



## OPTIFLEX 2200 C/F Technical Datasheet

Guided Radar (TDR) Level Transmitter for storage and process applications

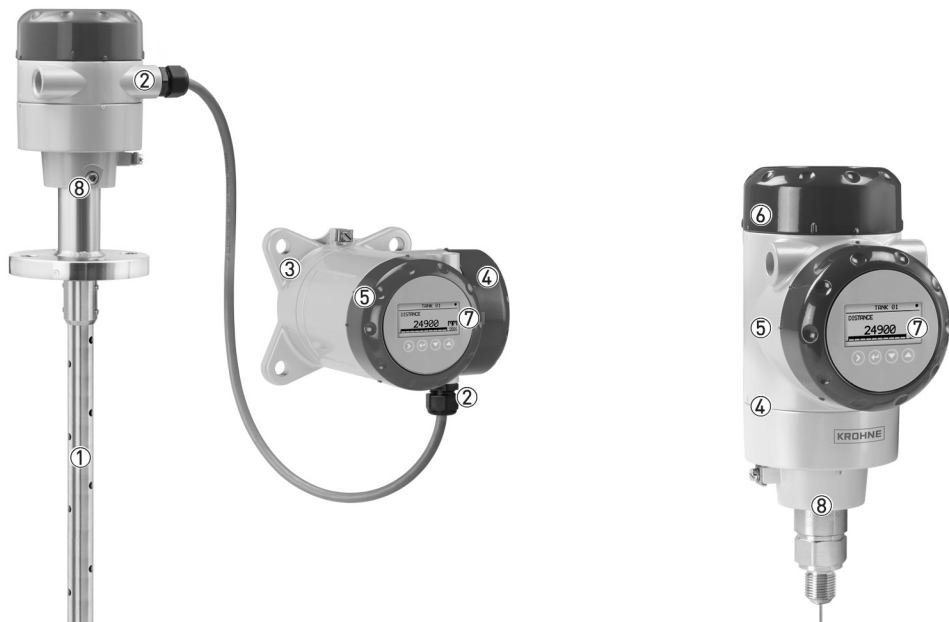
- Modular design of housing and sensor ensures suitability for a variety of mounting positions and applications
- Universal measurement device for liquids and solids
- SIL2-compliant according to IEC 61508 for safety-related systems



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## 1.1 The modular TDR level transmitter

This device is a TDR level transmitter for measuring distance, level, volume and mass. Its modular design makes it an economical and reliable solution for common applications.



- ① Large choice of probes to cover a vast range of applications
- ② Optional remote converter can be installed up to 100 m / 328 ft away from the probe
- ③ Wall support
- ④ Horizontal / vertical housings and segmented probe options makes the device suitable for many applications and for installation in a variety of positions
- ⑤ Aluminium or stainless steel housing
- ⑥ 2-wire level transmitter
- ⑦ Optional LCD display with 4-button keypad
- ⑧ Converter is rotatable and removable under process conditions

### Optional integrated display



The display can be ordered with the device or as an accessory. It shows measurement data on a 128 × 64 pixel screen. The configuration menu permits the device to be set up in a small number of intuitive steps.

### Highlights

- 2-wire loop-powered HART® TDR level transmitter for liquids and solids
- DPR (Dynamic Parasite Rejection): the software dynamically eliminates false reflections caused by environmental disturbances and product build-up
- Quick coupling system permits removal of the converter under process conditions and 360° rotation to make the display screen easier to read
- Horizontal and vertical housing position to suit every installation
- The remote converter can be installed up to 100 m / 328 ft from the probe
- Display keypad is directly accessible without opening the cover
- Measuring range up to 40 m / 131 ft
- Converter backwards compatible with all flange systems of current (OPTIFLEX 1300 C) and previous (BM 100 A, BM 102) generation TDR level transmitters from KROHNE
- SIL2-compliant according to IEC 61508 for safety-related systems
- The device has FDT1.2 DTM certification.

### Industries

- Chemical market
- Oil & Gas
- Power
- Food
- Wastewater
- Pulp & Paper
- Metals, Minerals & Mining

### Applications

- Liquid level measurement in process tanks for various chemical products
- Liquid and solid volume measurement for storage tanks

## 1.2 Overview

### OPTIFLEX 2200 C – Compact / Vertical version



This version makes it easier to read and operate devices installed on a tank roof or in a recess.

### OPTIFLEX 2200 C – Compact / Horizontal version

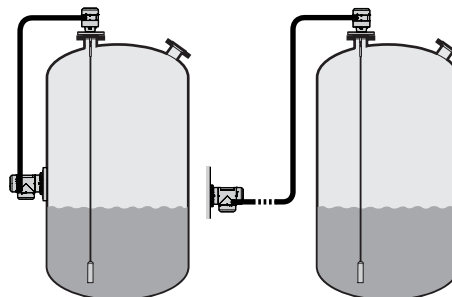


This version is ideal for installation in locations with low roofs.

## OPTIFLEX 2200 F – Remote version

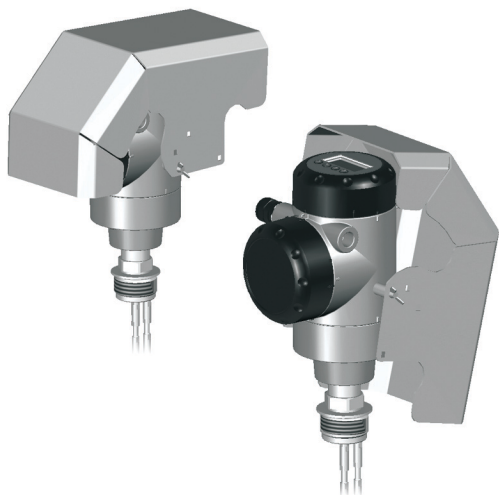


This version has a separate converter with a display which can be mounted and read off at the bottom of the tank or even at a distance of up to 100 m / 328 ft from the sensor.



## Weather protection

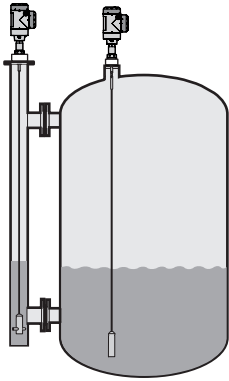
A weather protection option can also be ordered with the device. It is recommended for outdoor applications.



- Must be ordered with the device.
- Can be ordered for both compact versions of the device and the probe housing of the remote version.
- Easily opened and closed.

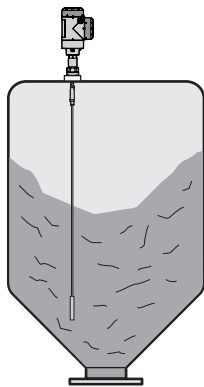
## 1.3 Applications

### 1. Level measurement of liquids



The level transmitter can measure the level of a wide range of liquid products on a large variety of installations within the stated pressure and temperature range. It does not require any calibration: it is only necessary to adapt the probe length and do a short configuration procedure.

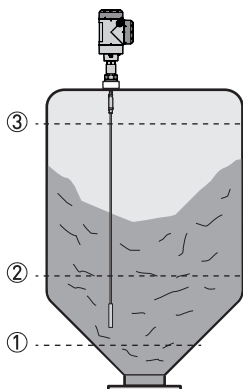
### 2. Level measurement of solids



The level transmitter has a  $\varnothing 4$  mm / 0.15" single cable probe for measuring powders and granulates in silos up to 20 m / 65.6 ft high. It does not require any calibration: it is only necessary to adapt the probe length and do a short configuration procedure.

For silos up to 20 m / 65.6 ft, the level transmitter also has a  $\varnothing 8$  mm / 0.32" single cable probe for silos up to 20 m / 65.6 ft.

### 3. Volume measurement



A conversion table (strapping table) function is available in the configuration menu for volume or mass measurement. Up to 30 volume values can be related to level values. For example:  
 Level ① = 2 m / Volume ① = e.g. 0.7 m<sup>3</sup>  
 Level ② = 10 m / Volume ② = e.g. 5 m<sup>3</sup>  
 Level ③ = 20 m / Volume ③ = e.g. 17 m<sup>3</sup>

This data permits the device to calculate volumes between strapping table entries.

1.4 Application table for probe selection

	Double rod	Single rod	Single rod (segmented)	Coaxial	Coaxial (segmented)	Double cable	Single cable Ø4 mm / 0.15"	Single cable Ø2 mm / 0.08"	Single cable Ø8 mm / 0.32"
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Maximum probe length, L

4 m / 13 ft	■	■							
6 m / 20 ft			■	■	■				
28 m / 92 ft						■			
40 m / 131 ft							■	■	

Liquids

Liquid application	■	■	■	■	■	■	■	■	■
LPG, LNG	■	①	①	■	■	■	①	①	■
Highly viscous liquids		■	■				■	■	
Highly crystallising liquids		■	■				■	■	
Highly corrosive liquids		②	③	■	■		■	■	
Foam		■	■	■	■		■	■	
Agitated liquids	④	④	④	④	④	④	④	④	
Spray in tank		①	①	■	■		①	①	
Storage tanks	■	■	■	■	■	■	■	■	■
Installation in bypass chamber	■	■	■	■	■	■	■	■	■
Small diameter nozzles and long nozzles	■	④	④	■	■		④	④	
Stilling wells	■	■	■	■	■	■	■	■	■

Solids

Powders		■					⑤		■
Granules, <5 mm / 0.2"		■					⑤		■

■ standard ■ optional □ on request

- ① Install the device in a stilling well or a bypass chamber
- ② Make a selection from one of these 2 options: a probe made of HASTELLOY® C-22® or a probe with a PVC, PVDF or PP protective sheath
- ③ Use a probe made of HASTELLOY® C-22®
- ④ Use this probe with an anchor fitting. For more data, refer to the handbook.
- ⑤ Max. length is 20 m / 65.5 ft, more on request



## 1.5 Measuring principle

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

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

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

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

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

### TDR measurement of level

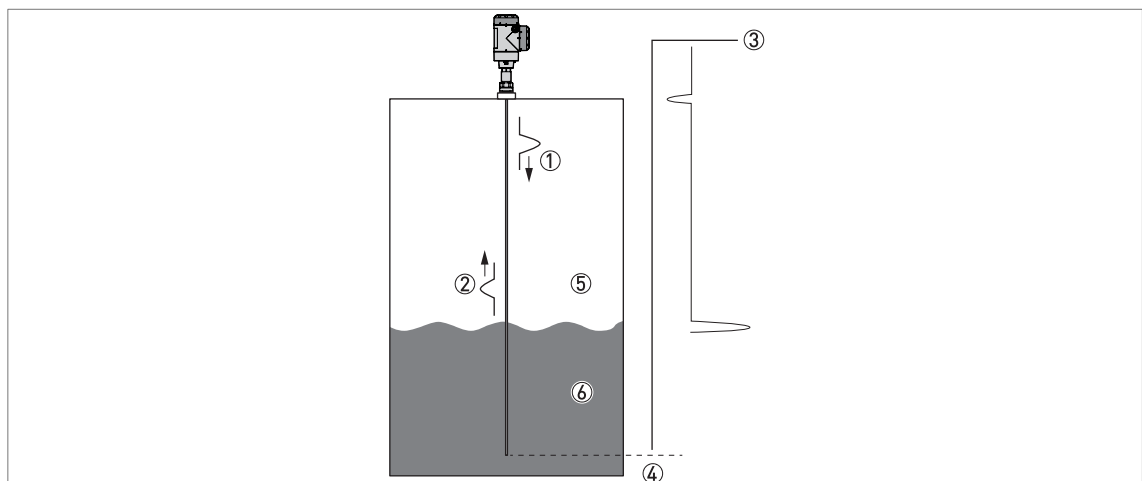


Figure 1-1: TDR measurement of level

- ① Transmitted pulses
- ② Reflected pulse
- ③ Pulse amplitude
- ④ Time of flight
- ⑤ Air,  $\epsilon_r = 1$
- ⑥  $\epsilon_r \geq 1.4$  in direct mode or  $\epsilon_r \geq 1.1$  in TBF mode

## 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 sales office.
- Additional information (certificates, special tools, software,...) and complete product documentation can be downloaded free of charge from the website (Downloadcenter).

### Converter

#### Measuring system

Application	Level and volume measurement of liquids, pastes, powders and granulates
Measuring principle	TDR (time domain reflectometry)
Construction	Compact (C) version: Measuring probe attached directly to a signal converter Remote (F) version: Measuring probe installed on a tank and connected by a signal cable (max. length 100 m / 328 ft) to a signal converter

#### Operating conditions

Ambient temperature	-40...+80°C / -40...+176°F Integrated LCD display: -20...+60°C / -5...+140°F; if the ambient temperature is not in these limits, the display switches off. The device continues to operate correctly.
Storage temperature	-50...+85°C / -60...+185°F (min. -40°C / -40°F for devices with the integrated LCD display option)
Ingress protection	IEC 60529: IP66 / IP67 NEMA 250: NEMA type 4X (housing) and type 6P (probe)

#### Materials

Housing	Polyester-coated aluminium or stainless steel (1.4404 / 316L)
Cable entry	Plastic; nickel-plated brass, stainless steel

#### Electrical connections

Power supply (terminals)	<b>Terminals output – Non-Ex / Ex i:</b> 11.5...30 VDC; min./max. value for an output of 22 mA at the terminal
	<b>Terminals output – Ex d:</b> 13.5...36 VDC; min./max. value for an output of 22 mA at the terminal
Current output load	<b>Non-Ex / Ex i:</b> $R_L [\Omega] \leq ((U_{ext} - 11.5 \text{ V}) / 22 \text{ mA})$ . For more data, refer to <i>Minimum power supply voltage</i> on page 17.
	<b>Ex d:</b> $R_L [\Omega] \leq ((U_{ext} - 13.5 \text{ V}) / 22 \text{ mA})$ . For more data, refer to <i>Minimum power supply voltage</i> on page 17.
Cable entry	M20×1.5; ½ NPT
Cable gland	Standard: none
	Options: M20×1.5 (cable diameter (non-Ex / Ex i: 6...7.5 mm / 0.24...0.30"; Ex d: 6...10 mm / 0.24...0.39"); others are available on request
Signal cable – remote version	None for non-Ex devices (4-wire shielded cable of max. length 100 m / 328 ft to be supplied by the customer). Supplied with all Ex-approved devices. For more data, refer to the handbook
Cable entry capacity (terminal)	0.5...2.5 mm <sup>2</sup>

#### Input and output

Measured variable	Time between the emitted and received signal
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<b>Current output / HART®</b>	
Output signal	4...20 mA HART® or 3.8...20.5 mA acc. to NAMUR NE 43 ①
Resolution	±3 µA
Temperature drift (analog)	Typically 50 ppm/K
Temperature drift (digital)	Max. ±15 mm for the full temperature range
Error signal options	High: 22 mA; Low: 3.6 mA acc. to NAMUR NE 43; Hold (frozen value – not available if the output agrees with NAMUR NE 43) ②
<b>PROFIBUS PA</b>	
Type	PROFIBUS MBP interface that agrees with IEC 61158-2 with 31.25 kbit/s; voltage mode (MBP = Manchester-Coded, Bus-Powered)
Function blocks	1 × Physical Block, 1 × Level Transducer Block, 4 × Analog Input Function Blocks
Device power supply	9...32 VDC - bus powered; no additional power supply required
Polarity sensitivity	No
Basic current	15 mA
<b>FOUNDATION™ fieldbus</b>	
Physical layer	FOUNDATION™ fieldbus protocol that agrees with IEC 61158-2 and FISCO model
Communication standard	H1
ITK version	6.1
Function blocks	1 × Resource Block (RB), 3 × Transducer Blocks (TB), 3 × Analog Input Blocks (AI), 1 × Proportional Integral Derivative Block (PID)
	Analog Input Block: 30 ms
	Proportional Integral Derivative Block: 40 ms
Device power supply	Not intrinsically safe: 9...32 VDC Intrinsically safe: 9...24 VDC
Basic current	14 mA
Maximum error current FDE	20.5 mA (= basic current + error current = 14 mA + 6.5 mA)
Polarity sensitivity	No
Minimum cycle time	250 ms
Output data	Level, distance, ullage conversion, level conversion
Input data	None
Link Active Scheduler	Supported

### Display and user interface

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

### Approvals and certification

CE	This device fulfils the statutory requirements of the EC directives. The manufacturer certifies successful testing of the product by applying the CE mark.
Vibration resistance	EN 60721-3-4 (1...9 Hz: 3 mm / 10...200 Hz: 1g; 10g shock ½sinus: 11 ms) For coaxial probes: <2 m / 6.56 ft, 0.5g or category 4M3 according to EN 60721-3-4 <6 m / 19.68 ft, 0.5g or category 4M1 according to EN 60721-3-4

Explosion protection	
ATEX (Ex ia, Ex d or Ex tb) DEKRA 11ATEX0166 X	<b>Compact version</b>
	II 1/2 G, 2 G Ex ia IIC T6...T2 Ga/Gb or Ex ia IIC T6...T2 Gb;
	II 1/2 D, 2 D Ex ia IIIC T90°C Da/Db or Ex ia IIIC T90°C Db IP6X;
	II 1/2 G, 2 G Ex d ia IIC T6...T2 Ga/Gb or Ex d ia IIC T6...T2 Gb;
	II 1/2 D, 2 D Ex ia tb IIIC T90°C Da/Db or Ex ia tb IIIC T90°C Db IP6X
	<b>Remote version, transmitter</b>
	II 2 G Ex ia [ia Ga] IIC T6...T4 Gb;
	II 2 D Ex ia [ia Da] IIIC T90°C Db;
	II 2 G Ex d ia [ia Ga] IIC T6...T4 Gb;
	II 2 D Ex ia tb [ia Da] IIIC T90°C Db
	<b>Remote version, sensor</b>
	II 1/2 G Ex ia IIC T6...T2 Ga/Gb
	II 1/2 D Ex ia IIIC T90°C Da/Db
	II 1/2 G Ex ia IIC T6...T2 Gb
II 1/2 D Ex ia IIIC T90°C Db	
ATEX (Ex ic) DEKRA 13ATEX0051 X	<b>Compact version</b>
	II 3 G Ex ic IIC T6...T2 Gc;
	II 3 D Ex ic IIIC T90°C Dc
	<b>Remote version, transmitter</b>
	II 3 G Ex ic [ic] IIC T6...T4 Gc;
	II 3 D Ex ic [ic] IIIC T90°C Dc
	<b>Remote version, sensor</b>
	II 3 G Ex ic IIC T6...T2 Gc;
II 3 D Ex ic IIIC T90°C Dc	
IECEX IECEX DEK 11.0060 X	<b>Compact version</b>
	Ex ia IIC T6...T2 Ga/Gb or Ex ia IIC T6...T2 Gb or Ex ic IIC T6...T2 Gc;
	Ex ia IIIC T90°C Da/Db or Ex ia IIIC T90°C Db or Ex ic IIIC T90°C Dc;
	Ex d ia IIC T6...T2 or Ex d ia IIIC T6...T2 Gb;
	Ex ia tb IIIC T90°C Da/Db or Ex ia tb IIIC T90°C Db
	<b>Remote version, transmitter</b>
	Ex ia [ia Ga] IIC T6...T4 Gb or Ex ic IIC T6...T4 Gc;
	Ex ia [ia Da] IIIC T90°C Db or Ex ic [ic] IIIC T90°C Dc;
	Ex d ia [ia Ga] IIC T6...T4 Gb;
	Ex ia tb [ia Da] IIIC T90°C Db
	<b>Remote version, sensor</b>
	Ex ia IIC T6...T2 Ga/Gb or Ex ia IIC T6...T2 Gb or Ex ic IIC T6...T2 Gc;
	Ex ia IIIC T90°C Da/Db or Ex ia IIIC T90°C Db or Ex ic IIIC T90°C Dc

cFMus – Dual Seal-approved	<b>NEC 500 (Division ratings)</b>
	XP-AIS / Cl. I / Div. 1 / Gr. ABCD / T6–T1;
	DIP / Cl. II, III / Div. 1 / Gr. EFG / T90°C;
	IS / Cl. I, II, III / Div. 1 / Gr. ABCDEFG / T6–T1;
	NI / Cl. I / Div. 2 / Gr. ABCD / T6–T1
	<b>NEC 505 and NEC 506 (Zone ratings)</b>
	Cl. I / Zone 0 / AEx d [ia] / IIC / T6–T1;
	Cl. I / Zone 0 / AEx ia / IIC / T6–T1;
	Cl. I / Zone 2 / AEx nA / IIC / T6–T1;
	Cl. I / Zone 2 / AEx ic / IIC / T6–T1 FISCO;
	Zone 20 / AEx ia / IIIC / T90°C
	Zone 20 / AEx tb [ia] / IIIC / T90°C
	Hazardous (Classified) Locations, indoor/outdoor Type 4X and 6P, IP66, Dual Seal
	<b>CEC Section 18 (Zone ratings)</b>
	Cl. I, Zone 0, Ex d [ia], IIC, T6–T1;
	Cl. I, Zone 0, Ex ia, IIC, T6–T1;
	Cl. I, Zone 2, Ex nA, IIC, T6–T1;
	Cl. I, Zone 2, Ex ic, IIC, T6–T1 FISCO
	<b>CEC Section 18 and Annex J (Division ratings)</b>
	XP-AIS / Cl. I / Div. 1 / Gr. BCD / T6–T1
	DIP / Cl. II, III / Div. 1 / Gr. EFG / T6–T1
IS / Cl. I / Div. 1 / Gr. BCD / T6–T1	
NI / Cl. I / Div. 2 / Gr. ABCD / T6–T1	
NEPSI	Ex ia IIC T2–T6 Gb or Ex ia IIC T2–T6 Ga/Gb DIP A20/A21 T <sub>A</sub> T90°C IP6X
	Ex d ia IIC T2–T6 Gb or Ex d ia IIC T2–T6 Ga/Gb DIP A20/A21 T <sub>A</sub> T90°C IP6X
DNV / INMETRO DNV 13.0142 X	<b>Compact version</b>
	Ex ia IIC T6...T2 Ga/Gb or Ex ia IIC T6...T2 Gb or Ex ic IIC T6...T2 Gc;
	Ex ia IIIC T90°C Da/Db or Ex ia IIIC T90°C Db or Ex ic IIIC T90°C Dc;
	Ex d ia IIC T6...T2 or Ex d ia IIIC T6...T2 Gb;
	Ex ia tb IIIC T90°C Da/Db or Ex ia tb IIIC T90°C Db
	<b>Remote version, transmitter</b>
	Ex ia [ia Ga] IIC T6...T4 Gb or Ex ic IIC T6...T4 Gc;
	Ex ia [ia Da] IIIC T90°C Db or Ex ic [ic] IIIC T90°C Dc;
	Ex d ia [ia Ga] IIC T6...T4 Gb;
	Ex ia tb [ia Da] IIIC T90°C Db
	<b>Remote version, sensor</b>
	Ex ia IIC T6...T2 Ga/Gb or Ex ia IIC T6...T2 Gb or Ex ic IIC T6...T2 Gc;
	Ex ia IIIC T90°C Da/Db or Ex ia IIIC T90°C Db or Ex ic IIIC T90°C Dc

Other standards and approvals	
SIL – only for 4...20 mA output	Compact version only: SIL 2 – certified according to all the requirements in EN 61508 (Full Assessment) and for high/low demand mode operation. HFT=0, SFF=94.3% (for non-Ex / Ex i devices) or 92.1% (for Ex d devices), type B device
EMC	EMC Directives 2004/108/EC in conjunction with EN 61326-1 (2013). The device agrees with this standard if: – the device has a coaxial probe or – the device has a single / double probe that is installed in a metallic tank. For more data. SIL 2-approved devices agree with EN 61326-3-1 (2008) and EN 61326-3-2 (2008)
NAMUR	NAMUR NE 21 Electromagnetic Compatibility (EMC) of Industrial Process and Laboratory Control Equipment
	NAMUR NE 43 Standardization of the Signal Level for the Failure Information of Digital Transmitters
	NAMUR NE 53 Software and Hardware of Field Devices and Signal Processing Devices with Digital Electronics
	NAMUR NE 107 Self-Monitoring and Diagnosis of Field Devices
CRN	This certification is applicable for all Canadian provinces and territories. For more data, refer to the website.
Construction code	On request: NACE MR0175 / ISO 15156; NACE MR0103

① HART® is a registered trademark of the HART Communication Foundation

② Only the 3.6 mA error signal is applicable to SIL-approved devices

### Probe options

	Single cable Ø2 mm / 0.08"	Single cable Ø4 mm / 0.16"	Single rod Ø8 mm / 0.32"	Single cable Ø8 mm / 0.32"

### Measuring system

Application	Liquids	Liquids and solids		Solids
Measuring range	1...40 m / 3.28...131.23 ft	Liquids: 1...40 m / 3.28...131.23 ft Solids: 1...20 m / 3.28...65.62 ft	1...6 m / 3.28...19.7 ft	1...40 m / 3.28...131.23 ft
Dead zone	This depends on the type of probe. For more data, refer to <i>Measurement limits</i> on page 20.			

### Measuring accuracy

Accuracy (in direct mode)	<b>Standard (liquids and solids):</b> ±10 mm / ±0.4", when distance ≤ 10 m / 33 ft; ±0.1% of measured distance, when distance > 10 m / 33 ft <b>Optional (liquids and solids):</b> ±3 mm / ±0.1", when distance ≤ 10 m / 33 ft; ±0.03% of measured distance, when distance > 10 m / 33 ft
Accuracy (in TBF mode)	±20 mm / ±0.8"
Resolution	1 mm / 0.04"
Repeatability	±1 mm / ±0.04"
Maximum rate of change at 4 mA	10 m/min / 32.8 ft/min

	Single cable Ø2 mm / 0.08"	Single cable Ø4 mm / 0.16"	Single rod Ø8 mm / 0.32"	Single cable Ø8 mm / 0.32"
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### Operating conditions

Min./Max. temperature at the process connection (also depends on the temperature limits of the gasket material. Refer to "Materials" in this table.)	-50...+300°C / -58...+572°F	-50...+150°C / -58...+302°F		
Pressure	-1...40 barg / -14.5...580 psig			
Viscosity (liquids only)	10000 mPa.s / 10000 cP			
Dielectric constant	≥ 1.8 in direct mode; ≥ 1.1 in TBF mode			

### Materials

Probe	Stainless steel (1.4404 / 316L); HASTELLOLOY® C-22® (2.4602)	Stainless steel (1.4401 / 316)	Stainless steel (1.4404 / 316L)	Stainless steel (1.4401 / 316)
Gasket (process seal)	FKM/FPM (-40...+300°C / -40...+572°F); Kalrez® 6375 (-20...+300°C / -4...+572°F); EPDM (-50...+250°C / -58...+482°F) ①	FKM/FPM (-40...+150°C / -40...+302°F); Kalrez® 6375 (-20...+150°C / -4...+302°F); EPDM (-50...+150°C / -58...+302°F) ①		
Process connection	Stainless steel (1.4404 / 316L); HASTELLOLOY® C-22® (2.4602)			

### Process connections

Thread	For more data on options, refer to <i>Order code</i> on page 50
Flange	For more data on options, refer to <i>Order code</i> on page 50

① Kalrez® is a registered trademark of DuPont Performance Elastomers L.L.C.

	Double cable 2 × Ø4 mm / 0.16"	Double rod 2 × Ø8 mm / 0.32"	Coaxial Ø22 mm / 0.87"
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### Measuring system

Application	Liquids		
Measuring range	1...28 m / 3.28...91.86 ft	1...4 m / 3.3...13.12 ft	0.6...6 m / 1.97...19.69 ft
Dead zone	This depends on the type of probe. For more data, refer to <i>Measurement limits</i> on page 20.		

### Measuring accuracy

Accuracy (in direct mode)	<b>Standard (liquids and solids):</b> ±10 mm / ±0.4", when distance ≤ 10 m / 33 ft; ±0.1% of measured distance, when distance > 10 m / 33 ft  <b>Optional (liquids and solids):</b> ±3 mm / ±0.1", when distance ≤ 10 m / 33 ft; ±0.03% of measured distance, when distance > 10 m / 33 ft
Accuracy (in TBF mode)	±20 mm / ±0.8"
Resolution	1 mm / 0.04"
Repeatability	±1 mm / ±0.04"

	Double cable 2 × Ø4 mm / 0.16"	Double rod 2 × Ø8 mm / 0.32"	Coaxial Ø22 mm / 0.87"
Maximum rate of change at 4 mA	10 m/min / 32.8 ft/min		

### Operating conditions

Min./Max. temperature at the process connection (also depends on the temperature limits of the gasket material. Refer to "Materials" in this table.)	-50...+150°C / -58...+302°F		
Pressure	-1...40 barg / -14.5...580 psig		
Viscosity (liquids only)	10000 mPa.s / 10000 cP	1500 mPa.s / 1500 cP	500 mPa.s / 500 cP
Dielectric constant	≥ 1.6 in direct mode		≥ 1.4 in direct mode
	≥ 1.1 in TBF mode		

### Materials

Probe	Stainless steel (1.4404 / 316L)	Stainless steel (1.4401 / 316); HASTELLOY® C-22® (2.4602)
Gasket (process seal)	FKM/FPM (-40...+150°C / -40...+302°F); Kalrez® 6375 (-20...+150°C / -4...+302°F); EPDM (-50...+150°C / -58...+302°F) ①	
Process connection	Stainless steel (1.4404 / 316L); HASTELLOY® C-22® (2.4602)	

### Process connections

Thread	For more data on options, refer to <i>Order code</i> on page 50
Flange	For more data on options, refer to <i>Order code</i> on page 50

① Kalrez® is a registered trademark of DuPont Performance Elastomers L.L.C.



## 2.2 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 2-1: 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  $R_L$  [ $\Omega$ ]

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

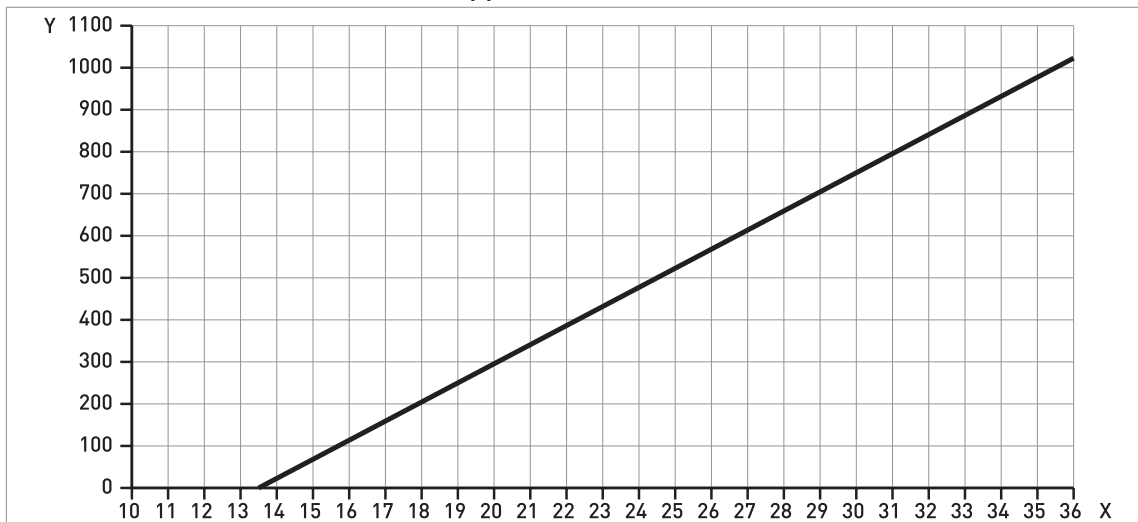


Figure 2-2: Minimum power supply voltage for an output of 22 mA at the terminal (Hazardous Location approval (Ex d / XP/NI))

X: Power supply U [VDC]  
Y: Current output load  $R_L$  [ $\Omega$ ]

## 2.3 Pressure / flange temperature graph for probe selection

Make sure that the transmitters are used within their operating limits. Obey the temperature limits of the process seal and the flange.

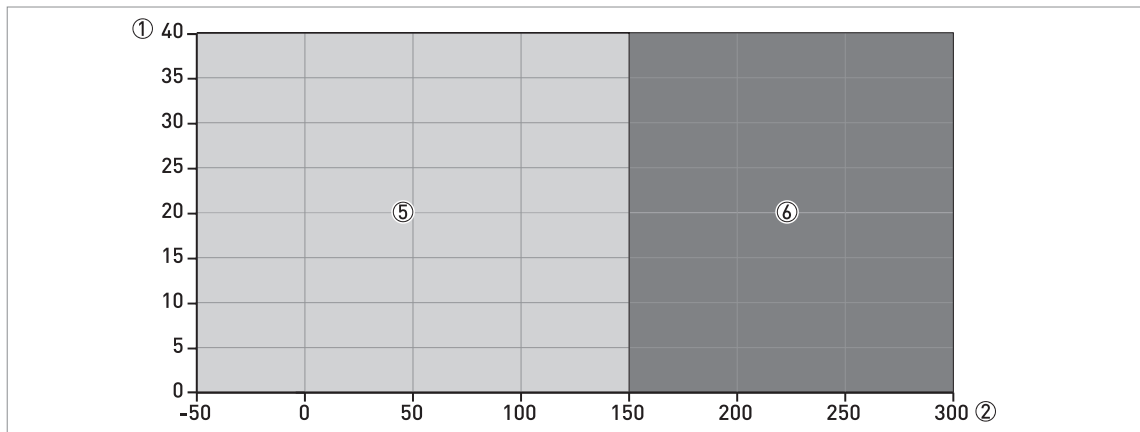


Figure 2-3: Pressure/temperature graph for probe selection in °C and barg

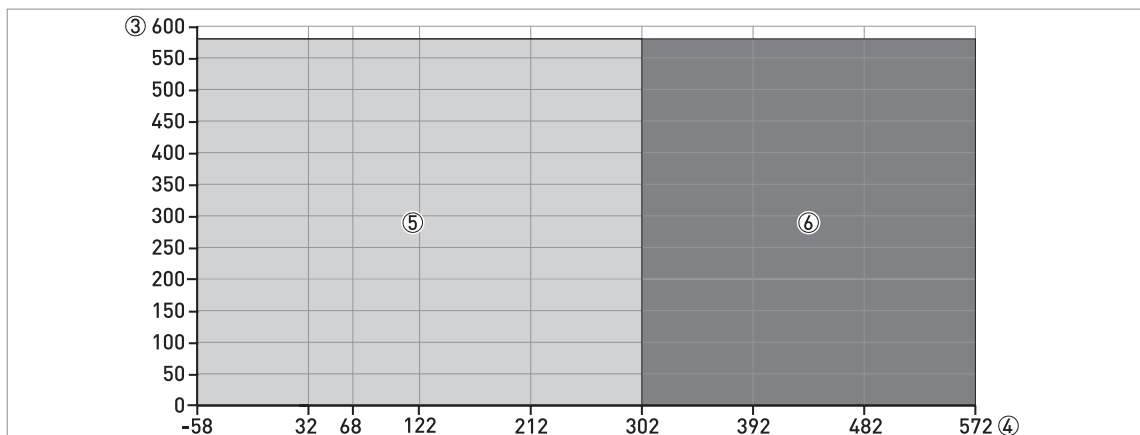


Figure 2-4: Pressure/temperature graph for probe selection in °F and psig

- ① Process pressure,  $P_s$  [barg]
- ② Process connection temperature,  $T$  [°C]
- ③ Process pressure,  $P_s$  [psig]
- ④ Process connection temperature,  $T$  [°F]
- ⑤ All probes
- ⑥ High-Temperature (HT) version of the  $\varnothing 2$  mm / 0.08" 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 10.*

**CRN CERTIFICATION**

There is a CRN certification option for devices with process connections that agree with ASME standards. This certification is necessary for all devices that are installed on a pressure vessel and used in Canada. 1" and 1½" ASME flanges are not available for CRN-approved devices.

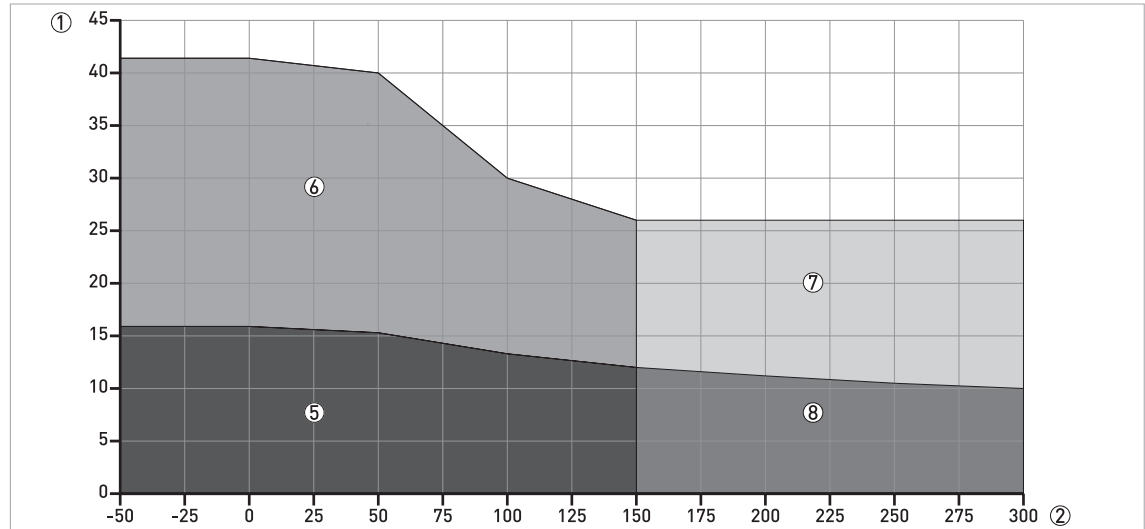
**ASME flanges for CRN-approved devices**

Figure 2-5: Pressure / temperature rating (ASME B16.5), flange and threaded connections, in °C and barg

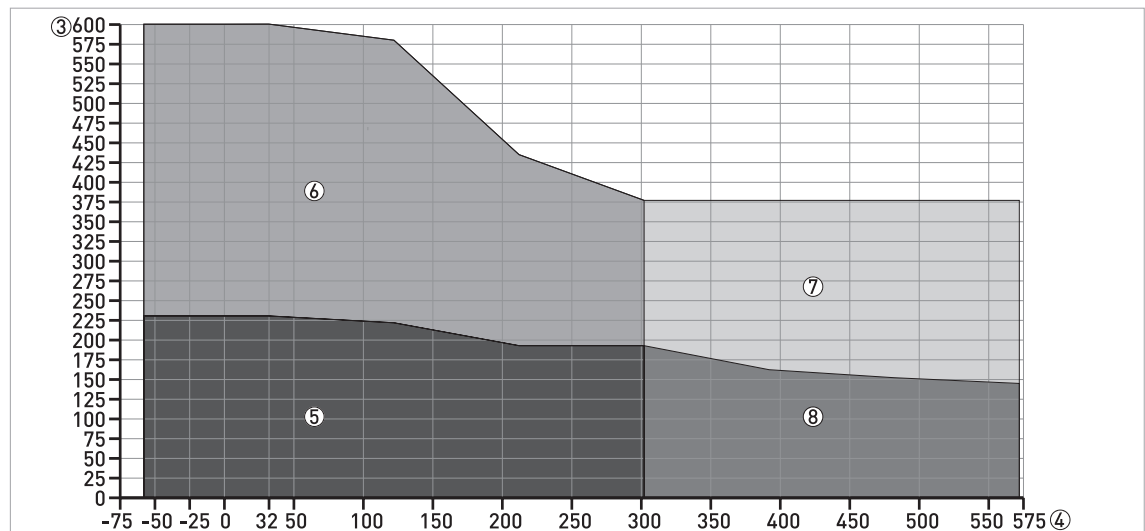


Figure 2-6: Pressure / temperature rating (ASME B16.5), flange and threaded connections, in °F and psig

① p [barg]

② T [°C]

③ p [psig]

④ T [°F]

⑤ Flange connection, Class 150 / Threaded connections, NPT: All probes

⑥ Flange connection, Class 300 / Threaded connections, NPT: All probes

⑦ Flange connection, Class 300 / Threaded connections, NPT: High-Temperature (HT) version of the Ø2 mm / 0.08" single cable probe

⑧ Flange connection, Class 150 / Threaded connections, NPT: High-Temperature (HT) version of the Ø2 mm / 0.08" single cable probe

## 2.4 Measurement limits

## Double cable and double rod probes

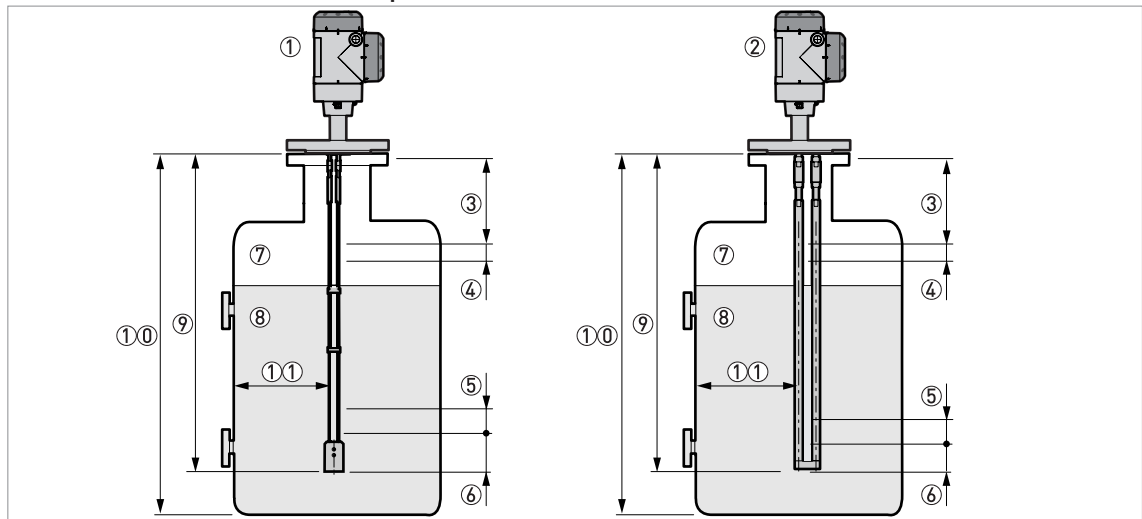


Figure 2-7: Measurement limits

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

### Measurement limits (dead zone) in mm and inches

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

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

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

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

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

80 is  $\epsilon_r$  of water; 2.5 is  $\epsilon_r$  of oil

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

## Single cable and single rod probes

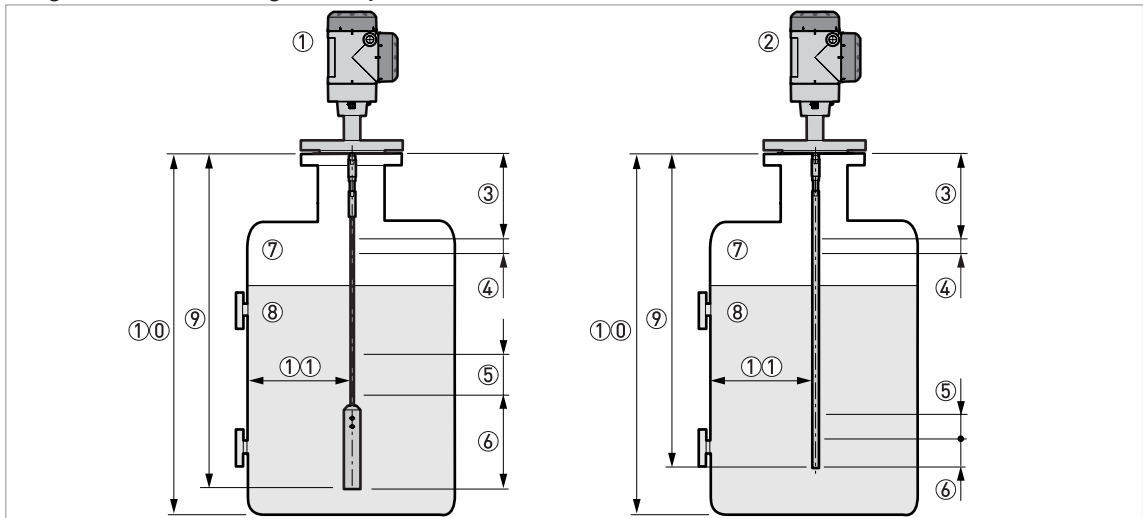


Figure 2-8: Measurement limits

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

## Measurement limits (dead zone) in mm and inches

Probes	$\epsilon_r = 80$				$\epsilon_r = 2.5$			
	Top ③		Bottom ⑥		Top ③		Bottom ⑥	
	[mm]	[inches]	[mm]	[inches]	[mm]	[inches]	[mm]	[inches]
Ø2 mm / 0.08" single cable ①	120	4.72	200	7.87	120	4.72	240	9.45
4 mm / 0.16" single cable ①	120	4.72	200	7.87	120	4.72	240	9.45
Ø8 mm / 0.32" single cable, type 1 ②	120	4.72	20	0.79	120	4.72	120	4.72
Ø8 mm / 0.32" single cable, type 2 ③	120	4.72	270	10.63	120	4.72	340	13.39
Single rod	120	4.72	20	0.79	120	4.72	120	4.72

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

② When the probe has the Ø12×100 mm (Ø0.5"×3.9") counterweight option. If the cable probe does not have a counterweight, speak or write to your local supplier for more data.

③ When the probe has the Ø38×245 mm (Ø1.5"×9.6") counterweight option. If the cable probe does not have a counterweight, speak or write to your local supplier for more data.

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

Probes	$\epsilon_r = 80$				$\epsilon_r = 2.5$			
	Top ④		Bottom ⑤		Top ④		Bottom ⑤	
	[mm]	[inches]	[mm]	[inches]	[mm]	[inches]	[mm]	[inches]
Ø2 mm / 0.08" single cable ①	0	0	0	0	0	0	0	0
Ø4 mm / 0.16" single cable ①	0	0	0	0	0	0	0	0
Ø8 mm / 0.32" single cable, type 1 ②	50	1.97	0	0	0	0	0	0
Ø8 mm / 0.32" single cable, type 2 ③	50	1.97	0	0	0	0	0	0
Single rod	50	1.97	0	0	0	0	0	0

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

② When the probe has the Ø12×100 mm (Ø0.5"×3.9") counterweight option. If the cable probe does not have a counterweight, speak or write to your local supplier for more data.

③ When the probe has the Ø38×245 mm (Ø1.5"×9.6") counterweight option. If the cable probe does not have a counterweight, speak or write to your local supplier for more data.

80 is  $\epsilon_r$  of water; 2.5 is  $\epsilon_r$  of oil

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

## Coaxial probe

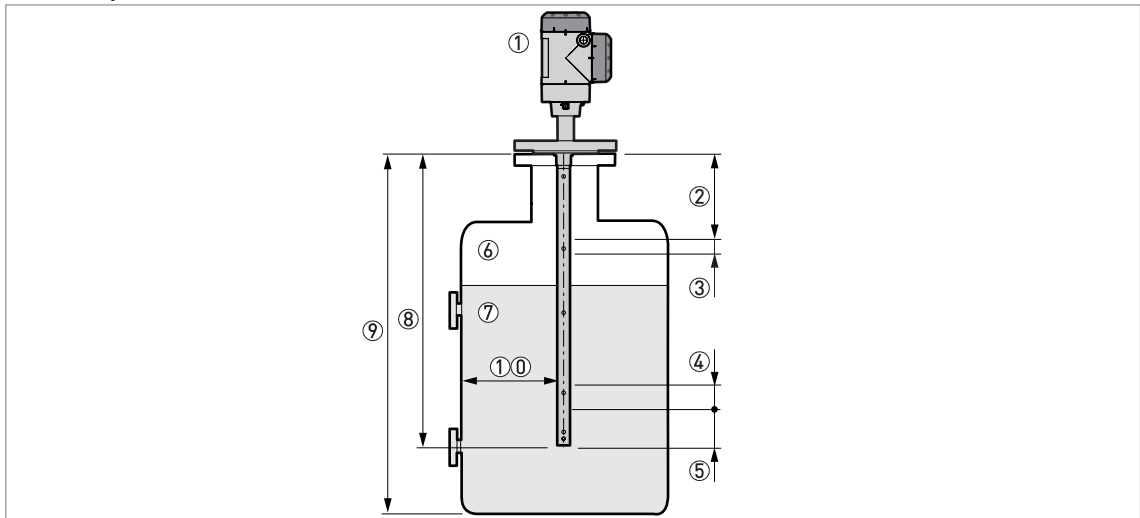


Figure 2-9: Measurement limits

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



### Measurement limits (dead zone) in mm and inches

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

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

Probe	$\epsilon_r = 80$				$\epsilon_r = 2.5$			
	Top ③		Bottom ④		Top ③		Bottom ④	
	[mm]	[inches]	[mm]	[inches]	[mm]	[inches]	[mm]	[inches]
Coaxial	0	0	0	0	0	0	0	0

80 is  $\epsilon_r$  of water; 2.5 is  $\epsilon_r$  of oil

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

## 2.5 Dimensions and weights

## Housing dimensions

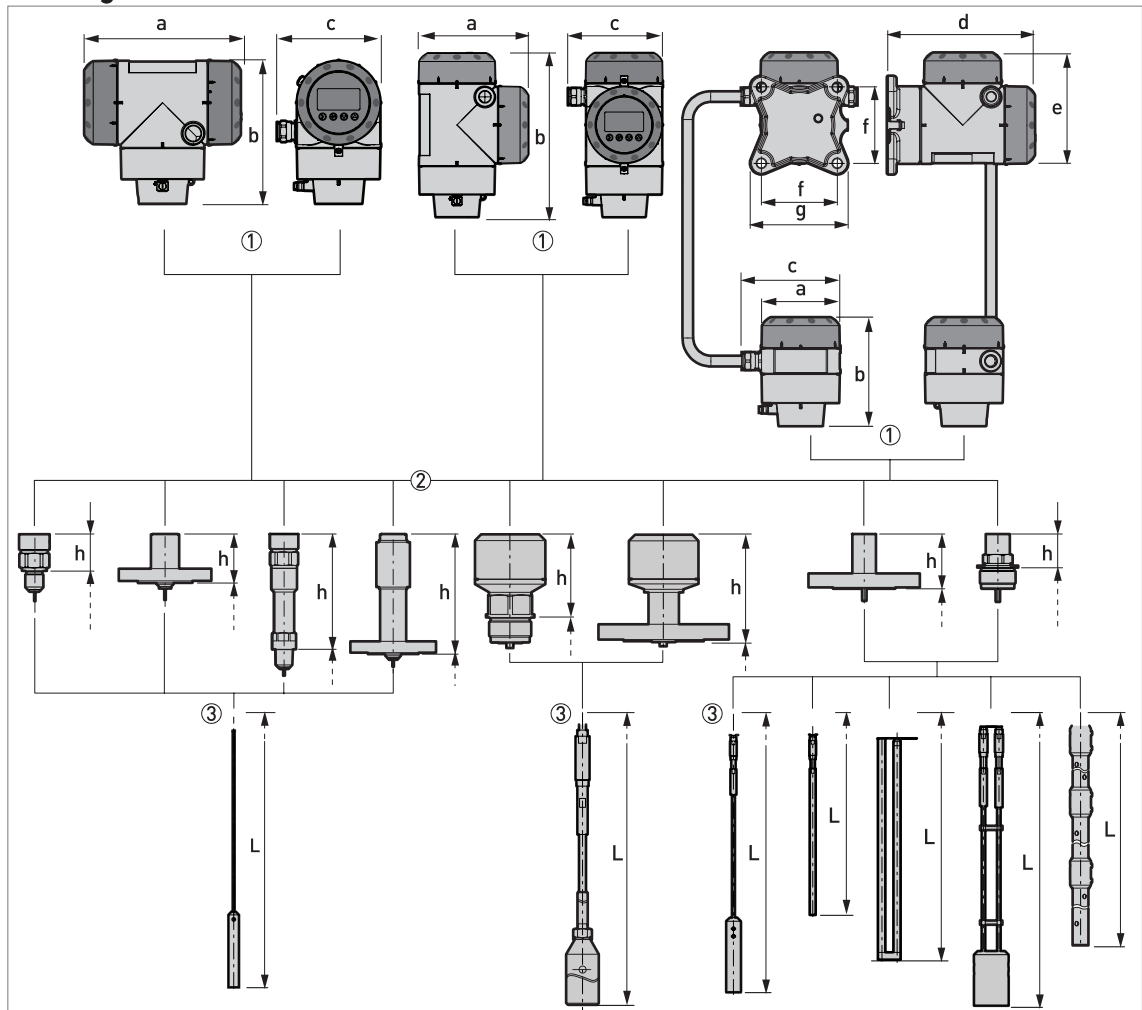


Figure 2-10: Housing dimensions

- ① **Housing options.** From left to right: compact converter with horizontal housing, compact converter with vertical housing, and remote converter (top) and probe housing (bottom)
- ② **Process connection options.** From left to right: threaded connection for  $\varnothing 2$  mm / 0.08" single cable probe, flange connection for  $\varnothing 2$  mm / 0.08" single cable probe, high-temperature [HT] threaded connection for  $\varnothing 2$  mm / 0.08" single cable probe, HT flange connection for  $\varnothing 2$  mm / 0.08" single cable probe, threaded connection for  $\varnothing 8$  mm / 0.32" single cable probe, flange connection for  $\varnothing 8$  mm / 0.32" single cable probe, flange connection for other probes, threaded connection for other probes
- ③ **Probe options.** From left to right:  $\varnothing 2$  mm / 0.08" single cable probe,  $\varnothing 8$  mm / 0.32" single cable probe,  $\varnothing 4$  mm / 0.16" single cable probe, single rod (single-piece or segmented) probe, double rod probe,  $\varnothing 4$  mm / 0.16" double cable probe and coaxial (single-piece or segmented) probe

*All housing covers have bayonet connectors unless it is an explosion-proof (XP / Ex d-approved) device. The terminal compartment cover for explosion-proof devices has a thread with a flame path.*

## Housing options: Dimensions in mm

Dimensions [mm]	Compact – horizontal		Compact – vertical		Remote	
	Non-Ex / Ex i / IS	Ex d / XP	Non-Ex / Ex i / IS	Ex d / XP	Non-Ex / Ex i / IS	Ex d / XP
<b>a</b>	191	258	147	210	104	104
<b>b</b>	175	175	218	218	142	142
<b>c</b>	127	127	127	127	129	129
<b>d</b>	—	—	—	—	195	195
<b>e</b>	—	—	—	—	146	209
<b>f</b>	—	—	—	—	100	100
<b>g</b>	—	—	—	—	130	130

## Housing options: Dimensions in inches

Dimensions [inches]	Compact – horizontal		Compact – vertical		Remote	
	Non-Ex / Ex i / IS	Ex d / XP	Non-Ex / Ex i / IS	Ex d / XP	Non-Ex / Ex i / IS	Ex d / XP
<b>a</b>	7.5	10.2	5.79	8.27	4.09	4.09
<b>b</b>	6.89	6.89	8.23	8.23	5.59	5.59
<b>c</b>	5.00	5.00	5.00	5.00	5.08	5.08
<b>d</b>	—	—	—	—	7.68	7.68
<b>e</b>	—	—	—	—	5.75	8.23
<b>f</b>	—	—	—	—	3.94	3.94
<b>g</b>	—	—	—	—	5.12	5.12

## Process connection and probe options: Dimensions in mm

Dimensions [mm]	Probes with threaded connections				Probes with flange connections			
	Ø2 mm single cable probe	HT Ø2 mm single cable probe	Ø8 mm single cable probe	Other probes	Ø2 mm single cable probe	HT Ø2 mm single cable probe	Ø8 mm single cable probe	Other probes
<b>h</b>	43	169	95	45	61	186	127	73
<b>L</b>	For more data, refer to "Single probes" and "Double and coaxial probes" in this section.							

## Process connection and probe options: Dimensions in inches

Dimensions [inches]	Probes with threaded connections				Probes with flange connections			
	Ø0.08" single cable probe	HT Ø0.08" single cable probe	Ø0.32" single cable probe	Other probes	Ø0.08" single cable probe	HT Ø0.08" single cable probe	Ø0.32" single cable probe	Other probes
<b>h</b>	1.69	6.65	3.74	1.77	2.40	7.32	5.00	2.87
<b>L</b>	For more data, refer to "Single probes" and "Double and coaxial probes" in this section.							

Weather protection option

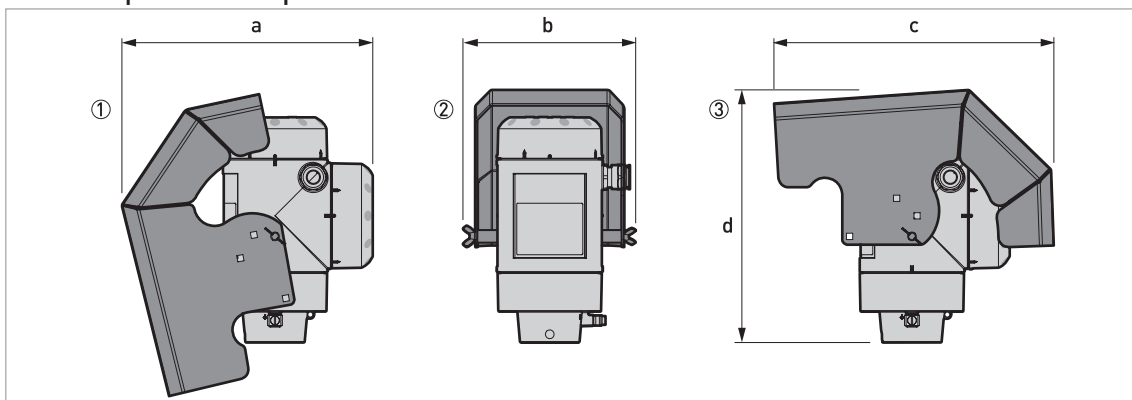


Figure 2-11: Weather protection option for Compact / Vertical and Remote versions

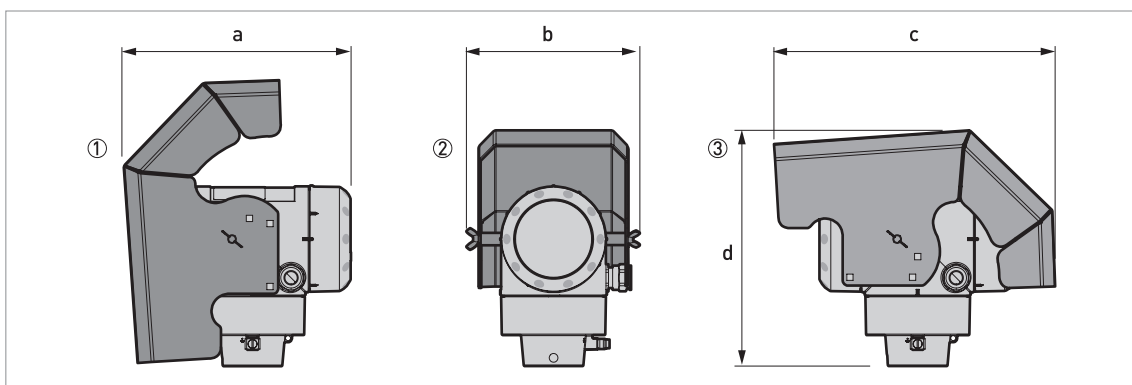


Figure 2-12: Weather protection option for Compact / Horizontal and Remote versions

- ① Left side (with weather protection open)
- ② Rear view (with weather protection closed)
- ③ Right side (with weather protection closed)

**Dimensions and weights in mm and kg**

Weather protection	Dimensions [mm]				Weights [kg]
	a	b	c	d	
Compact / Vertical or Remote versions	244	170	274	245	1.6
Compact / Horizontal or Remote versions	221	170	274	229	1.6

**Dimensions and weights in inches and lb**

Weather protection	Dimensions [inches]				Weights [lb]
	a	b	c	d	
Compact / Vertical or Remote versions	9.6	6.7	10.8	9.6	3.5
Compact / Horizontal or Remote versions	8.7	6.7	10.8	9.0	3.5

## Single probes

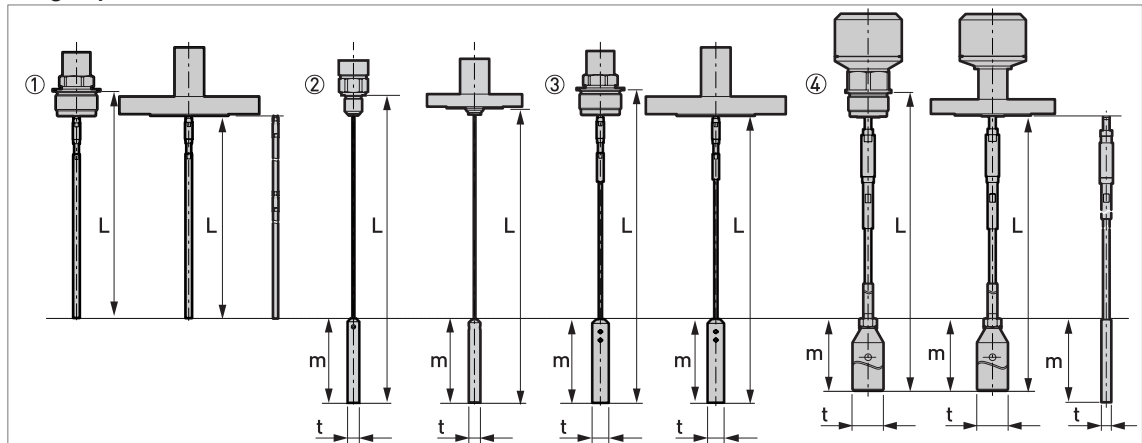


Figure 2-13: Single probe options

- ① Single rod  $\varnothing 8$  mm /  $\varnothing 0.32$ " (thread and flange versions – the segmented probe option is shown on the right side)
- ② Single cable  $\varnothing 2$  mm /  $\varnothing 0.08$ " (thread and flange versions)
- ③ Single cable  $\varnothing 4$  mm /  $\varnothing 0.16$ " (thread and flange versions)
- ④ Single cable  $\varnothing 8$  mm /  $\varnothing 0.32$ " (thread and flange versions – an alternative counterweight is shown on the right side)

*Probe length, L, includes the length of the counterweight.*

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	1000 ②	4000	—	—
Single rod Ø8 mm (segmented) ①	1000 ②	6000	—	—
Single cable Ø2 mm	1000 ②	40000	100	Ø14
Single cable Ø4 mm	1000 ②	40000	100	Ø20
Single cable Ø8 mm, type 1	1000 ②	40000	100	Ø12
Single cable Ø8 mm, type 2	1000 ②	40000	245	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

## Single probes: Dimensions in inches

Probes	Dimensions [inches]			
	L min.	L max.	m	t
Single rod Ø0.32" ①	39 ②	158	—	—
Single rod Ø0.32" (segmented) ①	39 ②	236	—	—
Single cable Ø0.08	39 ②	1575	3.9	Ø0.6
Single cable Ø0.16"	39 ②	1575	3.9	Ø0.8
Single cable Ø0.32", type 1	39 ②	1575	3.9	Ø0.5
Single cable Ø0.32", type 2	39 ②	1575	9.6	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

Double and coaxial probes

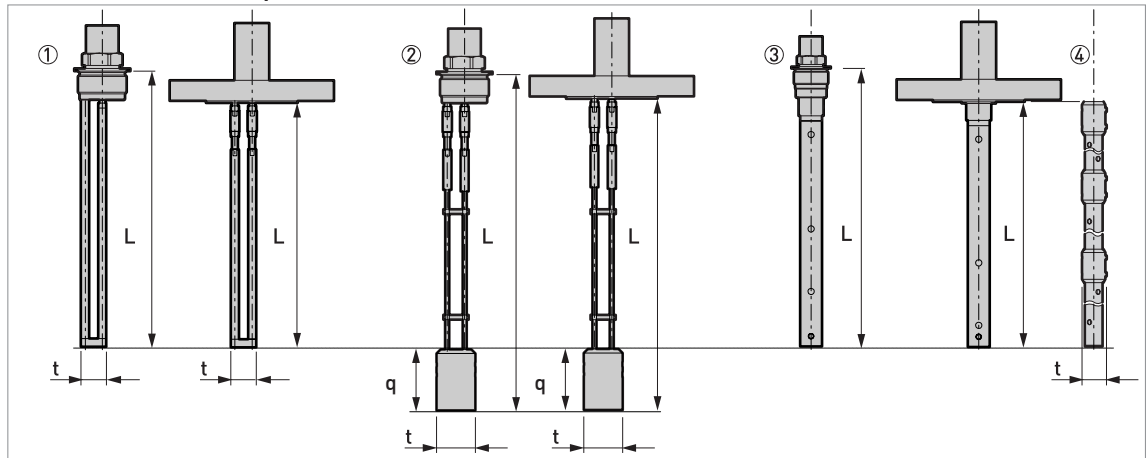


Figure 2-14: Double and coaxial probe options

- ① Double rod  $\varnothing 8$  mm /  $\varnothing 0.32$ " (thread and flange versions)
- ② Double cable  $\varnothing 4$  mm /  $\varnothing 0.16$ " (thread and flange versions)
- ③ Coaxial  $\varnothing 22$  mm /  $\varnothing 0.87$ " (thread and flange versions)
- ④ Coaxial  $\varnothing 22$  mm /  $\varnothing 0.87$ " (segmented version)

Probe length, L, includes the length of the counterweight.

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 $\varnothing 8$ mm	1000 ①	4000	—	25
Double cable $\varnothing 4$ mm	1000 ①	28000	60	$\varnothing 38$
Coaxial $\varnothing 22$ mm	600 ①	6000	—	—
Coaxial $\varnothing 22$ mm (segmented) ②	600 ①	6000	—	$\varnothing 28$

① A shorter probe length is available on request

② 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.

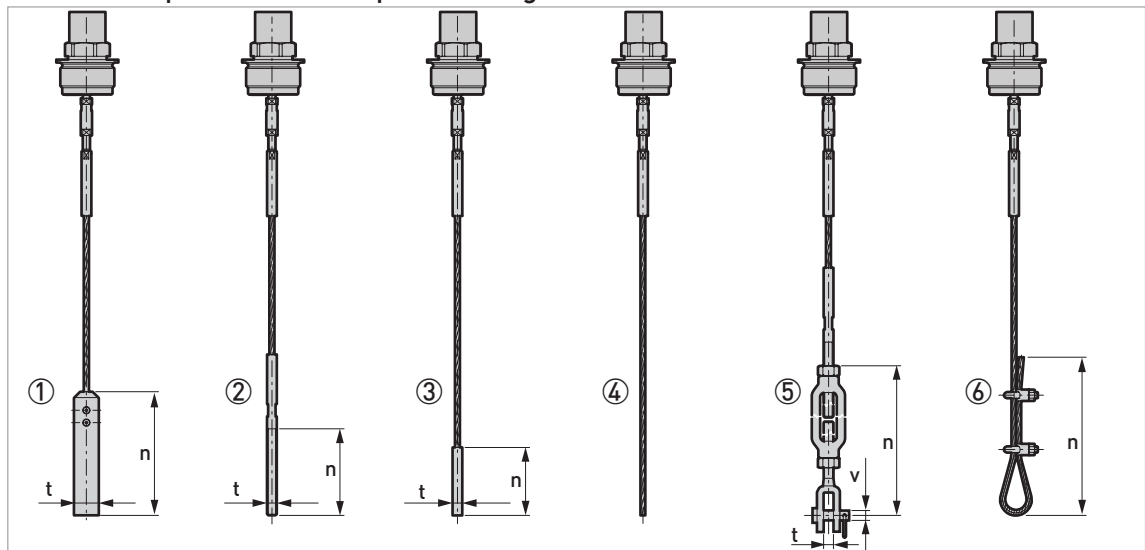
Double probes: Dimensions in inches

Probes	Dimensions [inches]			
	L min.	L max.	q	t
Double rod $\varnothing 0.32$ "	39 ①	158	—	1.0
Double cable $\varnothing 0.16$ "	39 ①	1102	2.4	$\varnothing 1.5$
Coaxial $\varnothing 0.87$ "	24 ①	236	—	—
Coaxial $\varnothing 0.87$ " (segmented) ②	24 ①	236	—	$\varnothing 1.1$

① A shorter probe length is available on request

② 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  $\varnothing 4$  mm / 0.16"Figure 2-15: Probe end options for cable probes: single cable  $\varnothing 4$  mm / 0.16"

- 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	$\varnothing 20$	—
Threaded end	70	M8	—
Crimped end	55	$\varnothing 8$	—
Open end	—	—	—
Turnbuckle	172 ①	11	$\varnothing 6$
Chuck	300	—	—

① Minimum length

### Dimensions in inches

Probe end type	Dimensions [inches]		
	n	t	v
Counterweight	3.9	$\varnothing 0.8$	—
Threaded end	2.8	M8	—
Crimped end	2.2	$\varnothing 0.3$	—
Open end	—	—	—
Turnbuckle	6.8 ①	0.4	$\varnothing 0.2$
Chuck	11.8	—	—

① Minimum length

Probe end options for cable probes: single cable Ø8 mm / 0.32"

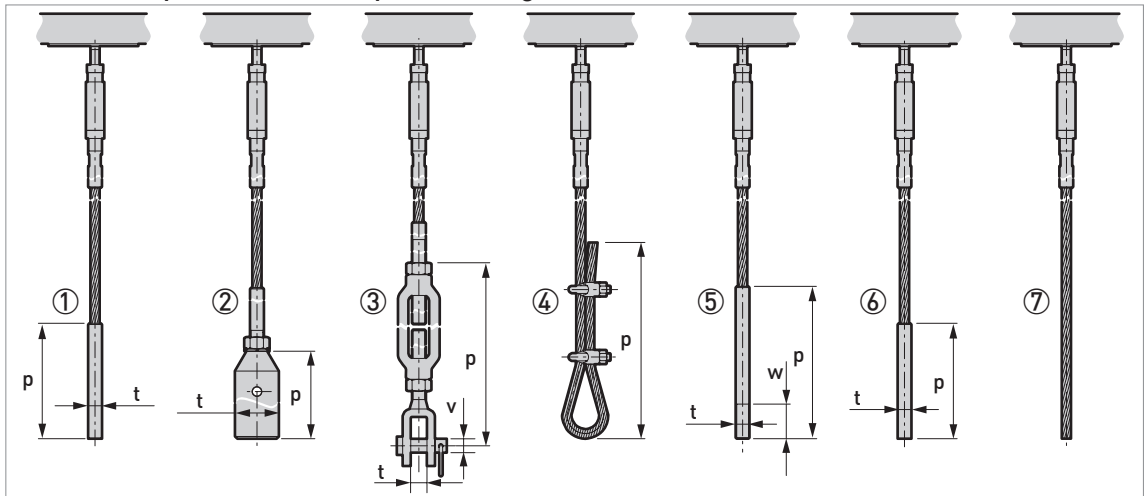


Figure 2-16: Probe end options for cable probes: single cable Ø8 mm / 0.32"

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

Dimensions in mm

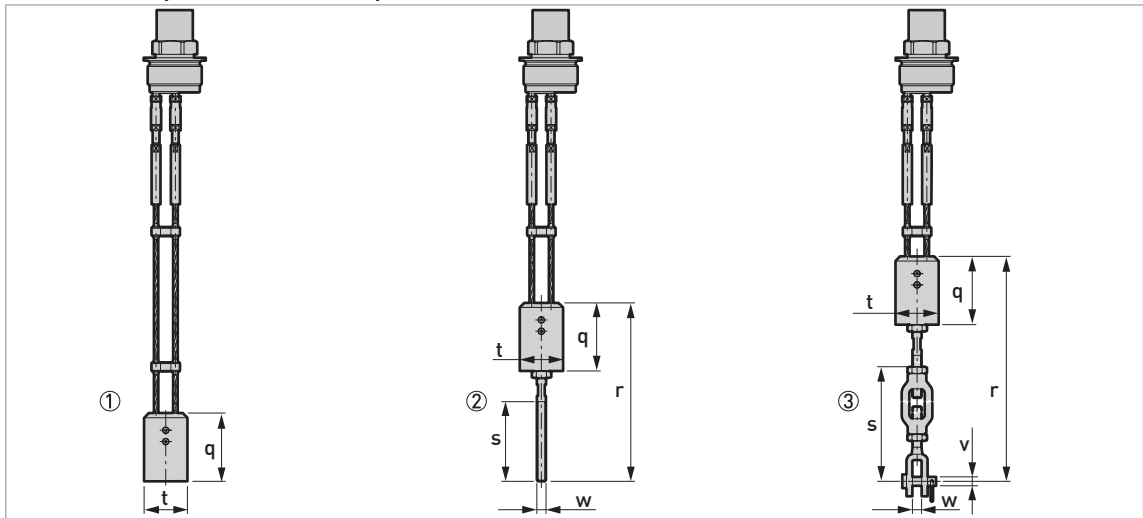
Probe end type	Dimensions [mm]			
	p	t	v	w
Counterweight 1	100	Ø12	—	—
Counterweight 2	245	Ø38	—	—
Turnbuckle	293 ①	14	Ø12	—
Chuck	300	—	—	—
Threaded end	132	M12	—	30
Crimped end	100	Ø12	—	—
Open end	—	—	—	—

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  $\varnothing 4$  mm / 0.16"Figure 2-17: Probe end options for cable probes: double cable  $\varnothing 4$  mm / 0.16"

- ① Standard counterweight
- ② Threaded end
- ③ Turnbuckle

## Dimensions in mm

Probe end type	Dimensions [mm]					
	q	r	s	t	v	w
Counterweight	60	—	—	$\varnothing 38$	—	—
Threaded end	60	157	70	$\varnothing 38$	—	M8
Turnbuckle	60	$289 \pm 46$	$172$ ①	$\varnothing 38$	$\varnothing 6$	11

① Minimum length

## Dimensions in inches

Probe end type	Dimensions [inches]					
	q	r	s	t	v	w
Counterweight	2.4	—	—	$\varnothing 1.5$	—	—
Threaded end	2.4	6.2	2.8	$\varnothing 1.5$	—	M8
Turnbuckle	2.4	$11.4 \pm 1.8$	$6.8$ ①	$\varnothing 1.5$	$\varnothing 0.2$	0.4

① Minimum length

## Converter and probe housing weights

Type of housing	Weights			
	Aluminium housing		Stainless steel housing	
	[kg]	[lb]	[kg]	[lb]

## Non-Ex / intrinsically-safe (Ex i / IS)

Compact	2.8	6.2	6.4	14.1
Remote converter ①	2.5	5.5	5.9	13.0
Probe housing ①	1.8	4.0	3.9	8.6

## Explosion proof (Ex d / XP)

Compact	3.2	7.1	7.5	16.5
Remote converter ①	2.9	6.40	7.1	15.65
Probe housing ①	1.8	4.0	3.9	8.6

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

## 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 PN40; 1" 150 lb; 1½" 300 lb	0.016 ①	0.035 ①
Single cable Ø4 mm / 0.16"	G ¾A; ¾ NPT	DN25 PN40; 1" 150 lb; 1½" 300 lb	0.12 ①	0.08 ①
Single cable Ø8 mm / 0.32"	G 1½A; 1½ NPT	DN40 PN40; 1½" 150 lb; 1½" 300 lb	0.41 ①	0.28 ①
Double cable Ø4 mm / 0.16"	G 1½A; 1½ NPT	DN50 PN40; 2" 150 lb; 2" 300 lb	0.24 ①	0.16 ①
Single rod Ø8 mm / 0.32"	G ¾A; ¾ NPT	DN25 PN40; 1" 150 lb; 1½" 300 lb	0.41 ②	0.28 ②
Double rod Ø8 mm / 0.32"	G 1½A; 1½ NPT	DN50 PN40; 2" 150 lb; 2" 300 lb	0.82 ②	0.56 ②
Coaxial Ø22 mm / 0.87"	G ¾A; ¾ NPT	DN25 PN40; 1" 150 lb; 1½" 300 lb	0.79 ②	0.53 ②

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

② This value does not include the weight of the flange

### 3.1 Intended use

*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.*

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

This TDR level transmitter measures distance, level, mass and volume of liquids, pastes, slurries, granulates and powders.

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

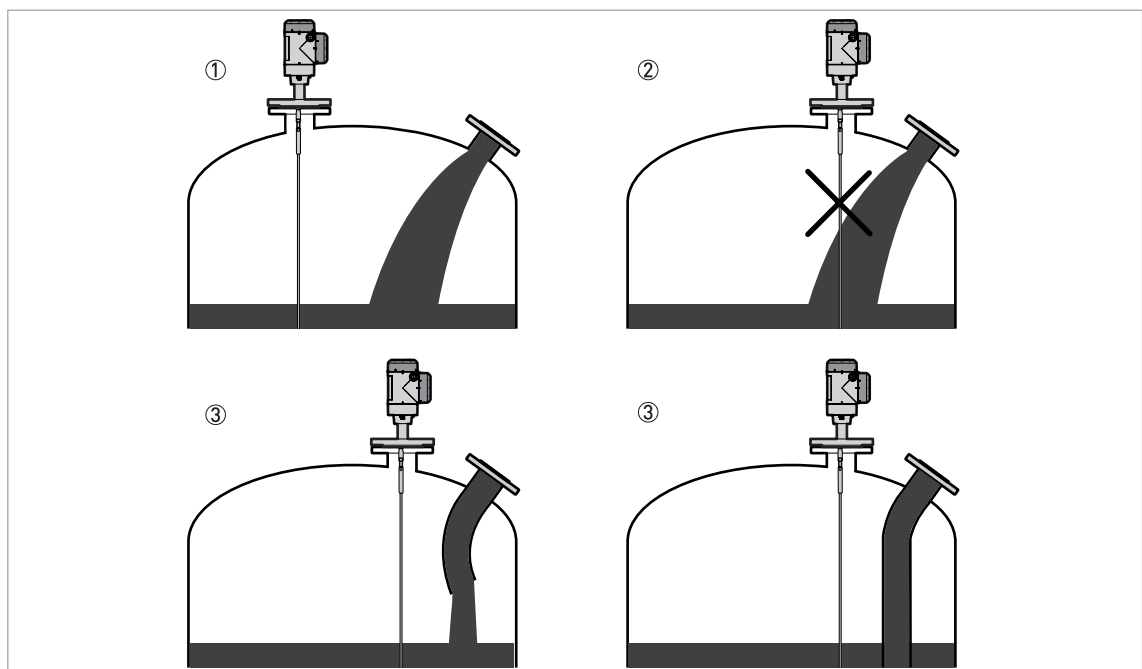
### 3.2 How to prepare the tank before you install the device

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

#### 3.2.1 General information for nozzles

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

*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 3-1: 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.

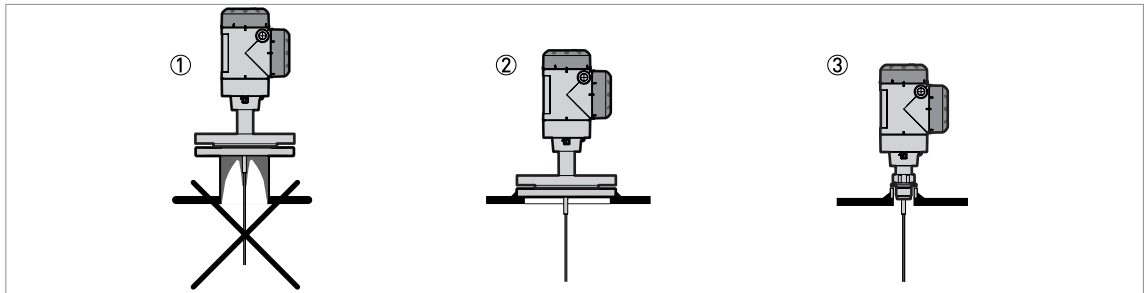


Figure 3-2: How to prevent build-up of product around the process connection

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

For single cable and single rod probes:

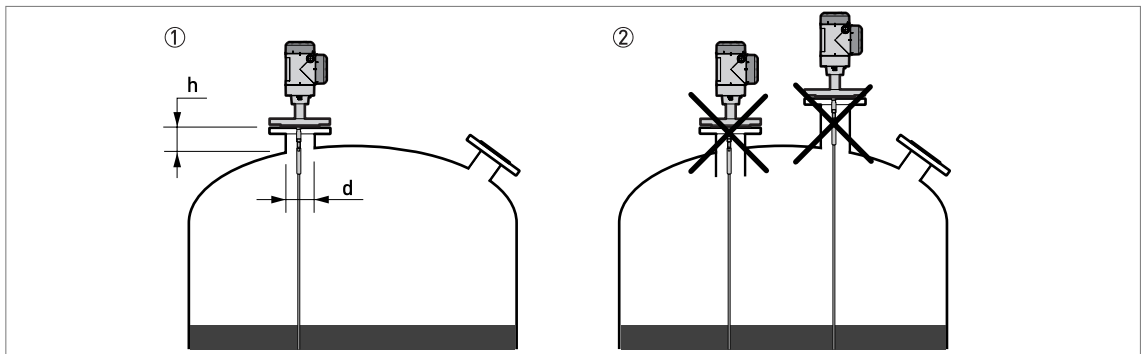


Figure 3-3: Recommended nozzle dimensions for single rod and single cable probes

- 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 etc.).*

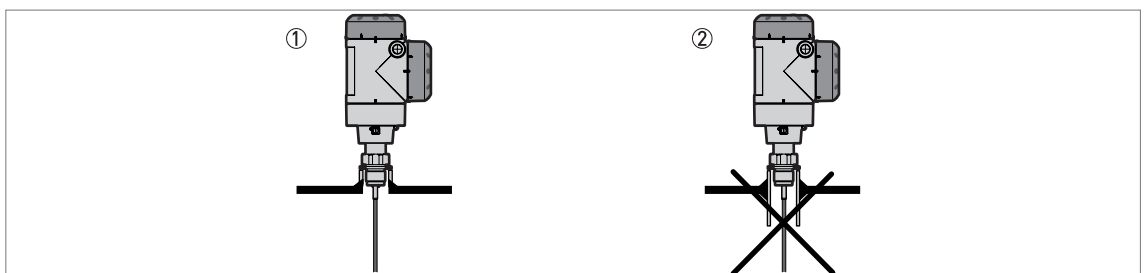


Figure 3-4: Sockets for threaded process connections

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

For double cable and double rod probes:

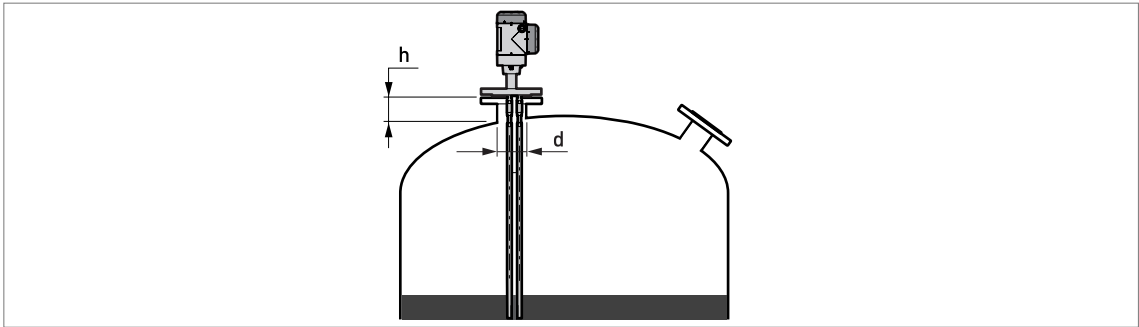


Figure 3-5: Recommended nozzle dimensions for double rod and double cable probes  
 $d \geq 50 \text{ mm} / 2''$ , where  $d$  is the diameter of the tank nozzle

For coaxial probes:

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

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

### 3.2.2 Installation requirements for concrete roofs

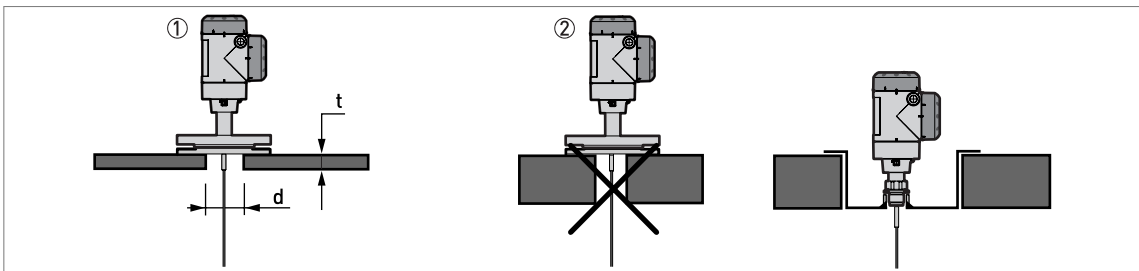


Figure 3-6: Installation on a concrete roof

- 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.

### 3.3 Installation recommendations for liquids

#### 3.3.1 General requirements

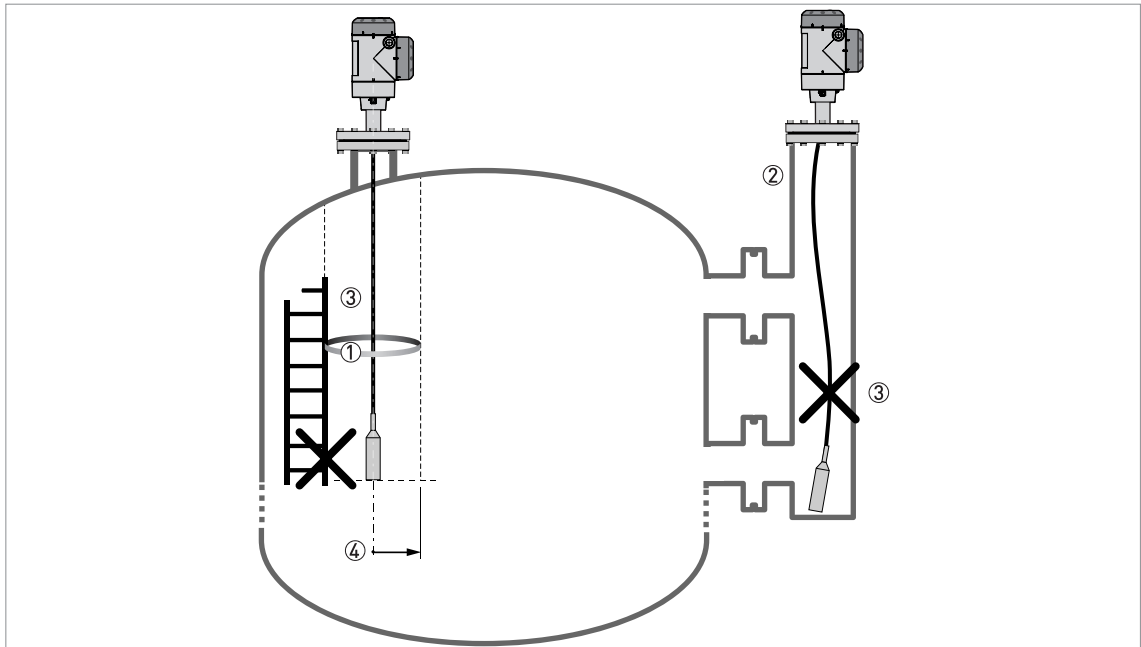


Figure 3-7: Installation recommendations for liquids

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

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

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



### 3.3.2 Installation in standpipes (stilling wells and bypass chambers)

Use a standpipe if:

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

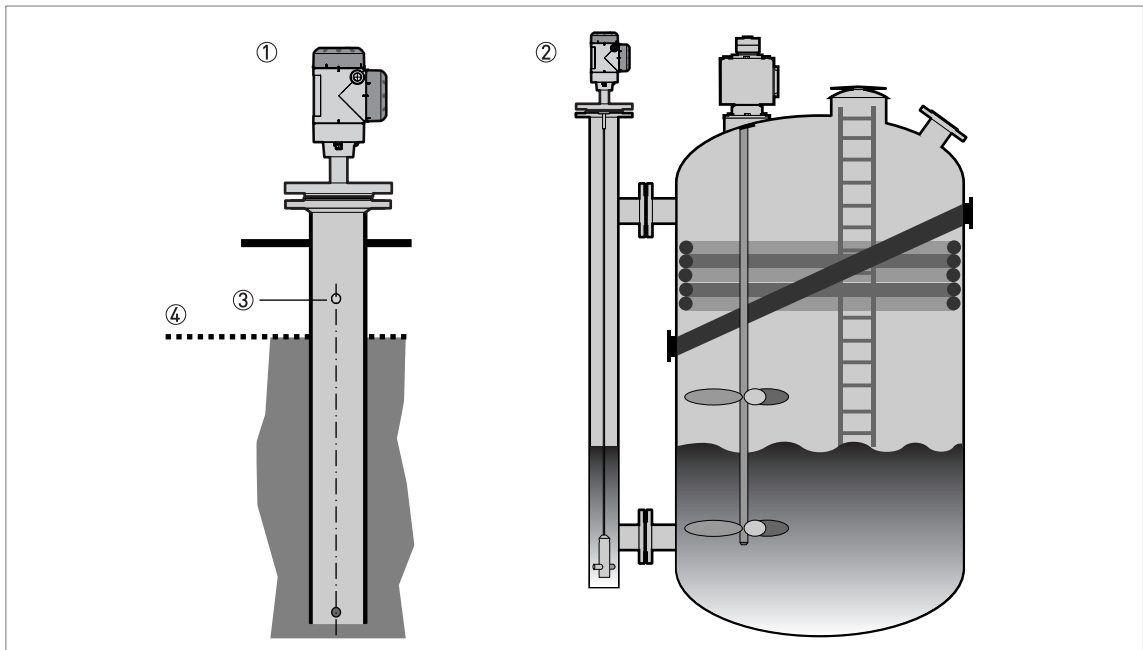


Figure 3-8: Installation recommendations for standpipes (stilling wells and bypass chambers)

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

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

- *The standpipe must be electrically conductive. If the standpipe is not made of metal, obey the instructions for empty space around the probe. For more data, refer to General requirements on page 40.*
- *The standpipe must be straight. There must be no changes in diameter from the device process connection to the bottom of the standpipe.*
- *The standpipe must be vertical.*
- *Recommended surface roughness:  $< \pm 0.1 \text{ mm} / 0.004''$ .*
- *The bottom of the stilling well must be open.*
- *Adjust the probe to the center of the standpipe.*
- *Make sure that there are no deposits at the bottom of the standpipe which can cause blockage of the process connections.*
- *Make sure that there is liquid in the standpipe.*

### Floating roofs

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

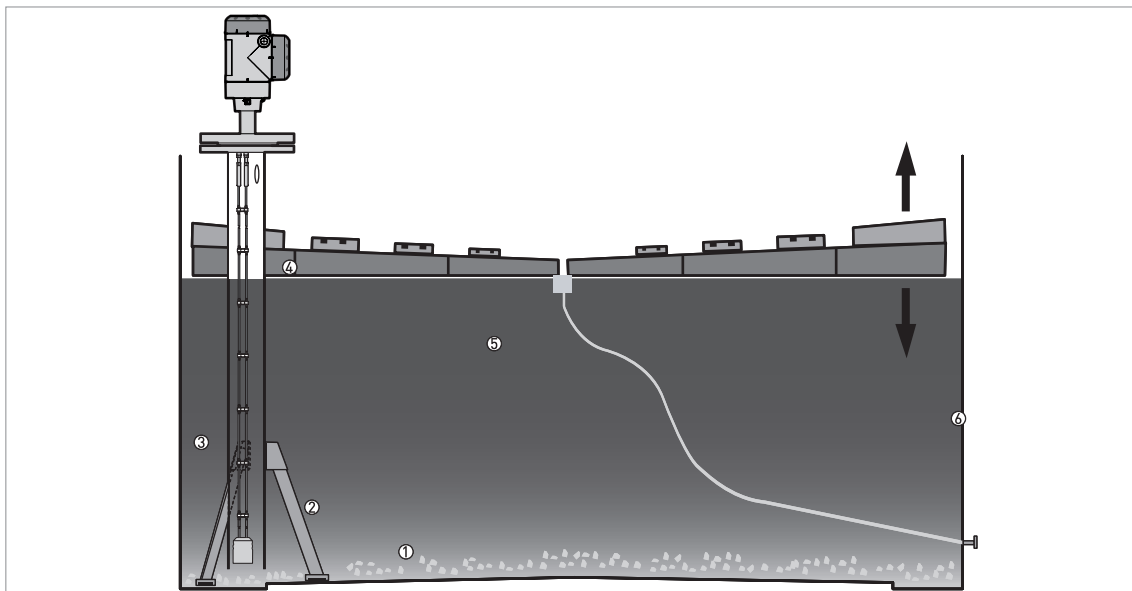


Figure 3-9: Floating roofs

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

## 3.4 Installation recommendations for solids

### 3.4.1 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 30 kV, but it is the responsibility of the fitter and the user to prevent ESD.*

*Install the device at the correct location to measure level correctly and prevent too much bending and traction. If necessary, attach the probe to the bottom of the tank.*

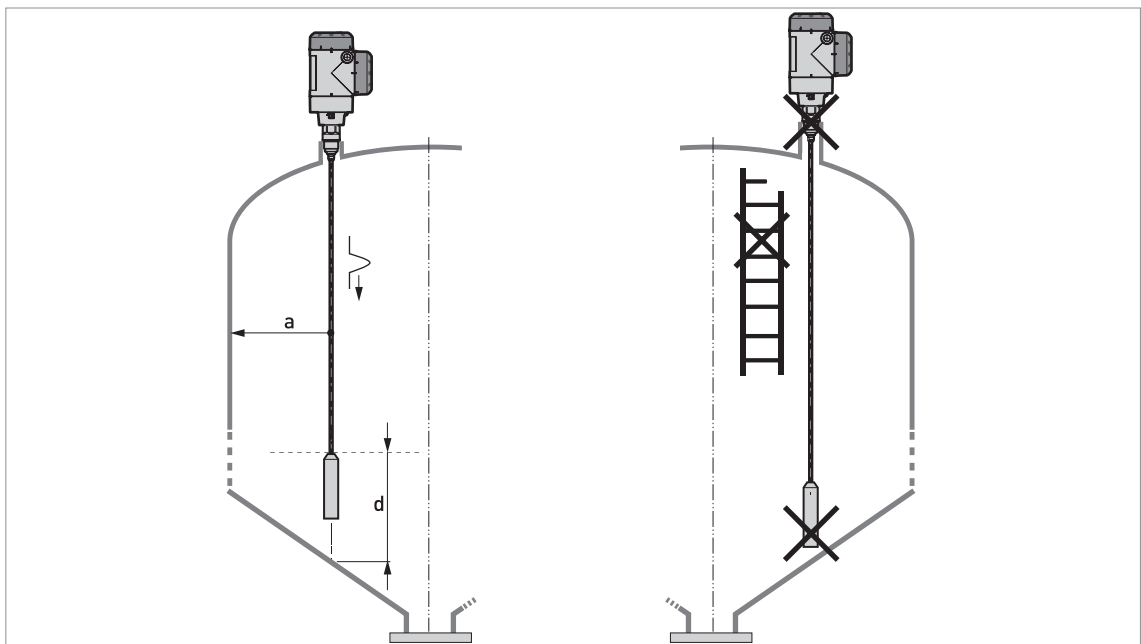


Figure 3-10: Installation recommendations for solids

$a \geq 300 \text{ mm} / 12''$

$d \geq 300 \text{ mm} / 12''$

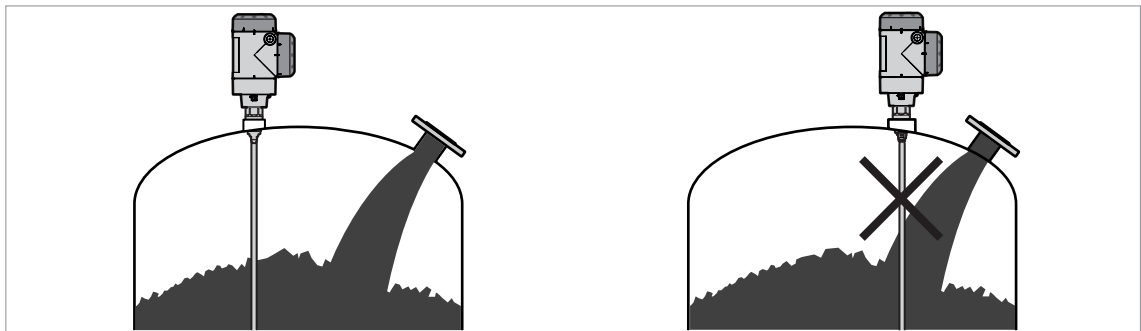


Figure 3-11: Do not install the probe near to a product inlet

## 4.1 Electrical installation: 2-wire, loop-powered

### 4.1.1 Compact version

#### Terminals for electrical installation

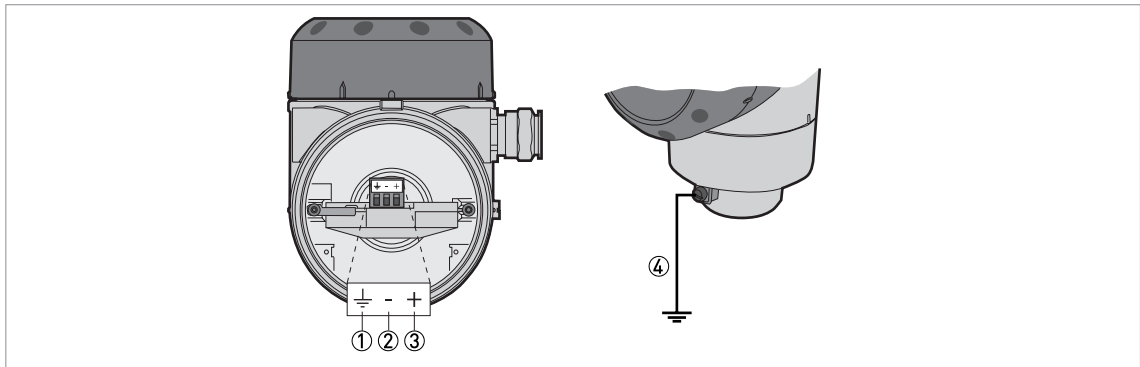


Figure 4-1: Terminals for electrical installation

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

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

### 4.1.2 Remote version

#### Terminals for electrical installation

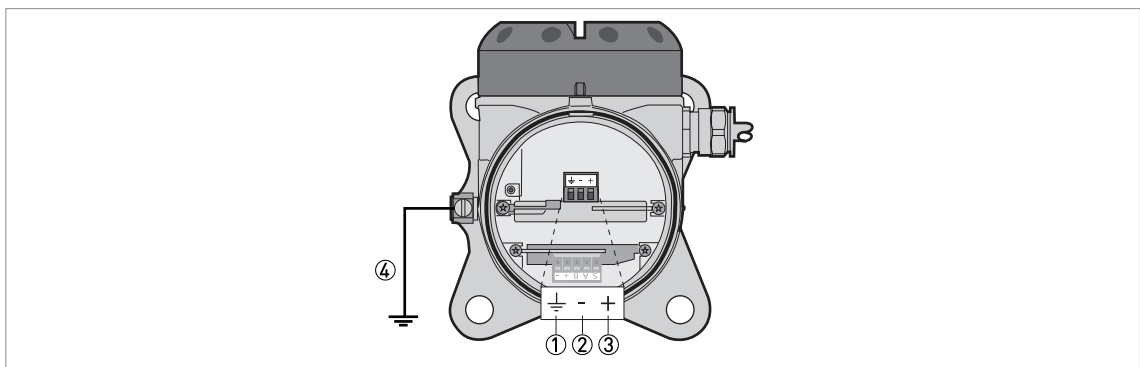


Figure 4-2: Terminals for electrical installation

- 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)

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

## Connections between the remote converter and the probe housing

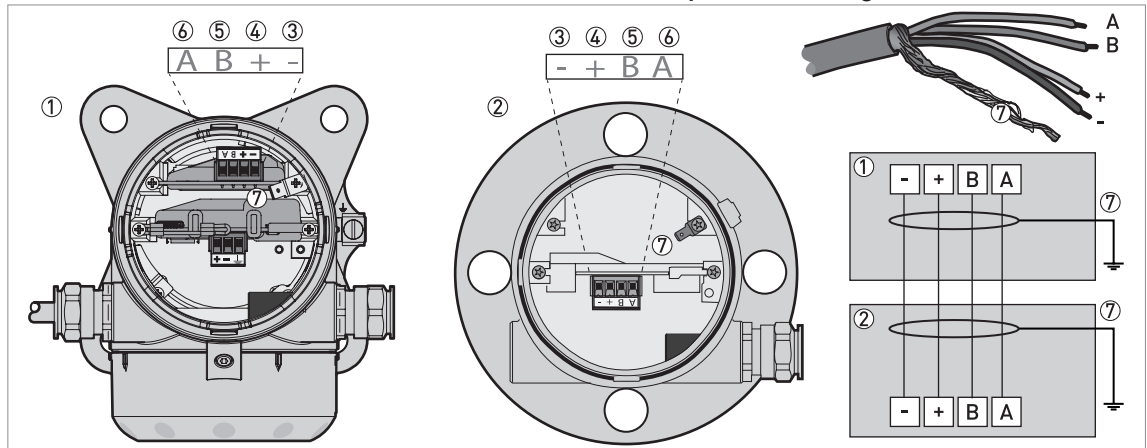


Figure 4-3: Connections between the remote converter and the probe housing

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

For more electrical installation data, refer to *Compact version* on page 44.

## 4.2 Non-Ex devices

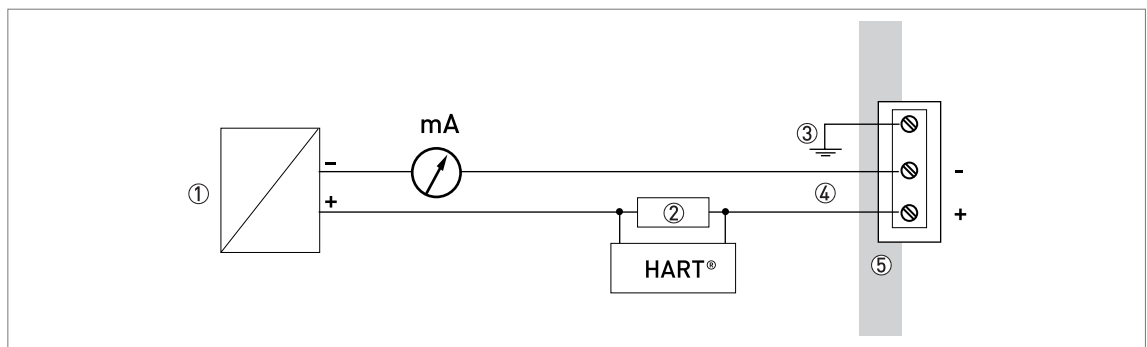


Figure 4-4: Electrical connections for non-Ex devices

- 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

### 4.3 Devices for hazardous locations

For electrical data for device operation in hazardous locations, refer to the related certificates of compliance and supplementary instructions (ATEX, IECEx, cFMus, ...). You can find this documentation on the DVD-ROM delivered with the device or it can be downloaded free of charge from the website (Download Center).

## 4.4 Networks

### 4.4.1 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.

### 4.4.2 Point-to-point networks

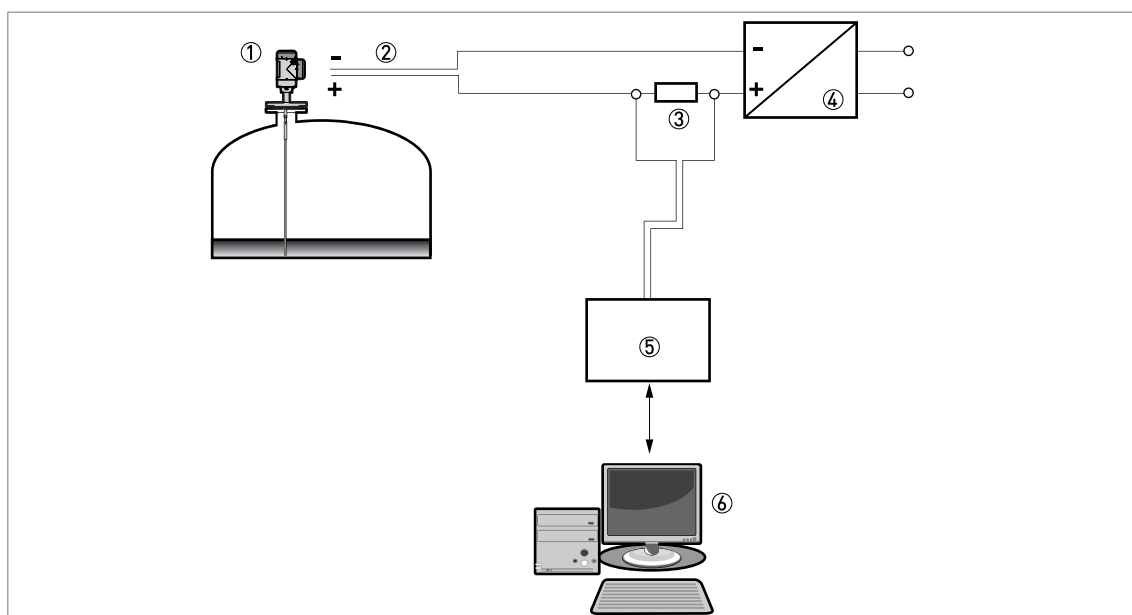


Figure 4-5: Point-to-point connection (non-Ex)

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

## 4.4.3 Multi-drop networks

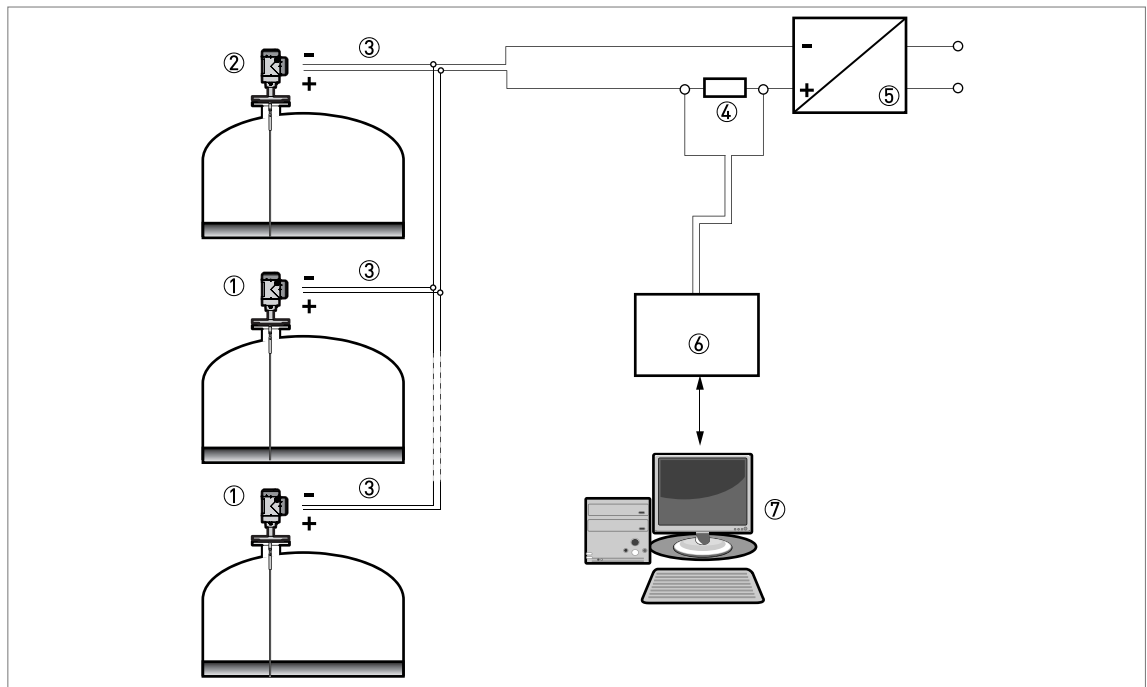


Figure 4-6: Multi-drop network (non-Ex)

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

#### 4.4.4 Fieldbus networks

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

##### FOUNDATION™ fieldbus network (non-Ex)

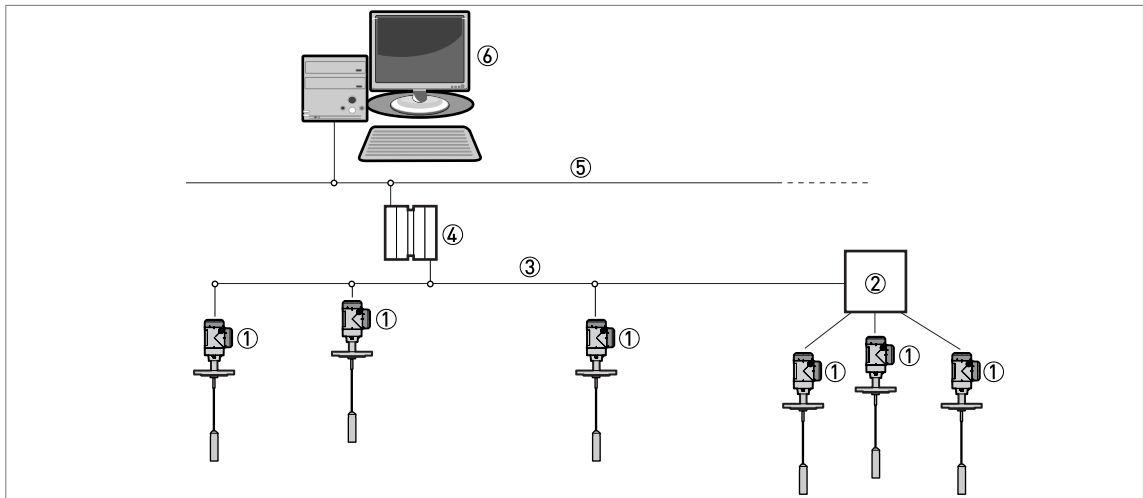


Figure 4-7: FOUNDATION™ fieldbus network (non-Ex)

- 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)

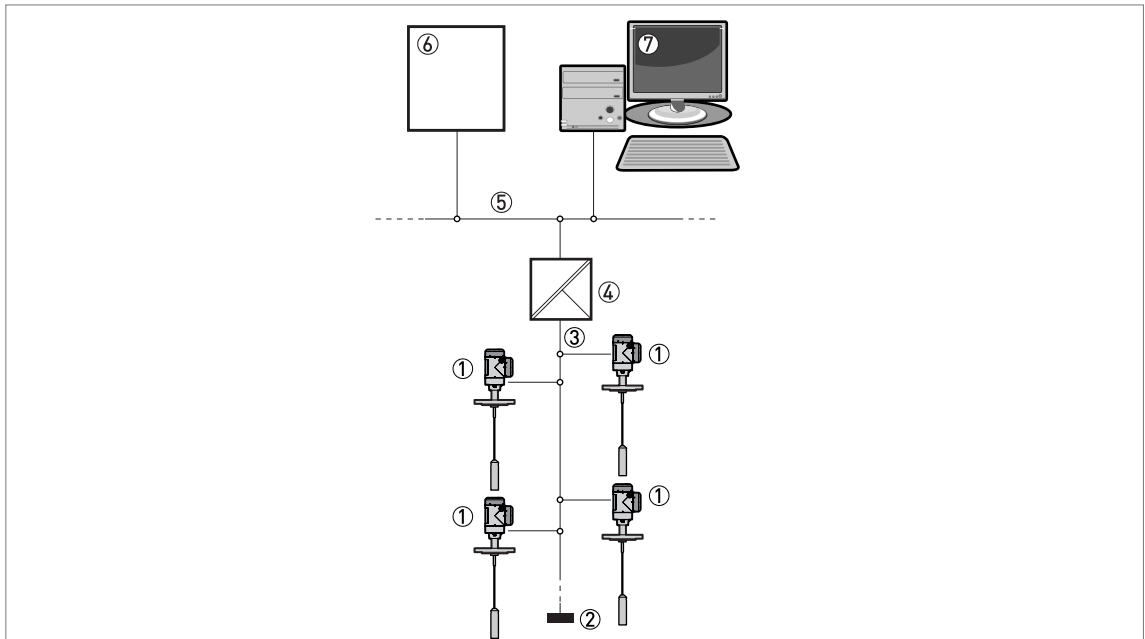


Figure 4-8: PROFIBUS PA/DP network (non-Ex)

- 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)

## 5.1 Order code

Make a selection from each column to get the full order code. The characters of the order code highlighted in light grey describe the standard.

VF20	4	<b>OPTIFLEX 2200 C/F Guided Radar (TDR) level transmitter</b>
		<b>Converter version (housing material / ingress protection)</b>
	1	OPTIFLEX 2200 C: Compact version (aluminium – IP66/67)
	2	OPTIFLEX 2200 C: Compact version (stainless steel – IP66/67)
	3	OPTIFLEX 2200 F: Remote version (converter and probe housing: aluminium – IP66/67)
	4	OPTIFLEX 2200 F: Remote version (converter and probe housing: stainless steel – IP66/67)
	5	OPTIFLEX 2200 F: Remote version (converter housing: aluminium – IP66/67 and probe housing: stainless steel – IP66/67)
		<b>Approval ①</b>
	0	Without
	1	ATEX II 1/2 G Ex ia IIC T6 Ga/Gb + II 1/2 D Ex ia IIIC Da/Db
	2	ATEX II 1/2 G Ex d ia IIC T6 Ga/Gb + II 1/2 D Ex ia tb IIIC Da/Db
	4	ATEX II 3 G Ex ic IIC T6 Gc + II 3 D Ex ic IIIC Dc (Zone 2 and 22)
	6	IECEX Ex ia IIC T6 Ga/Gb + Ex ia IIIC Da/Db
	7	IECEX Ex d ia IIC T6 Ga/Gb + Ex ia tb IIIC Da/Db
	8	IECEX Ex ic IIC T6 Gc + Ex ic IIIC Dc (Zone 2 and 22)
	A	cFMus IS CL I/II/III DIV 1 GPS A–G + CL I zone 0/20 Ex ia IIC/IIIC T6
	B	cFMus XP-AIS/DIP CL I/II/III DIV 1 GPS A–G (A not for CAN) + CL I zone 0/20 Ex d[ia]/tb[ia] IIC/IIIC T6
	C	cFMus NI CL I/II/III DIV 2 GPS A–G + CL I zone 2 Ex nA IIC T6
	L	NEPSI Ex ia IIC T6 Ga/Gb + DIP A20/A21 ②
	M	NEPSI Ex d ia IIC T6 Ga/Gb + DIP A20/A21 ②
	R	INMETRO Ex ia IIC T6 Ga/Gb + Ex ia IIIC Da/Db
	S	INMETRO Ex d ia IIC T6 Ga/Gb + Ex ia tb IIIC Da/Db
	T	INMETRO Ex ic IIC T6 Gc + Ex ic IIIC Dc (Zone 2 and 22)
		<b>Other approval</b>
	0	Without
	1	SIL2 – only available for the compact (C) version with the 4...20 mA output option
	4	CRN (Canadian Registration Number)
	5	CRN + SIL2 – only available for the compact (C) version with the 4...20 mA output option
	A	WHG (overfill protection approval – only with calibration certificate)
	B	EAC Russia
	C	EAC Belarus
	D	EAC Russia + SIL 2 – only available for the compact (C) version with the 4...20 mA output option
	E	EAC Belarus + SIL 2 – only available for the compact (C) version with the 4...20 mA output option
	K	EAC Kazakhstan
	L	EAC Kazakhstan + SIL 2 – only available for the compact (C) version with the 4...20 mA output option
VF20	4	<b>Order code (complete this code on the pages that follow)</b>

					<b>Process seal (temperature / pressure / material / notes)</b>
				0	Without
				1	-40...+150°C (-40...+302°F) / -1...40 barg (-14.5...580 psig) / FKM/FPM (Viton) – for all probes
				2	-20...+150°C (-4...+302°F) / -1...40 barg (-14.5...580 psig) / Kalrez® 6375 – for all probes
				3	-50...+150°C (-58...+302°F) / -1...40 barg (-14.5...580 psig) / EPDM – for all probes
				6	-40...+300°C (-40...+572°F) / -1...40 barg (-14.5...580 psig) / FKM/FPM (Viton) – only for the high-temperature (HT) version of the Ø2 mm (0.08") single cable probe
				7	-20...+300°C (-4...+572°F) / -1...40 barg (-14.5...580 psig) / Kalrez® 6375 – only for the high-temperature (HT) version of the Ø2 mm (0.08") single cable probe
				8	-50...+250°C (-58...+482°F) / -1...40 barg (-14.5...580 psig) / EPDM – only for the high-temperature (HT) version of the Ø2 mm (0.08") single cable probe
					<b>Probe (probe type / material / measuring range)</b>
				0	Without
					For liquids only
				2	Single rod – Ø8 mm (0.32") segmented / 316L – 1.4404 / 1...6 m (3.28...19.69 ft)
				3	Single cable – Ø2 mm (0.08") / 316 – 1.4401 / 1...40 m (3.28...131.23 ft)
				6	Double rod – 2xØ8 mm (0.32") / 316L – 1.4404 / 1...4 m (3.28...13.12 ft)
				7	Double cable – 2xØ4 mm (0.16") / 316 – 1.4401 / 1...28 m (3.28...91.86 ft)
				D	Single cable – Ø2 mm (0.08") / HASTELLOY® C-22® / 1...40 m (3.28...131.23 ft)
				A	Coaxial – Ø22 mm (0.87") / 316L – 1.4404 / 0.6...6 m (1.97...19.69 ft)
				B	Coaxial – Ø22 mm (0.87") segmented / 316L – 1.4404 / 0.6...6 m (1.97...19.69 ft)
				E	Coaxial – Ø22 mm (0.87") / HASTELLOY® C-22® / 0.6...6 m (1.97...19.69 ft)
				P	Single rod – Ø8 mm (0.32") / PVDF sheath Ø16 mm (0.64") – not for cFMus – IIB only / 1...4 m (3.28...13.12 ft)
				T	Single cable – Ø4 mm (0.16") for BM 26 ADVANCED / 316L – 1.4404 / 1...6 m (3.28...19.69 ft)
				V	Single cable – Ø4 mm (0.16") for BM 26 F / 316L – 1.4404 / 1...6 m (3.28...19.69 ft)
					For liquids and solids
				1	Single rod – Ø8 mm (0.32") / 316L – 1.4404 / 1...6 m (3.28...19.69 ft)
				4	Single cable – Ø4 mm (0.16") / 316 – 1.4401 / liquids: 1...40 m (3.28...131.23 ft); solids: 1...20 m (3.28...65.92 ft)
					For solids only
				5	Single cable – Ø8 mm (0.32") / 316 – 1.4401 / 1...40 m (3.28...65.92 ft)
					Probe connection without probe
				K	Probe connection (316L – 1.4404) for single rod or single cable probe – probe not included – not available for single cable Ø2 mm (0.08")
				L	Probe connection (316L – 1.4404) for double rod or double cable probe – probe not included
<b>VF20</b>	<b>4</b>				<b>Order code (complete this code on the pages that follow)</b>

										<b>Probe end (probe end type / material / probe)</b>
										0 Without
										1 Counterweight Ø14 × 100 mm (0.55 × 3.94") / 316L – 1.4404 / Single cable – Ø2 mm (0.08")
										F Counterweight Ø14 × 100 mm (0.55 × 3.94") / HASTELLOY® C-22® / Single cable – Ø2 mm (0.08")
										2 Counterweight Ø20 × 100 mm (0.79 × 3.94") / 316L – 1.4404 / Single cable – Ø4 mm (0.16")
										3 Counterweight Ø12 × 100 mm (0.47 × 3.94") / 316L – 1.4404 / Single cable – Ø8 mm (0.32")
										4 Counterweight Ø38 × 245 mm (1.50 × 9.65") / 316L – 1.4404 / Single cable – Ø8 mm (0.32")
										5 Counterweight Ø38 × 60 mm (1.50 × 2.36") / 316L – 1.4404 / Double cable – Ø4 mm (0.16")
										8 Chuck / 316L – 1.4404 / Single cable – Ø4 mm (0.16")
										B Crimped end / 316L – 1.4404 / Single cable – Ø4 mm (0.16")
										D Open end / 316L – 1.4404 / Single cable – Ø4 mm (0.16") and Ø8 mm (0.32")
										7 Turnbuckle / 316L – 1.4404 / Single/double cable – Ø4 mm (0.16")
										A Threaded end / 316L – 1.4404 / Single/double cable – Ø4 mm (0.16")
										L Centering counterweight / 316L – 1.4404 / Single cable – Ø4 mm (0.16") – for BM 26 F and BM 26 ADVANCED without float
										<b>Process connection (size / pressure rating / flange finish)</b>
										0 0 0 Without
										Threaded – ISO 228
										C P 0 G ½ ③
										D P 0 G ¾A ④
										E P 0 G 1A ④
										G P 0 G 1½A
										Threaded – ASME B1.20.1
										C B 0 ½ NPTF – B1.20.3 (Dryseal) ③
										D A 0 ¾ NPT ④
										E A 0 1 NPT ④
										G A 0 1½ NPT
										EN 1092-1 Flanges ⑤
										E D 1 DN25 PN10 – Type B1 ⑥
										E E 1 DN25 PN16 – Type B1 ⑥
										E F 1 DN25 PN25 – Type B1 ⑥
										E G 1 DN25 PN40 – Type B1 ⑥
										G D 1 DN40 PN10 – Type B1
										G E 1 DN40 PN16 – Type B1
										G F 1 DN40 PN25 – Type B1
										G G 1 DN40 PN40 – Type B1 / BM 26 ADVANCED
										H D 1 DN50 PN10 – Type B1
										H E 1 DN50 PN16 – Type B1
										H F 1 DN50 PN25 – Type B1
										H G 1 DN50 PN40 – Type B1
<b>VF20</b>	<b>4</b>									<b>Order code (complete this code on the pages that follow)</b>

								L	D	1	DN80 PN10 – Type B1
								L	E	1	DN80 PN16 – Type B1
								L	F	1	DN80 PN25 – Type B1
								L	G	1	DN80 PN40 – Type B1
								M	D	1	DN100 PN10 – Type B1
								M	E	1	DN100 PN16 – Type B1
								M	F	1	DN100 PN25 – Type B1
								M	G	1	DN100 PN40 – Type B1
								P	D	1	DN150 PN10 – Type B1
								P	E	1	DN150 PN16 – Type B1
								P	F	1	DN150 PN25 – Type B1
								P	G	1	DN150 PN40 – Type B1
								R	E	1	DN200 PN16 – Type B1
								R	G	1	DN200 PN40 – Type B1 (for non-Ex devices only)
								ASME B16.5 / ANSI Flanges ⑦			
								E	1	A	1" 150 lb RF ⑥
								E	2	A	1" 300 lb RF ⑥
								G	1	A	1½" 150 lb RF
								G	2	A	1½" 300 lb RF
								H	1	A	2" 150 lb RF
								H	2	A	2" 300 lb RF / BM 26 F
								L	1	A	3" 150 lb RF
								L	2	A	3" 300 lb RF
								M	1	A	4" 150 lb RF
								M	2	A	4" 300 lb RF
								P	1	A	6" 150 lb RF
								P	2	A	6" 300 lb RF (for non-Ex devices only)
								R	1	A	8" 150 lb RF
								R	2	A	8" 300 lb RF (for non-Ex devices only)
								JIS B2220 Flanges			
								G	U	P	40A JIS 10K RF
								H	U	P	50A JIS 10K RF
								L	U	P	80A JIS 10K RF
								M	U	P	100A JIS 10K RF
								P	U	P	150A JIS 10K RF
								R	U	P	200A JIS 10K RF
								Alternative flange faces			
								2	Type B2, EN 1092-1 (surface roughness must be specified in the order)		
								3	Type C, EN 1092-1 (Tongue)		
								4	Type D, EN 1092-1 (Groove)		
								5	Type E, EN 1092-1 (Spigot)		
								6	Type F, EN 1092-1 (Recess)		
<b>VF20</b>	<b>4</b>							<b>Order code (complete this code on the pages that follow)</b>			

										B	FF, ASME B16.5 (Flat face)
										M	RJ, ASME B16.5 (Ring joint)
										C	LG, ASME B16.5 (Large groove)
										D	LF, ASME B16.5 (Large female)
										E	LT, ASME B16.5 (Large tongue)
										F	LM, ASME B16.5 (Large male)
										G	SG, ASME B16.5 (Small groove)
										H	SF, ASME B16.5 (Small female)
										K	ST, ASME B16.5 (Small tongue)
										L	SM, ASME B16.5 (Small male)
										<b>Output</b>	
										1	2-wire / 4...20 mA passive HART
										2	2-wire / FOUNDATION™ fieldbus
										3	2-wire / PROFIBUS PA
										<b>Cable entry / cable gland</b>	
										1	M20×1.5 / Without
										2	M20×1.5 / Plastic
										3	M20×1.5 / Brass
										4	M20×1.5 / Stainless steel
										A	½ NPT (brass) / Without
										B	½ NPT (stainless steel) / Without
										<b>Housing (orientation / display / weather protection)</b>	
										0	Without
										1	Horizontal / No display / Without (for the compact version only)
										2	Horizontal / Display on side / Without (for the compact version only)
										3	Horizontal / No display / With (for the compact version only)
										4	Horizontal / Display on side / With (for the compact version only)
										A	Vertical / No display / Without
										B	Vertical / Display on top / Without
										C	Vertical / Display on side / Without (not available for Ex d ia / XP-approved devices)
										D	Vertical / No display / With
										E	Vertical / Display on top / With
										F	Vertical / Display on side / With (not available for Ex d ia / XP-approved devices)
<b>VF20</b>	<b>4</b>									<b>Order code (complete this code on the pages that follow)</b>	



																<b>Calibration certificate</b>			
																0	Without – for accuracy $\pm 10$ mm ( $\pm 0.39''$ ) up to 10 m (32.81 ft)		
																1	Calibration certificate 2 points – for accuracy $\pm 3$ mm ( $\pm 0.12''$ ) up to 10 m (32.81 ft) (for coaxial >600 mm (23.62'') – other probes: 1st point >500 mm (19.69''))		
																2	Calibration certificate 5 points – for accuracy $\pm 3$ mm ( $\pm 0.12''$ ) up to 10 m (32.81 ft) (for coaxial >1000 mm (39.37'') – other probes: 1st point >500 mm (19.69''))		
																<b>Drawing/TAG Number</b>			
																0	Without		
																2	Tag No. on stainless steel plate (18 characters max.)		
																<b>Extra option</b>			
<b>VF20</b>	4															0	Without		
																1	NACE design (MR0175 / MR0103 / ISO 15156)		
																		0	<b>Order code</b>

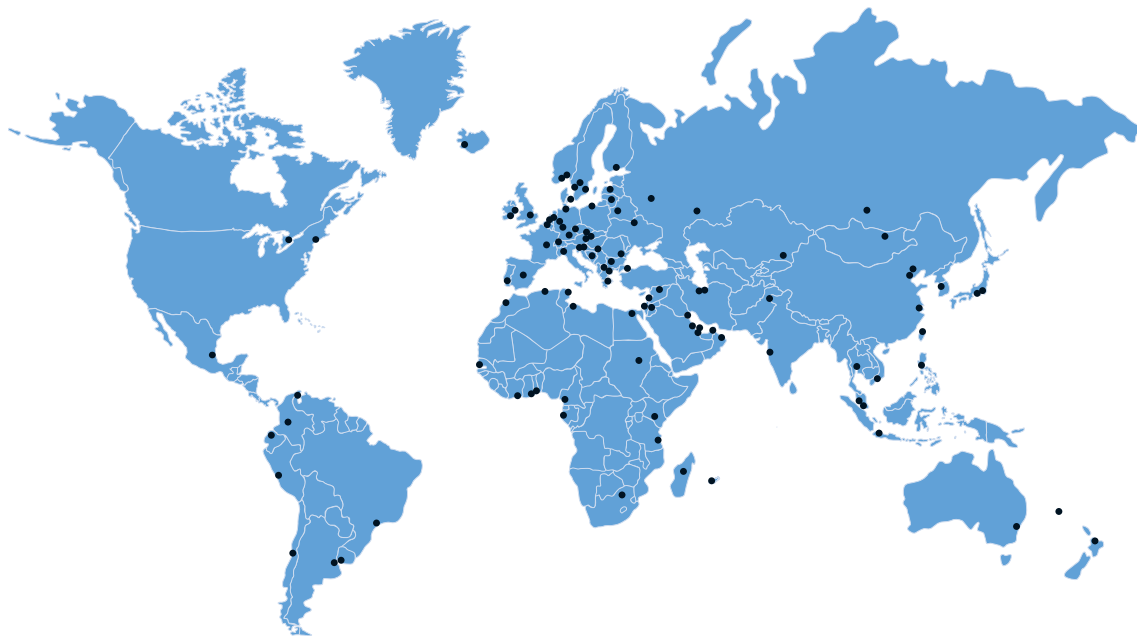
- ① For more data, refer to the Technical data section (Approvals and certification)
- ② DIP= Dust Ignition Proof
- ③ For  $\text{\O}2$  mm / 0.08'' single cable probes only
- ④ Do not use with double rod and double cable probes
- ⑤ Other flange faces are available. Refer to your local supplier for more data.
- ⑥ Do not use with double rod, double cable and coaxial probes
- ⑦ Flanges with RF faces have a slip on-type design with an anti-blowout feature. Other flange faces are available. Refer to your local supplier for more data.











## KROHNE – Process instrumentation and measurement solutions

- Flow
- Level
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