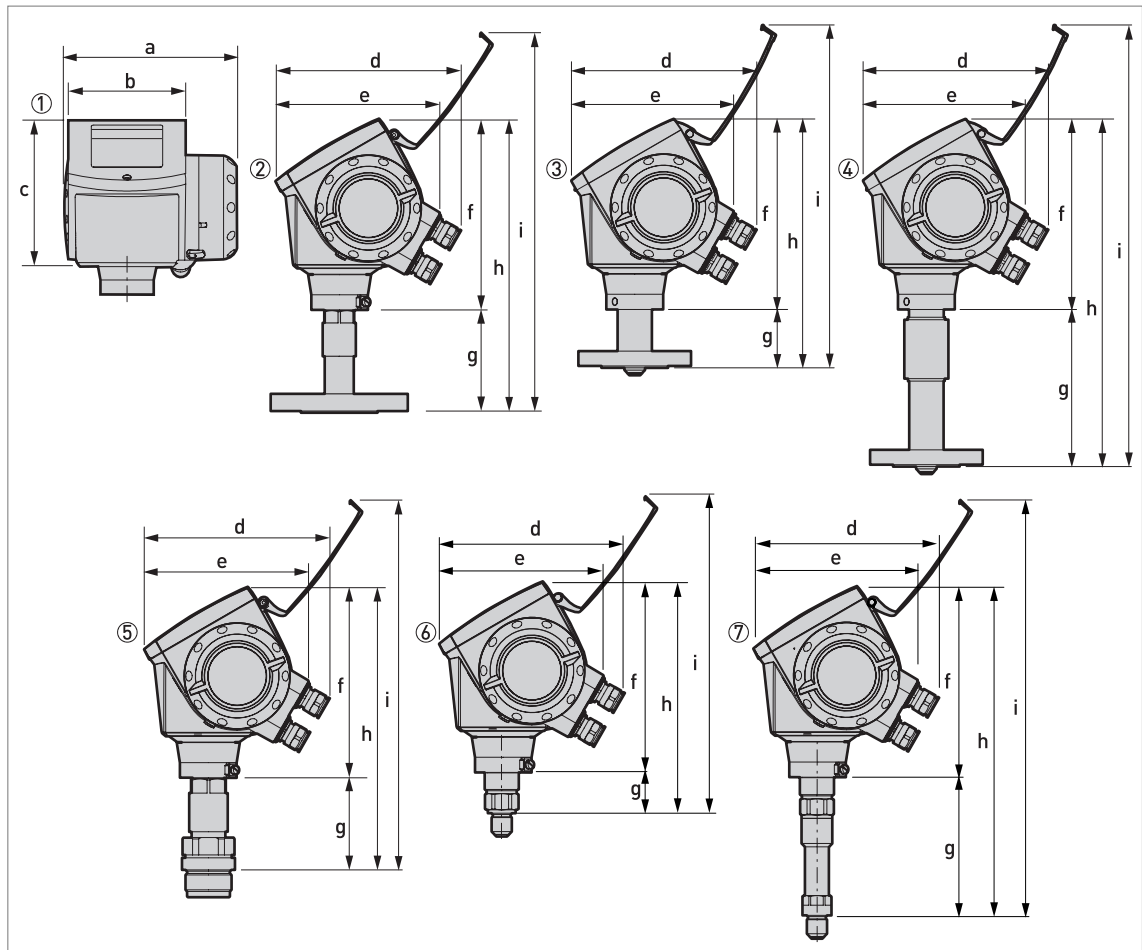


Figure 2-6: Standard converter

- ① Converter (front view)
- ② Flange version for all probes except the  $\varnothing 2$  mm / 0.08" single cable probe (right side)
- ③ Flange version for  $\varnothing 2$  mm / 0.08" single cable probe - High-Pressure (HP) version (right side)
- ④ Flange version for  $\varnothing 2$  mm / 0.08" single cable probe - High-Temperature (HT) and High-Temperature/High-Pressure (HT/HP) versions (right side)
- ⑤ Thread version for all probes except the  $\varnothing 2$  mm / 0.08" single cable probe (right side)
- ⑥ Thread version for  $\varnothing 2$  mm / 0.08" single cable probe - High-Pressure (HP) version (right side)
- ⑦ Thread version for  $\varnothing 2$  mm / 0.08" single cable probe - High-Temperature (HT) and High-Temperature/High-Pressure (HT/HP) versions (right side)

- Cable glands are delivered on demand with non-Ex, Ex i- and Ex d-approved devices.
- Non-Ex and Ex i fittings are plastic and Ex d fittings are metallic. Non-Ex fittings are black and Ex i fittings are blue.
- The diameter of the outer sheath of the cable must be 6...12 mm or 0.2...0.5".
- Cable glands for FM- or CSA-approved devices must be supplied by the customer.

## Dimensions and weights in mm and kg

	Dimensions [mm]									Weights [kg]
	a	b	c	d	e	f	g	h	i	
Converter	180	122	158.5	182 ①	170	197	-	-	-	3.3
Flange, single cable Ø2 - version HT or HT/HP	180	122	158.5	182 ①	170	197	59	357 ②	450 ②	6...15
Flange, single cable Ø2 - version HP	180	122	158.5	182 ①	170	197	160	256 ②	349 ②	5...14
Flange, all other probes	180	122	158.5	182 ①	170	197	123	320 ②	357 ②	4...12
Thread, single cable Ø2 - version HT or HT/HP	180	180	158.5	182 ①	170	197	144	341 ②	378 ②	4.5
Thread, single cable Ø2 - version HP	180	180	158.5	182 ①	170	197	43	240 ②	277 ②	4
Thread, all other probes	180	122	158.5	182 ①	170	197	95	292 ②	329 ②	3

① This dimension is subject to the size of the cable gland used

② With 30 kV ESD protection option: add 99 mm to this dimension. With Metaglas® option: add 43 mm to this dimension.

## Dimensions and weights in inches and lb

	Dimensions [inches]									Weights [lb]
	a	b	c	d	e	f	g	h	i	
Converter	7.1	4.8	6.2	7.2 ①	6.7	7.8	-	-	-	7.3
Flange, single cable Ø0.08 - version HT or HT/HP	7.1	4.8	6.2	7.2 ①	6.7	7.8	2.3	14 ②	17.7 ②	13.2...33.1
Flange, single cable Ø0.08 - version HP	7.1	4.8	6.2	7.2 ①	6.7	7.8	6.3	10.1 ②	13.7 ②	11...30.9
Flange, all other probes	7.1	4.8	6.2	7.2 ①	6.7	7.8	4.8	12.6 ②	14.1 ②	8.8...26.5
Thread, single cable Ø0.08 - version HT or HT/HP	7.1	4.8	6.2	7.2 ①	6.7	7.8	5.7	13.4 ②	14.9 ②	9.9
Thread, single cable Ø0.08 - version HP	7.1	4.8	6.2	7.2 ①	6.7	7.8	1.7	9.4 ②	10.9 ②	8.8
Thread, all other probes	7.1	4.8	6.2	7.2 ①	6.7	7.8	3.7	11.5 ②	12.9 ②	6.6

① This dimension is subject to the size of the cable gland used

② With 30 kV ESD protection option: add 3.9" to this dimension. With Metaglas® option: add 1.7" to this dimension.

Remote converter

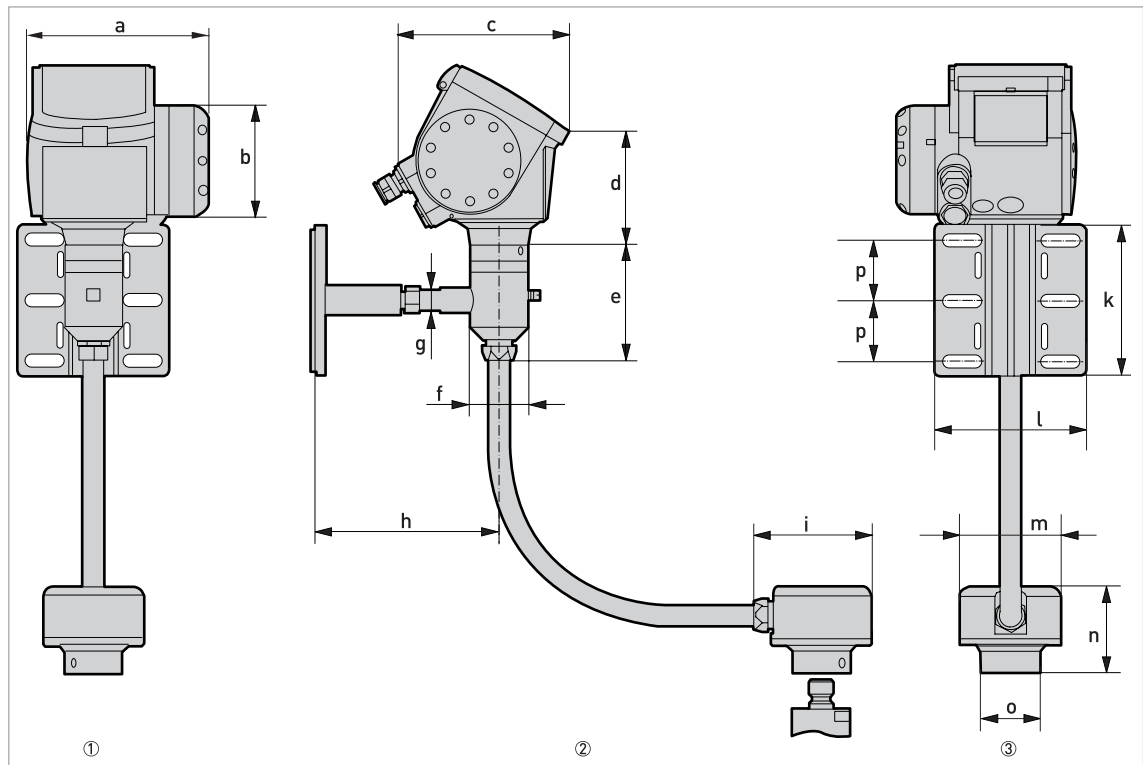


Figure 2-7: Remote housing option

- ① Front view
- ② Left side
- ③ Rear view

Note:

- Refer to "ESD protection and Metaglas® (dual process sealing system for dangerous products) options" for the height to add to dimension "n".



### Dimensions and weights in mm and kg

	Dimensions [mm]															Weights [kg]
	a	b	c	d	e	f	g	h	i	k	l	m	n	o	p	
Remote version	180	109	165	193	98.5	58	21	183	117	150	150.4	100	86	58	60	6.6... 12.8 ①

① Wall bracket (1.4 kg) + converter support (1.5 kg) + remote probe converter (2.7 kg) + flexible conduit (2 m: 1 kg; 4.5 m: 2.25 kg; 9.5 m: 4.75 kg; 14.5 m: 7.25 kg)

### Dimensions and weights in inches and lb

	Dimensions [inches]															Weights [lb]
	a	b	c	d	e	f	g	h	i	k	l	m	n	o	p	
Remote version	7.09	4.29	6.50	7.60	3.88	2.28	0.83	7.20	4.60	5.91	5.92	3.94	3.39	2.28	2.36	14.6... 28.3 ①

① Wall bracket (3.1 lb) + converter support (3.3 lb) + remote probe converter (6.0 lb) + flexible conduit (6.6 ft: 2.2 lb; 14.8 ft: 5.0 lb; 31.2 ft: 10.5 lb; 47.6 ft: 16.0 lb)

#### Remote version limits

- For interface and solid (powder, granulate) applications, the maximum extension length is 4.5 m / 14.8 ft.
- For liquid level applications, the maximum measuring range is reduced according to the length of the coaxial cable between the flange and the converter (extension length).

Extension length		Max. measuring range (or sensor length, L)	
[m]	[ft]	[m]	[ft]
2	6.6	30	98
4.5	14.8	25	82
9.5	31.2	15	29
14.5	47.6	5	16.4

#### Applications

- Tanks which are subjected to a lot of vibration
- Limited space on the top of the tank or limited access (due to the size of the compact converter)
- Remote display at the bottom of the tank

Weather protection option

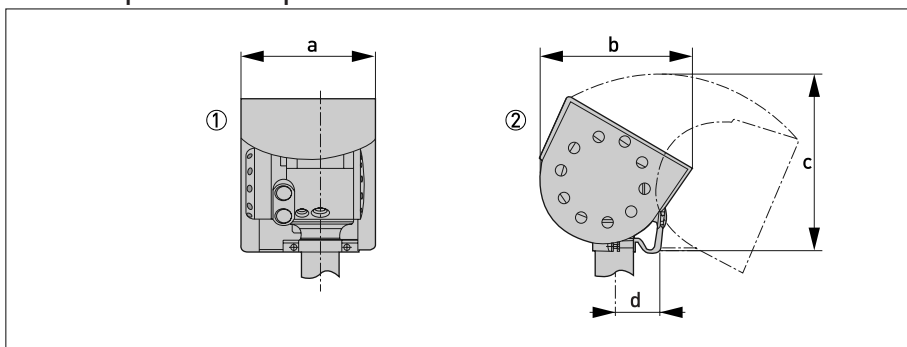


Figure 2-8: Weather protection option

- ① Weather protection (rear view)
- ② Weather protection (left side)

Dimensions and weights in mm and kg

	Dimensions [mm]				Weights [kg]
	a	b	c	d	
Weather protection	208	231.5	268 ①	66	2.9

① Radius

Dimensions and weights in inches and lb

	Dimensions [inches]				Weights [lb]
	a	b	c	d	
Weather protection	8.2	9.1	10.6 ①	2.6	6.4

① Radius

## ESD protection and Metaglas® options

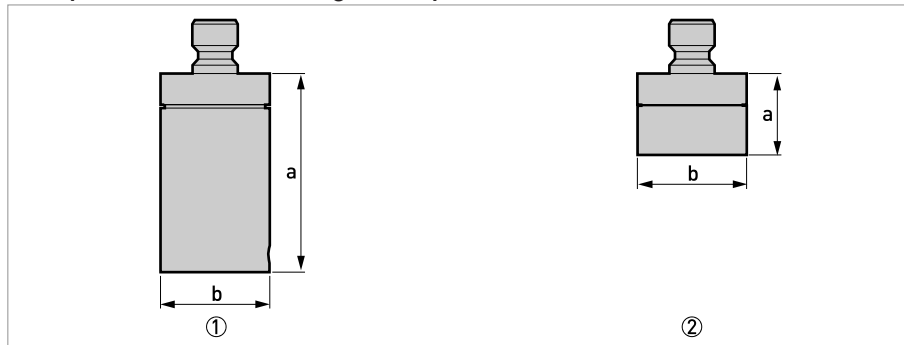


Figure 2-9: ESD protection and secondary Metaglas® seal options

- ① Optional ESD protection (30 kV) for solid applications
- ② Optional Metaglas® (dual process sealing system for dangerous products)

*The ESD protection and the Metaglas® options cannot be fitted to the same device.*

## Special options: Dimensions and weights in mm and kg

Options	Dimensions [mm]		Weights [kg]
	a	b	
ESD protection 30 kV	99	Ø58	0.85
Metaglas®	43	Ø58	0.83

## Special options: Dimensions and weights in inches and lb

Options	Dimensions [inches]		Weights [lb]
	a	b	
ESD protection 30 kV	3.9	Ø2.3	1.87
Metaglas®	1.7	Ø2.3	1.82

## Single probes

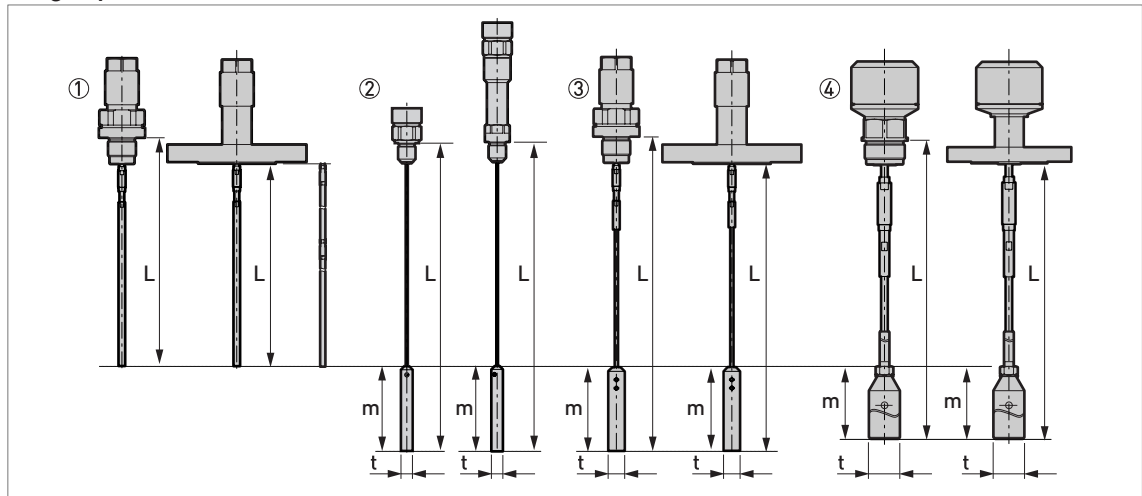


Figure 2-10: Single probe options

- ① Single rod  $\varnothing 8$  mm /  $\varnothing 0.3$ " (thread and flange versions). A segmented probe option shown on the right side. An optional protective sheath is available on request for the flange version.
- ② Single cable  $\varnothing 2$  mm /  $\varnothing 0.08$ " (the only thread version for the High-Pressure (HP) option and the only thread version for the High-Temperature (HT) and High-Temperature/High-Pressure (HT/HP) options)
- ③ Single cable  $\varnothing 4$  mm /  $\varnothing 0.15$ " (thread and flange versions - an optional FEP coating is available on request)
- ④ Single cable  $\varnothing 8$  mm /  $\varnothing 0.3$ " (thread and flange versions)

*A wide range of counterweights and anchoring solutions are available. For dimensional data, refer to the pages that follow. For installation data, refer to the handbook.*

## Single probes: Dimensions in mm

Probes	Dimensions [mm]			
	L min.	L max.	m	t
Single rod Ø8 mm ①	600 ②	4000	-	-
Single rod Ø8 mm (segmented) ①	600 ②	6000	-	-
Single cable Ø2 mm ③	600 ②	35000	100	Ø14
Single cable Ø4 mm ④	600 ②	35000	100	Ø20
Single cable Ø8 mm ④	600 ②	35000	0 ⑤	Ø38

① A device with this probe option must be assembled on site. For the assembly procedure, refer to the handbook or the printed procedure supplied with the components.

② A shorter probe length is available on request

③ 1 counterweight option (Ø14×100 mm). No anchoring solution is available.

④ Refer to the end of this section for data about all the probe end options

⑤ This value is for the Ø12 mm counterweight. If you ordered the Ø38 mm counterweight: 245 mm

## Single probes: Dimensions in inches

Probes	Dimensions [inches]			
	L min.	L max.	m	t
Single rod Ø0.3" ①	24 ②	158	-	-
Single rod Ø0.3" (segmented) ①	24 ②	236	-	-
Single cable Ø0.08" ③	24 ②	1378	3.9	Ø0.6
Single cable Ø0.15" ④	24 ②	1378	3.9	Ø0.8
Single cable Ø0.3" ④	24 ②	1378	0 ⑤	Ø1.5

① A device with this probe option must be assembled on site. For the assembly procedure, refer to the handbook or the printed procedure supplied with the components.

② A shorter probe length is available on request

③ 1 counterweight option (Ø0.6×3.9"). No anchoring solution is available.

④ Refer to the end of this section for data about all the probe end options

⑤ This value is for the Ø0.5" counterweight. If you ordered the Ø1.5" counterweight: 9.6"

## Double probes

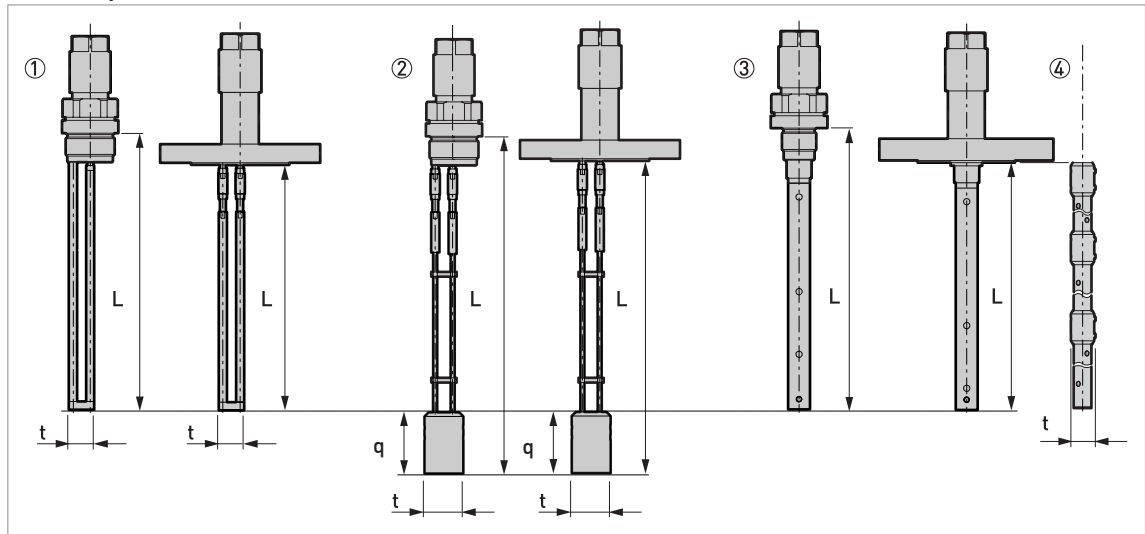


Figure 2-11: Double probe options

- ① Double rod  $\varnothing 8$  mm /  $\varnothing 0.3$ " (thread and flange versions)
- ② Double cable  $\varnothing 4$  mm /  $\varnothing 0.15$ " (thread and flange versions)
- ③ Coaxial  $\varnothing 22$  mm /  $\varnothing 0.9$ " (thread and flange versions)

*A wide range of counterweights and anchoring solutions are available. For dimensional data, refer to the pages that follow. For installation data, refer to the handbook.*

**Double probes: Dimensions in mm**

Probes	Dimensions [mm]			
	L min.	L max.	q	t
Double rod Ø8 mm	1000 ①	4000	-	25
Double cable Ø4 mm ②	1000 ①	8000	60	Ø38
Coaxial Ø22 mm	500 ①	6000	-	-
Coaxial Ø22 mm (segmented) ③	500 ①	6000	-	Ø28

① A shorter probe length is available on request

② Refer to the end of this section for data about all the probe end options

③ A device with this probe option must be assembled on site. For the assembly procedure, refer to the handbook or the printed procedure supplied with the components.

**Double probes: Dimensions in inches**

Probes	Dimensions [inches]			
	L min.	L max.	q	t
Double rod Ø0.3"	40 ①	158	-	1.0
Double cable Ø0.15" ②	40 ①	315	2.4	Ø1.5
Coaxial Ø0.9"	20 ①	236	-	-
Coaxial Ø0.9" (segmented) ③	20 ①	236	-	Ø1.1

① A shorter probe length is available on request

② Refer to the end of this section for data about all the probe end options

③ A device with this probe option must be assembled on site. For the assembly procedure, refer to the handbook or the printed procedure supplied with the components.

Probe end options for cable probes: single cable Ø4 mm/0.15"

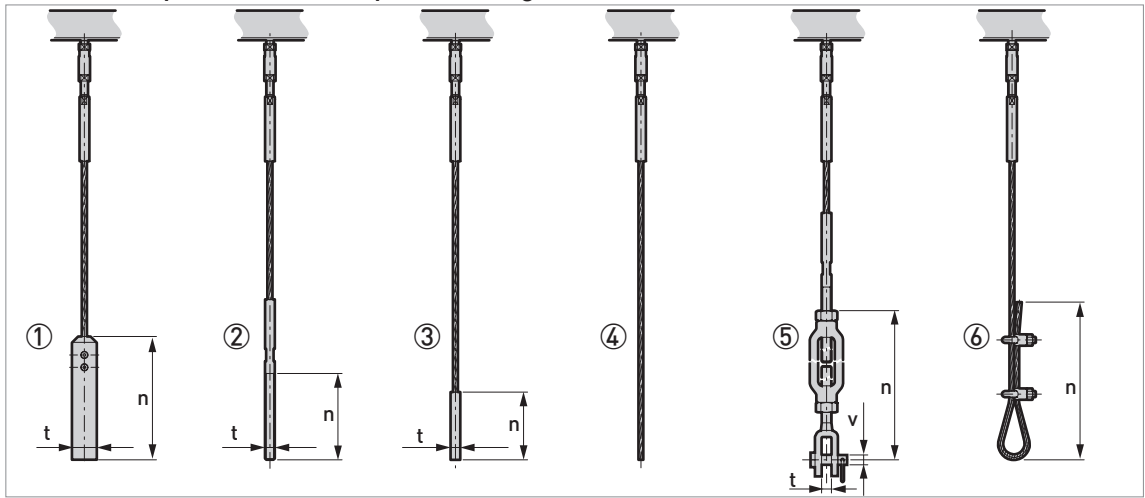


Figure 2-12: Probe end options for cable probes: single cable Ø4 mm/0.15"

- ① Standard counterweight
- ② Threaded end
- ③ Crimped end
- ④ Open end
- ⑤ Turnbuckle
- ⑥ Chuck

Dimensions in mm

Probe end type	Dimensions [mm]		
	n	t	v
Counterweight	100	Ø20	-
Threaded end	70	M8	-
Crimped end	55	Ø8	-
Open end	-	-	-
Turnbuckle	172 ①	11	Ø6
Chuck	300	-	-

① Minimum length

Dimensions in inches

Probe end type	Dimensions [inches]		
	n	t	v
Counterweight	3.9	Ø0.8	-
Threaded end	2.8	M8	-
Crimped end	2.2	Ø0.3	-
Open end	-	-	-
Turnbuckle	6.8 ①	0.4	Ø0.2
Chuck	11.8	-	-

① Minimum length



Probe end options for cable probes: single cable Ø8 mm/0.3"

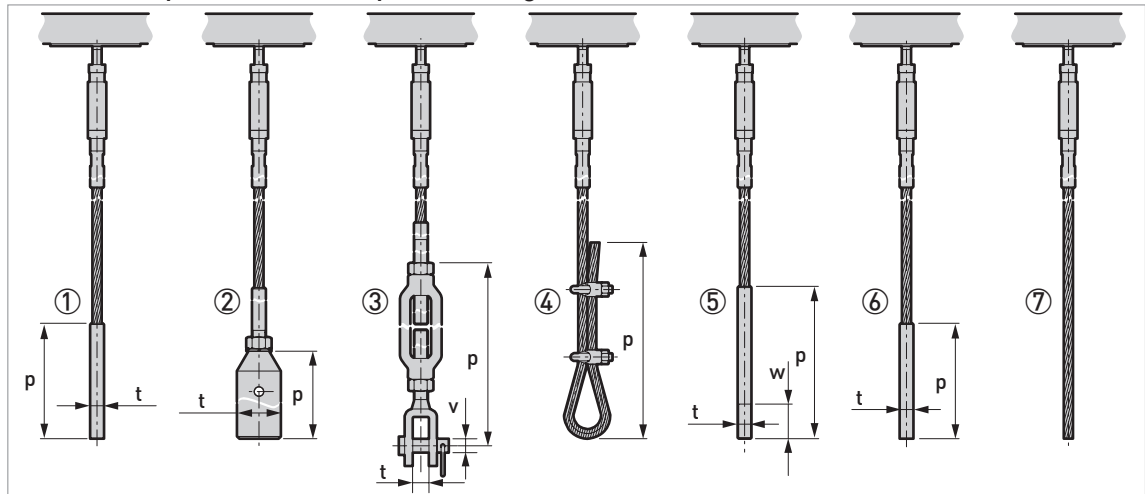


Figure 2-13: Probe end options for cable probes: single cable Ø8 mm/0.3"

- ① Standard counterweight 1
- ② Standard counterweight 2
- ③ Turnbuckle
- ④ Chuck
- ⑤ Threaded end
- ⑥ Crimped end
- ⑦ Open end

## Dimensions in mm

Probe end type	Dimensions [mm]			
	p	t	v	w
Counterweight 1	100	Ø12	-	-
Counterweight 2	245	Ø38	-	-
Turnbuckle	293 ①	14	Ø12	-
Chuck	300	-	-	-
Threaded end	132	M12	-	30
Crimped end	100	Ø12	-	-
Open end	-	-	-	-

① Minimum length

## Dimensions in inches

Probe end type	Dimensions [inches]			
	p	t	v	w
Counterweight 1	3.9	Ø0.5	-	-
Counterweight 2	9.6	Ø1.5	-	-
Turnbuckle	11.5 ①	0.6	Ø0.5	-
Chuck	11.8	-	-	-
Threaded end	5.2	M12	-	1.2
Crimped end	3.9	Ø0.5	-	-
Open end	-	-	-	-

① Minimum length

Probe end options for cable probes: double cable Ø4 mm/0.15"

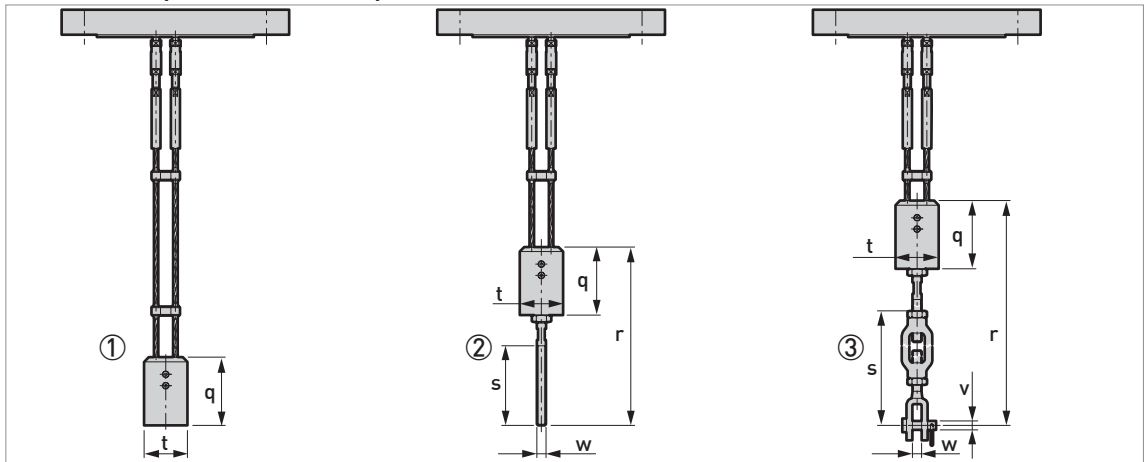


Figure 2-14: Probe end options for cable probes: double cable Ø4 mm/0.15"

- ① Standard counterweight
- ② Threaded end
- ③ Turnbuckle

Dimensions in mm

Probe end type	Dimensions [mm]					
	q	r	s	t	v	w
Counterweight	60			Ø38	-	-
Threaded end	60	157	70	Ø38	-	M8
Turnbuckle	60	289 ±46	172 ①	Ø38	Ø6	11

① Minimum length

Dimensions in inches

Probe end type	Dimensions [inches]					
	q	r	s	t	v	w
Counterweight	2.4			Ø1.5	-	-
Threaded end	2.4	6.2	2.8	Ø1.5	-	M8
Turnbuckle	2.4	11.4 ±1.8	6.8 ①	Ø1.5	Ø0.2	0.4

① Minimum length

## Probe weights

Probes	Min. process connection size		Weights	
	Thread	Flange	[kg/m]	[lb/ft]
Single cable Ø2 mm / 0.08"	G ½A; ½ NPTF	DN25 in PN16, PN40, PN63 or PN100; 1" in 150 lb, 600 lb, 900 lb, 1500 lb or 2500 lb; 1½" in 300 lb	0.016	0.01
Single cable Ø4 mm / 0.15"	G ¾A; ¾ NPT	DN25 in PN16, PN40, PN63 or PN100; 1" in 150 lb, 600 lb, 900 lb or 1500 lb; 1½" in 300 lb	0.12	0.08
Single cable Ø8 mm / 0.3"	G 1½A; 1½ NPT	DN40 in PN16, PN40, PN63 or PN100; 1½" in 150 lb, 300 lb, 600 lb, 900 lb or 1500 lb	0.41	0.28
Double cable Ø4 mm / 0.15"	G 1½A; 1½ NPT	DN50 in PN16, PN40, PN63 or PN100; 2" in 150 lb, 300 lb, 600 lb, 900 lb or 1500 lb	0.24	0.16
Single rod Ø8 mm / 0.3"	G ¾A; ¾ NPT	DN25 in PN16, PN40, PN63 or PN100; 1" in 150 lb, 600 lb, 900 lb or 1500 lb; 1½" in 300 lb	0.41	0.28
Double rod Ø8 mm / 0.3"	G 1½A; 1½ NPT	DN50 in PN16, PN40, PN63 or PN100; 2" in 150 lb, 300 lb, 600 lb, 900 lb or 1500 lb	0.82	0.56
Coaxial Ø22 mm / 0.9"	G ¾A; ¾ NPT	DN25 in PN16, PN40, PN63 or PN100; 1" in 150 lb, 600 lb, 900 lb or 1500 lb; 1½" in 300 lb	0.79	0.53

### 3.1 Intended use

This TDR level transmitter measures distance, level, mass and volume of liquids, pastes, slurries, granulates and powders. It can also measure level and interface of liquids at the same time.

It can be installed on tanks, silos and open pits.

### 3.2 Pre-installation requirements

*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. The devices are tested for vibration and agree with EN 50178 and IEC 60068-2-6.

### 3.3 How to prepare the tank before you install the device

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

#### 3.3.1 General information for nozzles

*Follow these recommendations to make sure that the device measures correctly.*

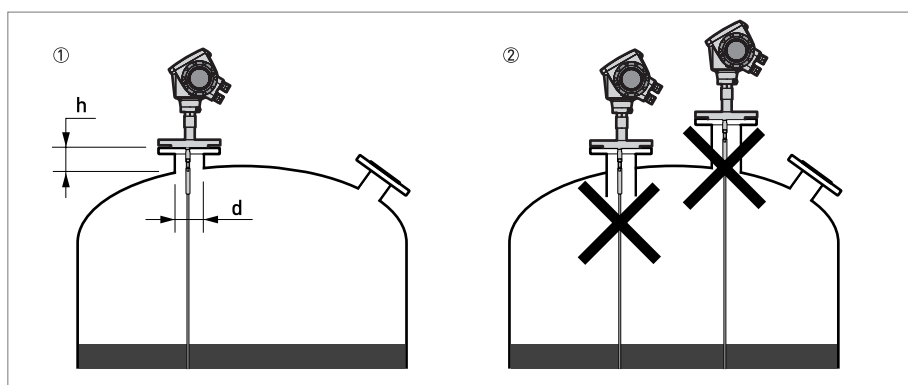


Figure 3-1: Recommended nozzle dimensions

- ① Recommended conditions:  $h \leq d$ , 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.

*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, ...).*

*It is possible to measure in these conditions with a minimum top dead zone. Use the snapshot function to filter the parasite signals from long nozzles. For more data, refer to the Handbook.*

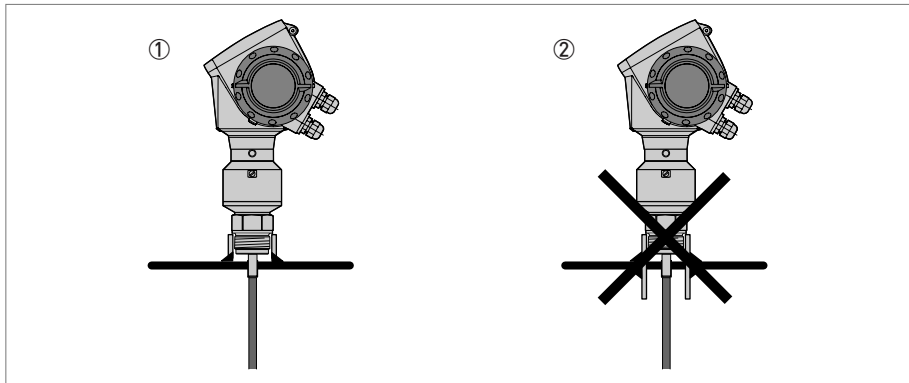


Figure 3-2: Sockets for threaded process connections

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

*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.*

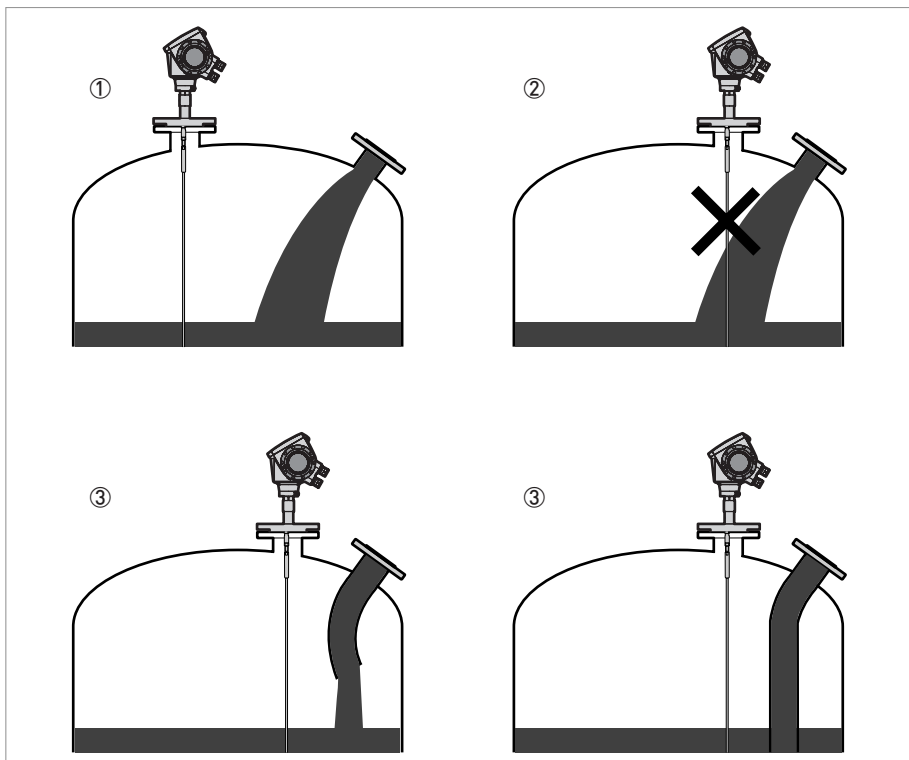


Figure 3-3: Do not put the device near to a product inlet

- 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.

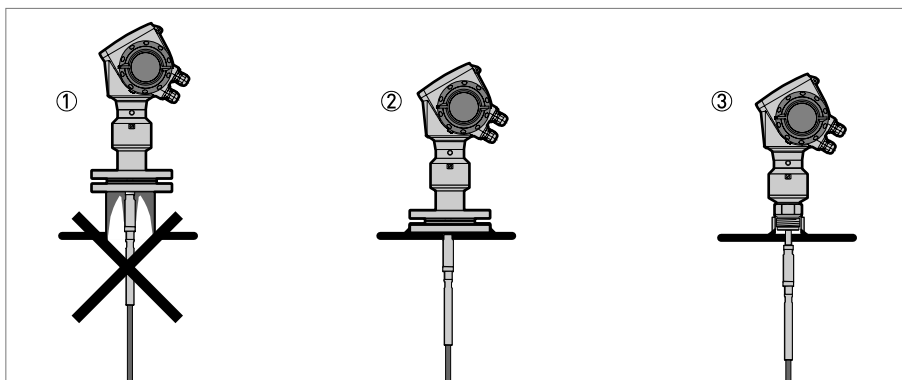


Figure 3-4: How to prevent build up of product around the process connection

- 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 thread connection to attach the device to the tank.

### 3.3.2 Installation requirements for concrete roofs

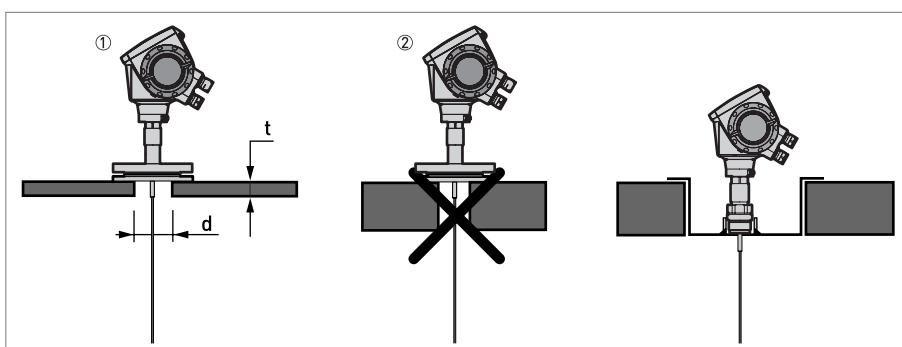


Figure 3-5: Installation on a concrete roof

- 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.

## 3.4 Installation recommendations for liquids

### 3.4.1 General requirements

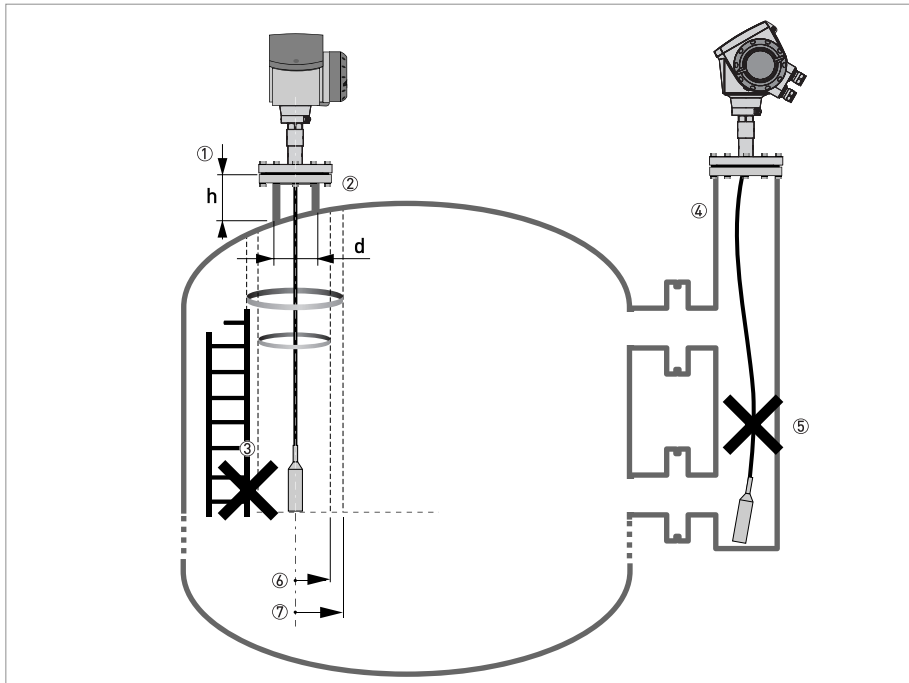


Figure 3-6: Installation recommendations for liquids

- ①  $h \leq d$ , where  $h$  is the height of the tank nozzle and  $d$  is its diameter.
- ② Make sure that the probe does not touch the nozzle. Attach the probe if the liquid is turbulent.
- ③ 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.
- ④ If there are too many objects in the tank, install a bypass chamber or stilling well.
- ⑤ 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 the handbook.
- ⑥ Empty space necessary for double probes. Refer to the table that follows.
- ⑦ Empty space necessary for single probes. Refer to the table that follows.

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

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

*If the device has to measure the level of dangerous products (ammonia etc.), we recommend that you use a device with the Metaglas<sup>®</sup> option.*

## 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 ⑥ Double cable $\varnothing 4$ mm / 0.15" ⑥	100	4
Single rod ⑦ Single cable $\varnothing 4$ mm / 0.15" ⑦ Single cable $\varnothing 2$ mm / 0.08" ⑦	300	12

## 3.4.2 Standpipes

## 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.

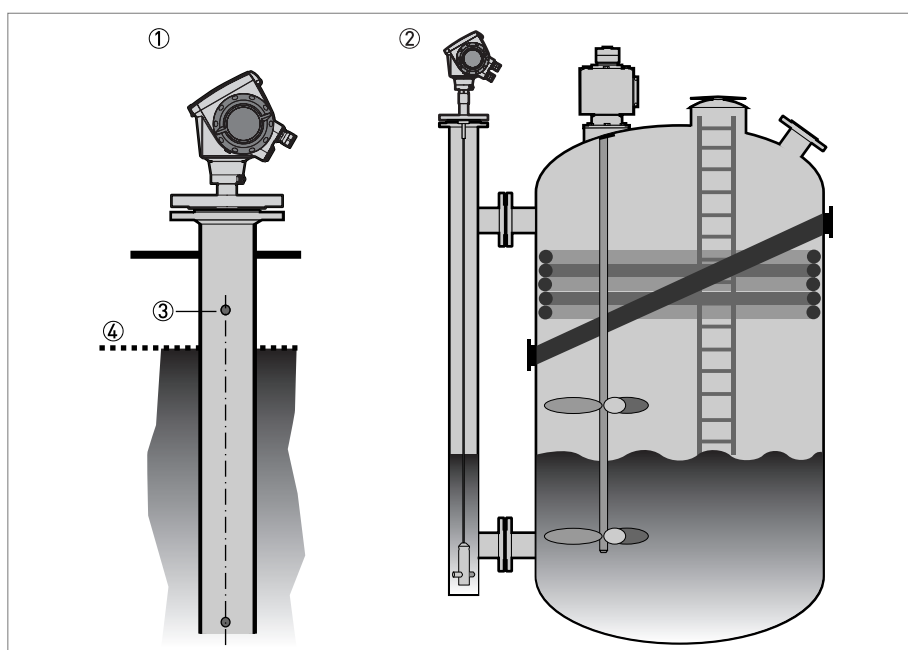


Figure 3-7: Basic installation recommendations for standpipes (stilling wells and bypass chambers)

- ① Stilling well
- ② Bypass chamber
- ③ Air circulation hole
- ④ Level of the liquid



### Installation requirements

- The standpipe must be electrically conductive.
- The inside diameter of the standpipe must not be more than 5 mm / 0.2" over the diameter of the antenna (for a high-dielectric constant liquid).
- The standpipe must be straight. There must be no sudden changes in internal diameter greater than 1 mm / 0.04".
- The standpipe must be vertical.
- Recommended surface roughness:  $\leq \pm 0.1 \text{ mm} / 0.004''$ .
- Stilling well only: 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.
- Make sure that there is liquid in the standpipe.

Standpipes are not necessary for devices with coaxial probes. But if there is a sudden change in diameter in the standpipe, we recommend that you install a device with a coaxial probe.

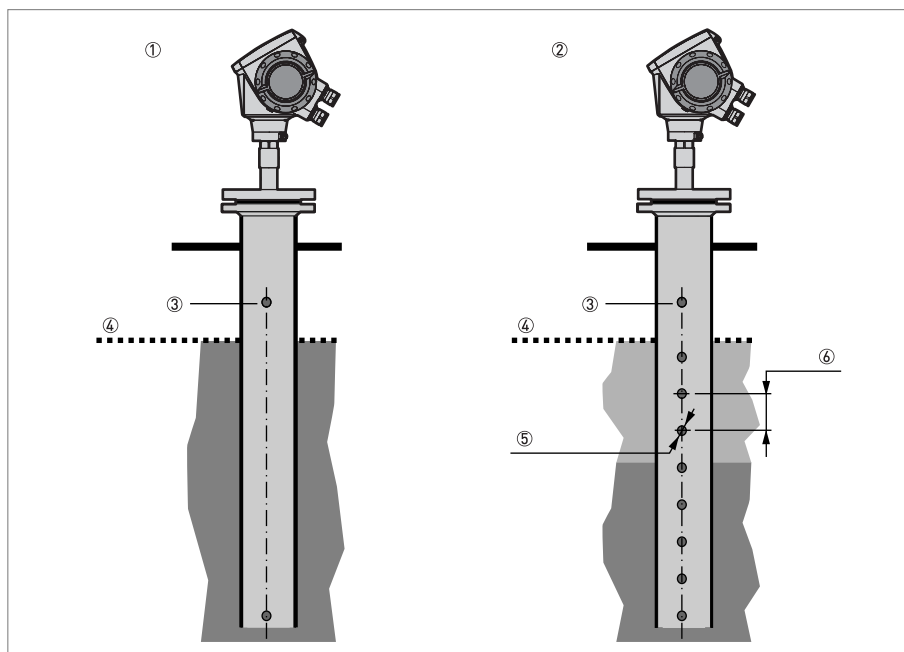


Figure 3-8: Installation recommendations for stilling wells

- ① Stilling well in tanks containing one liquid
- ② Stilling well in tanks containing more than one liquid
- ③ Air circulation hole
- ④ Maximum level of the liquid
- ⑤ Liquid circulation hole
- ⑥ Distance between holes  $\geq 25 \text{ mm} / 1''$  (depends on the minimum layer to be measured)

### Installation in tanks containing one liquid and foam

- Drill a pressure equalization hole in the stilling well above the maximum level.
- Deburr the hole.
- If the probe has a counterweight, make sure that there is enough space between the counterweight and the wall of the stilling well.

### Installation in tanks containing more than one liquid

- Drill a pressure equalization hole in the stilling well above the maximum level of the top liquid.
- Drill more holes along the length of the stilling well. Distance between holes  $\geq 25$  mm / 1" (depends on the minimum layer to be measured)
- ➡ These holes help the liquids to move freely.
- Deburr the holes.
- If the probe has a counterweight, make sure that there is enough space between the counterweight and the wall of the stilling well.

### Floating roofs

If the device is for a tank with a floating roof, install it in a stilling well.

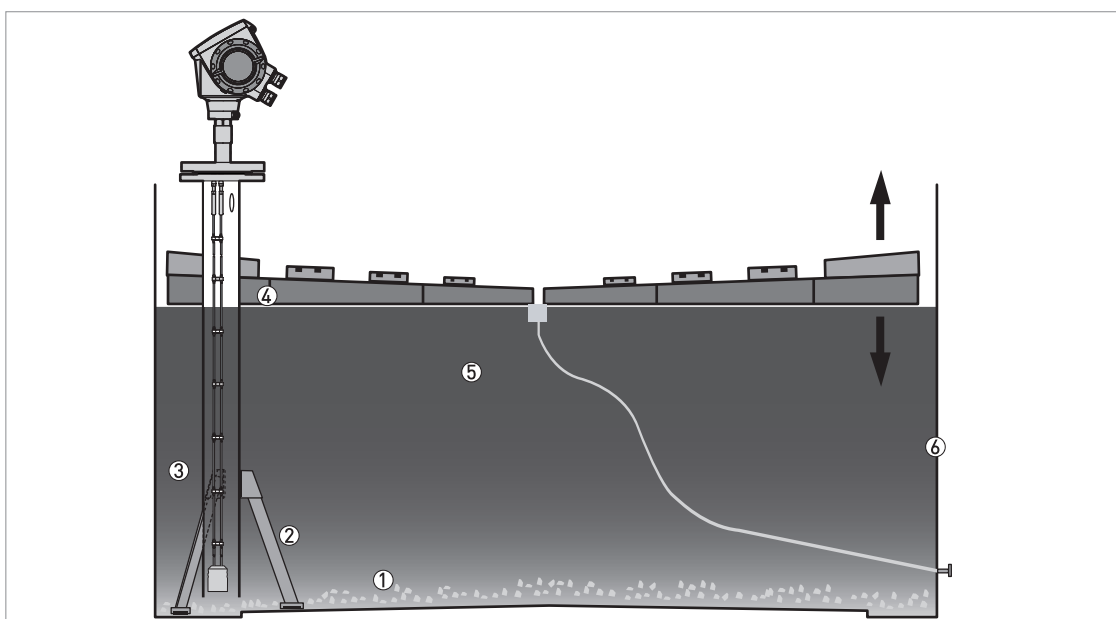


Figure 3-9: Floating roofs

- ① Sediment
- ② Support fixtures
- ③ Stilling well
- ④ Floating roof
- ⑤ Product
- ⑥ Tank

### Bypass chamber - general notes

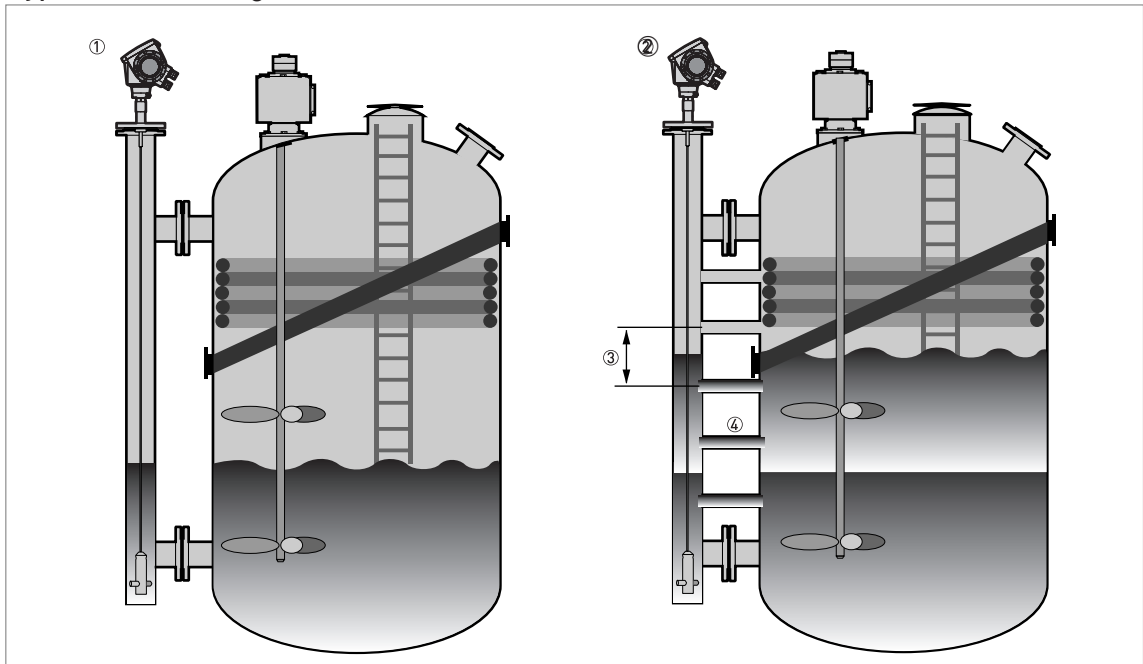


Figure 3-10: Installation recommendations for bypass chambers

- ① Bypass chamber for tanks that contain one liquid
- ② Bypass chamber for tanks that contain more than one liquid
- ③ Distance between holes  $\leq$  minimum level of each liquid in the tank
- ④ Additional process connection

### Installation on tanks containing one liquid and foam

- The bypass chamber must have a process connection that is above the maximum level of liquid.
- The bypass chamber must have a process connection that is below the lowest measured level of liquid.

### Installation on tanks containing more than one liquid

- The bypass chamber must have a process connection that is above the maximum level of liquid.
- The bypass chamber must have a process connection that is below the lowest measured level of liquid.
- There must be more process connections along the length of the bypass chamber. These must have a minimum diameter of 25 mm / 1" with a minimum distance of 100 mm / 4" between the holes.
- If the probe has a counterweight, make sure that there is enough space between the counterweight and the wall of the stilling well.
- If the interface liquid does not have a layer of air above it, fit a vent at the top of the bypass chamber. Refer to the illustration that follows:

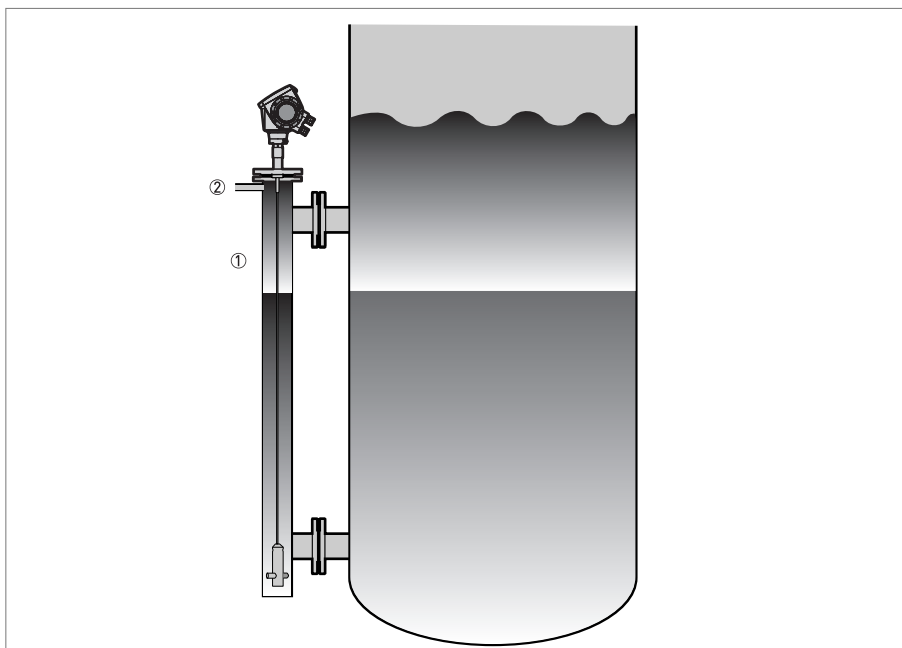


Figure 3-11: Installation recommendations for bypass chambers with no air gap

- ① Bypass chamber with no air gap
- ② Air vent

## 3.5 Installation recommendations for solids

### 3.5.1 Nozzles on conical silos

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

**Risk of electrostatic discharge (ESD):** The device is resistant to electrostatic discharges of up to 15 kV (30 kV with the ESD protection option - recommended for solid applications), but it is the responsibility of the fitter and the user to prevent ESD.

Install the nozzle in the correct position to measure correctly and prevent too much bending and traction.

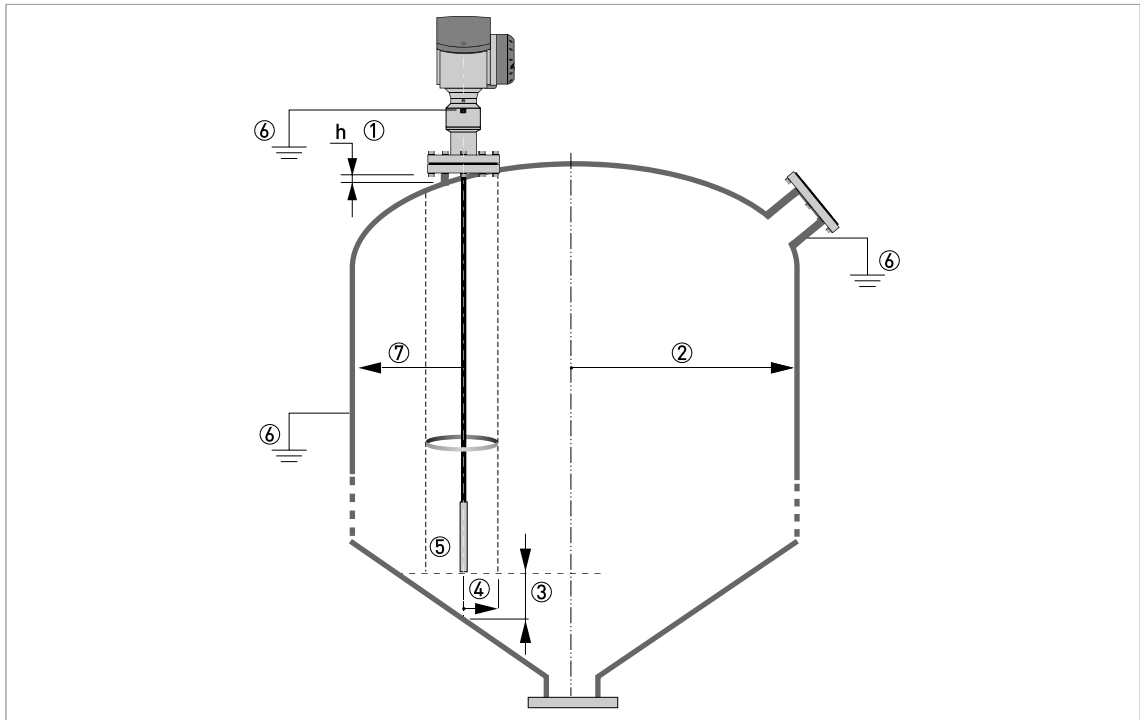


Figure 3-12: Installation recommendations for solids

- ① We recommend installation without a nozzle. If not,  $h \leq 50 \text{ mm} / 2''$ .
- ② Radius of the tank,  $r$
- ③ The end of the probe must be more than  $300 \text{ mm} / 12''$  above the tank bottom.
- ④ Empty space (radius,  $R_{\min}$ ) around the probe.
- ⑤ The electromagnetic (EM) field generated by the device. It is also the measurement zone of the probe. Make sure that the EM field is clear of objects and product flow.
- ⑥ Ground the tank, the product and the probe (if attached).
- ⑦ If possible, put the process fitting  $\geq 300 \text{ mm} / 12''$  from the tank wall

#### Clearance between the probe and other objects in the tank

Probe type	Empty space (radius, $R_{\min}$ ) around the probe	
	[mm]	[inches]
Single cable $\varnothing 4 \text{ mm} / 0.15''$ ④	300	12
Single cable $\varnothing 8 \text{ mm} / 0.3''$ ④	300	12

*If the probe is longer than  $10 \text{ m} / 33 \text{ ft}$ , we recommend that you do not attach the end of the probe.*

### 3.5.2 Traction loads on the probe

**Traction load depends on:**

- The height and shape of the tank.
- The particle size and density.
- The rate at which the tank is emptied.

*Risk of damage to the cable probe. High loads can break the cable.*

*If the load on the  $\varnothing 8$  mm / 0.3" single cable probe is more than 3500 kg / 7700 lb, contact your supplier.*

*Make sure that the tank roof is resistant to deformation at high loads.*

**Estimated traction load on the probe in kg**

Material	Probe length, 10 m	Probe length, 20 m	Probe length, 30 m
	[kg]		
Cement	1000	2000	3000
Fly ash	500	1000	1500
Wheat	300	500	1200

**Estimated traction load on the probe in lb**

Material	Probe length, 33 ft	Probe length, 65 ft	Probe length, 98 ft
	[lb]		
Cement	2200	4410	6520
Fly ash	1100	2200	3300
Wheat	660	1100	2650

## 3.6 How to install the device on the tank

### 3.6.1 How to install a device with a flange connection

**Equipment needed:**

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

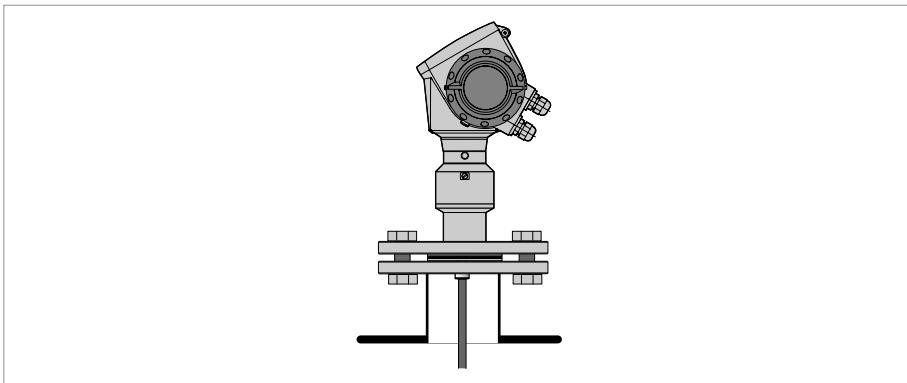


Figure 3-13: Flange connection

### 3.6.2 How to install a device with a threaded connection

**Equipment needed:**

- Device
- Gasket (not supplied with G (ISO 228) threaded connections)
- 50 mm / 2" wrench (not supplied)

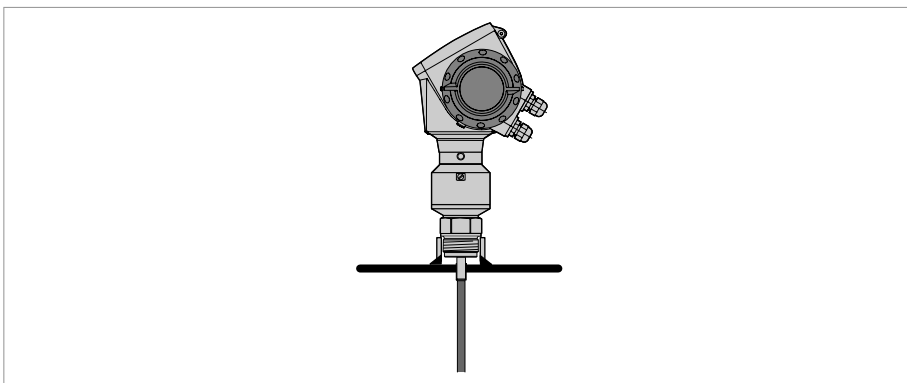


Figure 3-14: Threaded connection

### 3.6.3 Installation recommendations for non-metallic tanks and pits

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  $DN \geq 200$  /  $\geq 8''$  for flange connections.

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

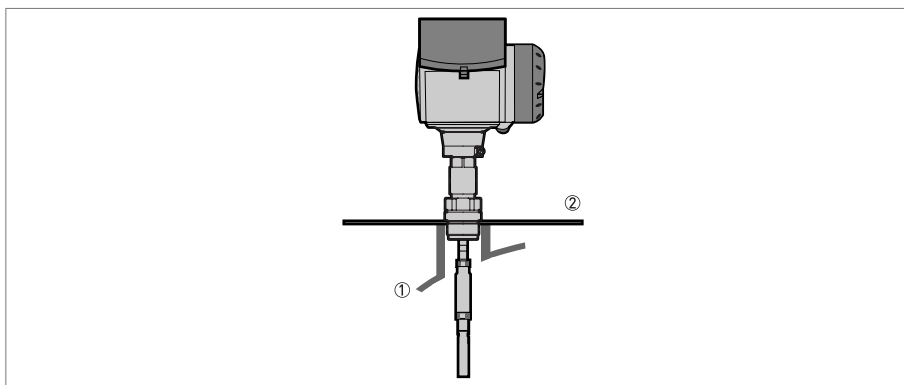


Figure 3-15: Installation in a non-metallic tank or pit with a thread connection

- ① Non-metallic (plastic...) tank or pit
- ② Metal sheet,  $\varnothing \geq 200$  mm / 8"

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



### 3.6.4 How to assemble the remote housing

You can attach the wall bracket of the remote housing to a wall or pipe (DN50...100 / 2"...4"). These are the dimensions:

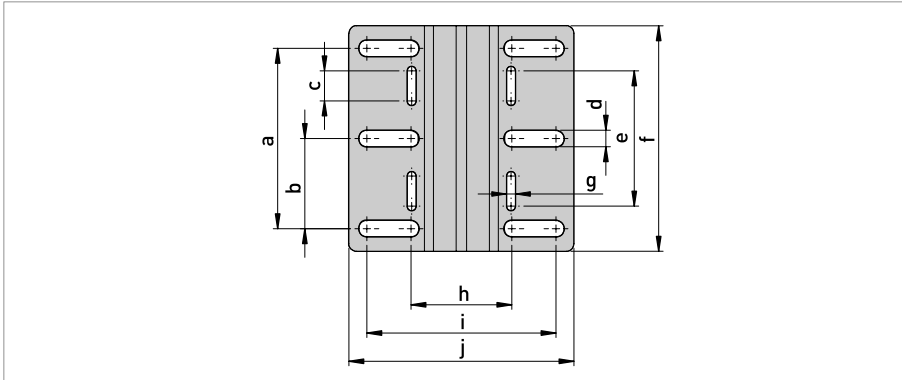


Figure 3-16: Dimensions of the wall bracket

#### 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

For the assembly procedure, refer to the handbook.

## 4.1 Safety instructions

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

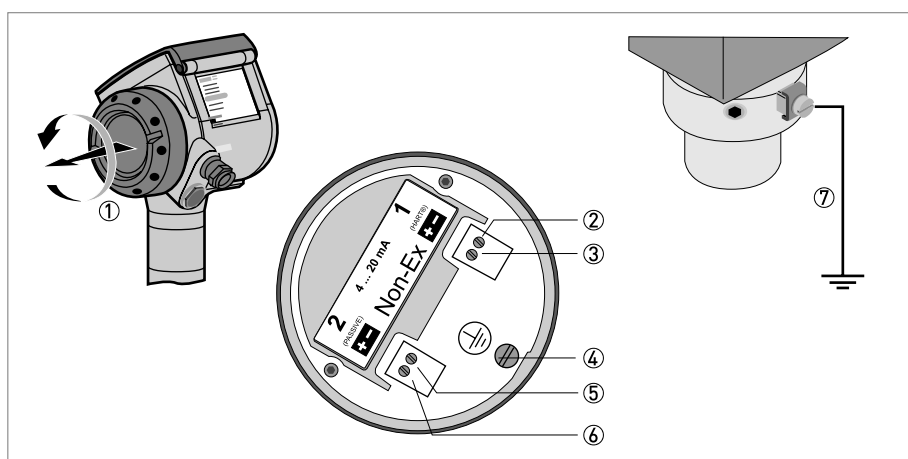
*Observe the national regulations for electrical installations!*

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

*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.*

*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: outputs 1 and 2



**Figure 4-1: Electrical installation**

- ① Terminal compartment cover
- ② Output 1: current output -
- ③ Output 1: current output +
- ④ Grounding terminal in the housing
- ⑤ Output 2: current output -
- ⑥ Output 2: current output +
- ⑦ Grounding terminal between the process connection and the converter

Output 1 energizes the device and is used for HART® communication. If the device has the second current output option, use a separate power supply to energize output 2.

*If the polarity is not correct, this will not cause damage to the device. But the device will not operate and the output will be 0 mA.*

### 4.2.1 Non-Ex

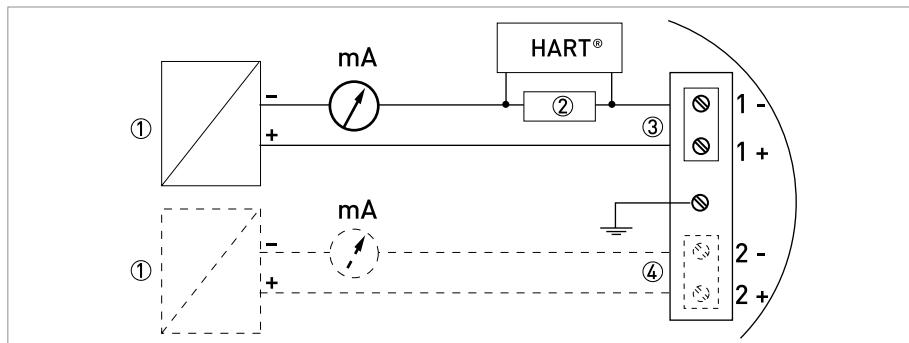


Figure 4-2: Electrical connections for non-Ex devices

- ① Power supply
- ② Resistor for HART® communication
- ③ Output 1: 14...30 VDC for an output of 22 mA at the terminal
- ④ Output 2: 10...30 VDC for an output of 22 mA at the terminal

### 4.2.2 Ex i

*For electrical data for Ex i applications, refer to the Ex supplements. You can find this documentation on the CD-ROM delivered with the device or it can be downloaded free of charge from the website (Downloadcenter).*

### 4.2.3 Ex d

*For electrical data for Ex d applications, refer to the Ex supplements. You can find this documentation on the CD-ROM delivered with the device or it can be downloaded free of charge from the website (Downloadcenter).*

### 4.2.4 PROFIBUS PA

For electrical data for PROFIBUS PA networks, refer to the PROFIBUS PA supplement. You can find this documentation on the CD-ROM delivered with the device or it can be downloaded free of charge from the website (Downloadcenter).

### 4.2.5 FOUNDATION Fieldbus

For electrical data for FOUNDATION Fieldbus networks, refer to the FOUNDATION Fieldbus supplement. You can find this documentation on the CD-ROM delivered with the device or it can be downloaded free of charge from the website (Downloadcenter).

### 4.3 Protection category

*The device fulfills all requirements per protection class IP 66/67 (equivalent to NEMA type 4X (housing) and type 6P (probe)).*

*Make sure that the cable gland is watertight.*

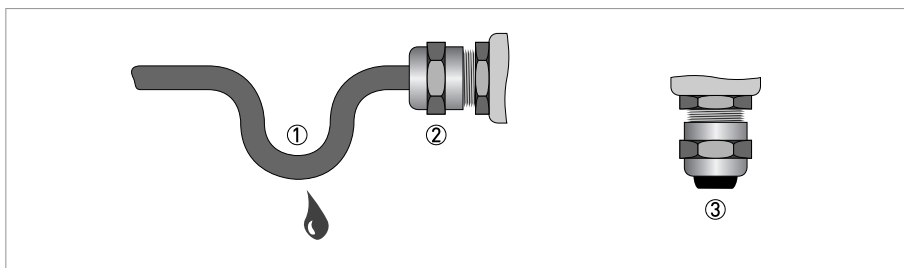


Figure 4-3: How to make the installation agree with protection category IP 67

- 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.

## 4.4 Networks

### 4.4.1 General information

The device uses the HART<sup>®</sup> communication protocol. This protocol agrees with the HART<sup>®</sup> Communication Foundation standard. The device can be connected point-to-point. It can also operate in a multi-drop network of up to 15 devices.

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.

### 4.4.2 Point-to-point networks

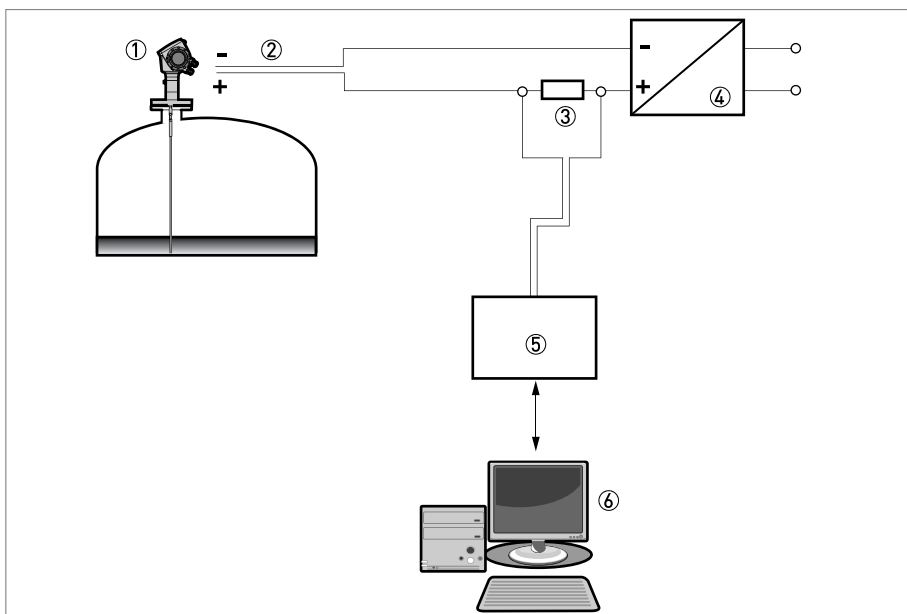


Figure 4-4: Point-to-point connection (non-Ex)

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

## 4.4.3 Multi-drop networks

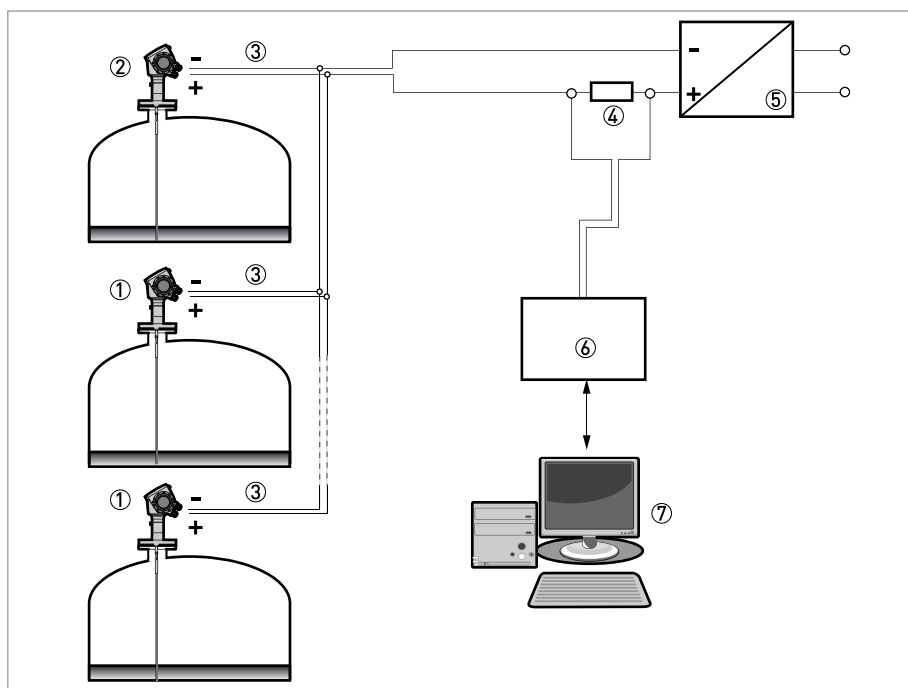


Figure 4-5: Multi-drop network (non-Ex)

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

## 4.4.4 Fieldbus networks

## FOUNDATION Fieldbus™ network (non-Ex)

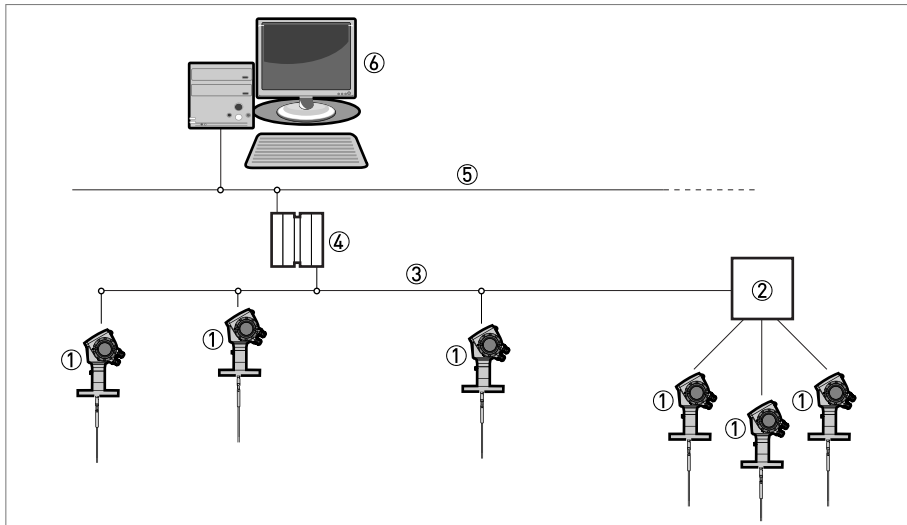


Figure 4-6: FOUNDATION Fieldbus™ network (non-Ex)

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

*It is necessary to have a separate power supply to energize devices with the FOUNDATION™ Fieldbus output option (4-wire device with local HART® connection). The FF terminal is connected to a Fieldbus Power Hub. The 24 VDC terminal energizes the device. The power supply is not shown in the illustration.*

## PROFIBUS PA/DP network (non-Ex)

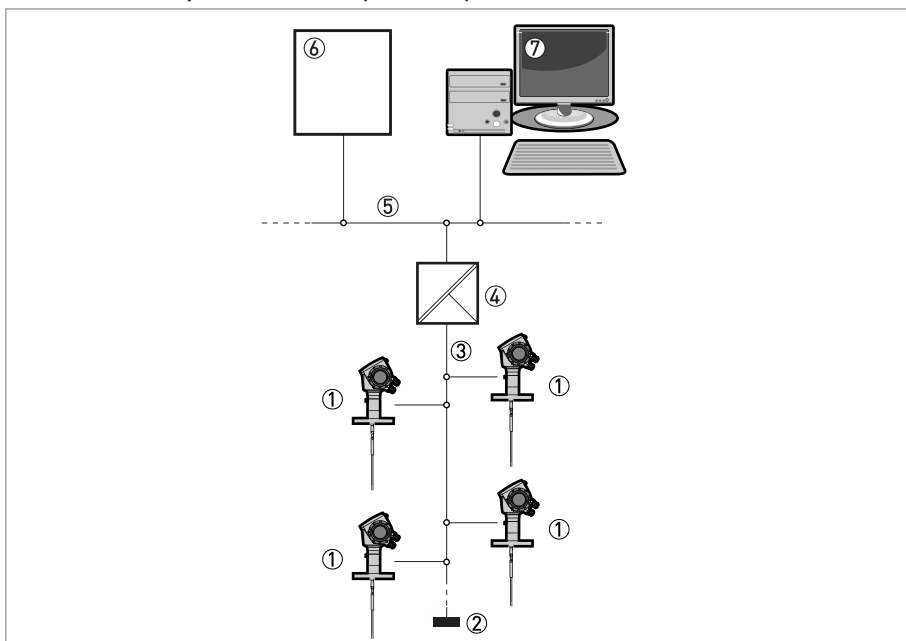


Figure 4-7: PROFIBUS PA/DP network (non-Ex)

- 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)

*It is necessary to have a separate power supply to energize devices with the PROFIBUS PA output option (4-wire device with local HART<sup>®</sup> connection). The **PROFIBUS PA** terminal is connected to a segment coupler. The **24 VDC** terminal energizes the device. The power supply is not shown in the illustration.*



You can help us to assist you as quickly as possible by giving us a few items of information.

Then just fax them to us. Your personal consultant will contact you within 24 hours.

## 5.1 Device data

Connection type	<input type="checkbox"/> Flange	<input type="checkbox"/> Threaded ①	Specify size:
Connection material	<input type="checkbox"/> 316 L	<input type="checkbox"/> Hastelloy® C-22	
Probe end type (cable probes only)	<input type="checkbox"/> Counterweight	<input type="checkbox"/> Turnbuckle	<input type="checkbox"/> Chuck
	<input type="checkbox"/> Threaded end	<input type="checkbox"/> Crimped end	<input type="checkbox"/> Open end/None
Feedthrough/Sealing ②	<input type="checkbox"/> Standard / FKM/FPM (-40...+200°C)	<input type="checkbox"/> Standard / Kalrez® 6375 (-20...+200°C)	<input type="checkbox"/> Standard / EPDM (-50...+150°C)
Housing version ③	<input type="checkbox"/> Compact, standard (T <sub>max</sub> = +200°C, P <sub>max</sub> = 100 bar)	<input type="checkbox"/> Compact, high-pressure (T <sub>max</sub> = +200°C, P <sub>max</sub> = 300 bar)	<input type="checkbox"/> Compact, high-temperature (T <sub>max</sub> = +300°C, P <sub>max</sub> = 100 bar)
	<input type="checkbox"/> Compact, high-temperature / high-pressure (T <sub>max</sub> = +300°C, P <sub>max</sub> = 300 bar)	<input type="checkbox"/> Remote housing	Specify length of conduit for the remote housing (2 m, 4.5 m, 9.5 m or 14.5 m):
Outputs	<input type="checkbox"/> 1 output 4...20 mA/HART®	<input type="checkbox"/> 1 output 4...20 mA/HART® - for interface measurement	<input type="checkbox"/> 2 outputs 4...20 mA/HART® + 4...20 mA
	<input type="checkbox"/> 2 outputs 4...20 mA/HART® + 4...20 mA - for interface measurement	<input type="checkbox"/> PROFIBUS PA (4-wire + local HART®)	<input type="checkbox"/> FOUNDATION Fieldbus (4-wire + local HART®)
Display	<input type="checkbox"/> Without	<input type="checkbox"/> With	Specify language:
Approvals	<input type="checkbox"/> No Ex	<input type="checkbox"/> ATEX Ex ia	<input type="checkbox"/> ATEX Ex d[ia]
	<input type="checkbox"/> WHG ④	<input type="checkbox"/> FM IS Class 1 Div. 1 (Dual Seal)	<input type="checkbox"/> FM XP-IS Class 1 Div. 1 (Dual Seal)
	<input type="checkbox"/> CSA IS Class 1 Div. 1 (Dual Seal)	<input type="checkbox"/> CSA XP-IS Class 1 Div. 2 (Dual Seal)	<input type="checkbox"/> IECEx Ex ia
	<input type="checkbox"/> IECEx Ex d[ia] ④	<input type="checkbox"/> NEPSI Ex ia	<input type="checkbox"/> NEPSI Ex dia
	<input type="checkbox"/> ATEX Ex nA	<input type="checkbox"/> INMETRO BR-Ex ia	<input type="checkbox"/> INMETRO BR-Ex d[ia]

① This is necessary for a process connection temperature >200°C / 390°F

② The temperature limits for the feedthrough and gasket materials must agree with the temperature limits of the housing version.

③ Refer also to the Pressure / temperature table for probe selection in the "Technical data" section.

④ Pending

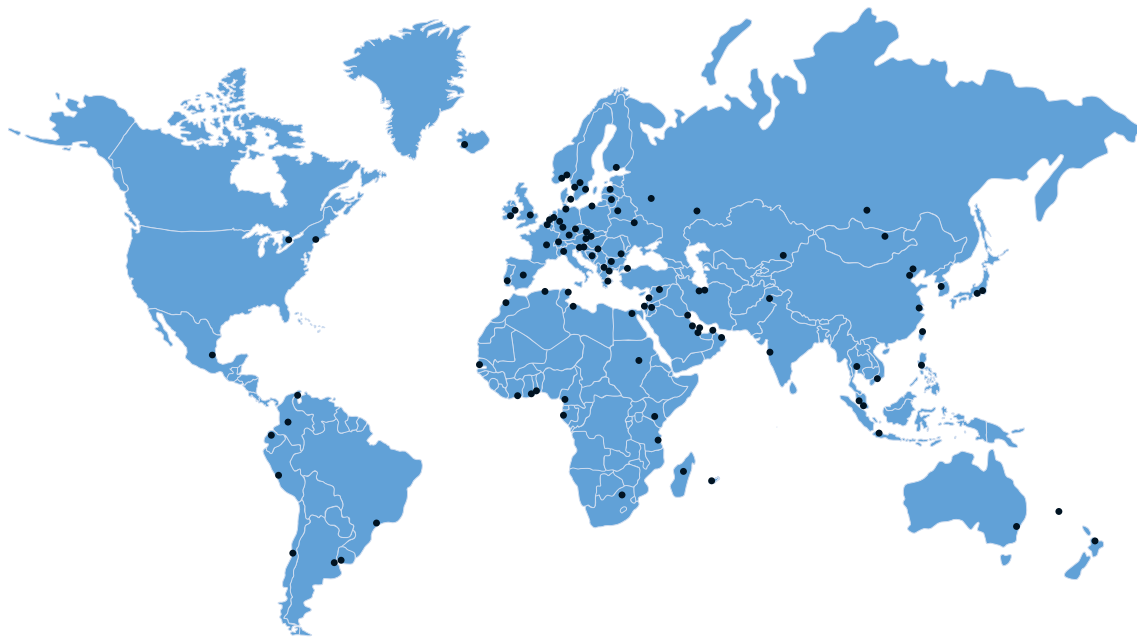
## 5.2 Rating data

Product name:	
Operating pressure:	
Rated pressure:	
Process connection temperature:	
Ambient temperature:	
Viscosity:	
Measurand (level, volume,...):	
Tank height:	
Comments (indoors, exposed to weather, ...):	

## 5.3 Contact data

Company:	
Contact person:	
Telephone number:	
Fax number:	
E-mail:	





## KROHNE product overview

- Electromagnetic flowmeters
- Variable area flowmeters
- Ultrasonic flowmeters
- Mass flowmeters
- Vortex flowmeters
- Flow controllers
- Level meters
- Temperature meters
- Pressure meters
- Analysis products
- Measuring systems for the oil and gas industry
- Measuring systems for sea-going tankers

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The current list of all KROHNE contacts and addresses can be found at:  
[www.krohne.com](http://www.krohne.com)

**KROHNE**