

RM77 Radar (FMCW) Level Transmitter Specifications

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RM77 Radar (FMCW) Level Transmitter for liquids in storage and process applications.

This device is a non-contact radar level meter that uses FMCW technology. It measures distance, level and volume of liquids and pastes. It is ideal for measuring the level of corrosive products with its PP or PTFE antenna options.

Highlights

- PP or PTFE Wave Horn antennas for the measurement of corrosive products
- Modular design: horizontal or vertical position of housing is suitable for almost all installations
- Optional local display with an integrated 4-button keypad. It is not necessary to remove the housing cover to get access to the keypad.
- Quick coupling system permits removal of the housing under process conditions and rotation of the housing through 360°
- Bayonet housing cover permits easy opening and closing of the housing, even after years in service
- Measuring range up to 30m/ 98.4ft
- Converter is backwards compatible with all BM70x flange systems
- SIL2-compliant according to IEC61508 for safety-related systems
- Each device is calibrated on dedicated calibration rigs before it leaves the factory

Industries

- Waste water
- Chemical
- Oil and Gas
- Food
- Power
- Material, Metals and Mining
- Pharmaceutical



Figure 1 – Low-cost FMCW Level Radar

1. PP or PTFE Wave Horn antennas for the measurement of corrosive products
2. Optional remote converter can be installed up to 100m/ 328ft away from the antenna
3. Wall support
4. Horizontal/ vertical housings and antenna 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 meter
7. Optional LCD display with 4-button keypad
8. Converter is rotatable 360° and removable under process conditions
9. Dual process seal system

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. 9 languages are available.



Applications

- Storage tanks
- Process tanks
- Open channel flow (if PACTware™ software tool is used)
- River level

Product Features

Overview



RM77 - Compact/ Vertical version

- The converter is vertical. It is attached directly to the process connection (compact version).
- For installation of the device on the ground or in a recess.
- The optional LCD display is attached to the top or the side of the device.



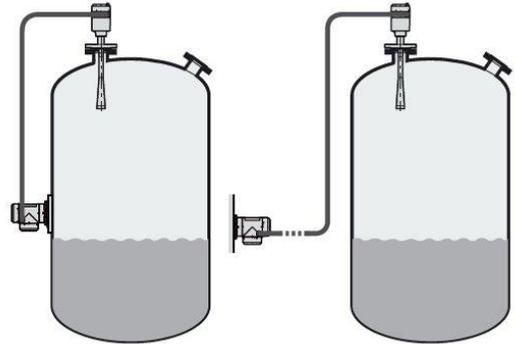
RM77 - Compact/ Horizontal version

- The converter is horizontal. It is attached directly to the process connection (compact version).
- This version is ideal for installation in areas with low roof clearances.
- For locations where it is easier to read data on the optional LCD display if the converter is in a horizontal position.



RM77 – Remote version

- Users can read measurements and configure the device from the bottom of the tank.
- The remote converter can be installed up to 100m/ 328ft away from the process connection on the tank.
- Attach the remote converter to a wall, pipe or rigid surface with the supplied wall support.

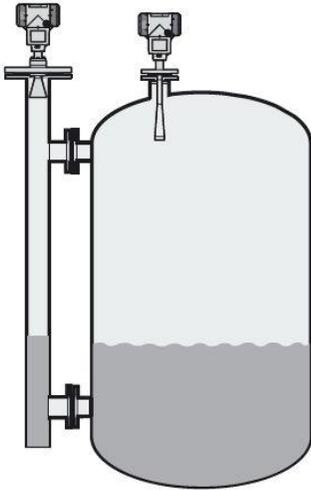


Weather protection

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

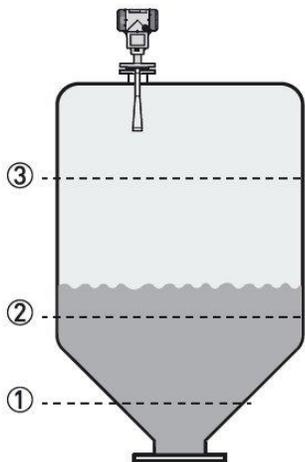
- Can be ordered for the compact version of the device and the antenna housing of the remote version.
- Easily opened and closed.

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. It does not require any calibration: it is only necessary to do a short configuration procedure.



2. Volume (mass) measurement

- A strapping table function is available in the configuration menu for volume or mass measurement. Up to 30 volume (mass) values can be related to level values. For example: Level 1= 2m/ Volume 1= e.g. 0.7m³ Level 2= 10m/ Volume 2= e.g. 5m³ Level 3= 20m/ Volume 3= e.g. 17m³

This data permits the device to calculate (by linear interpolation) volume or mass between strapping table entries.



3. Flow rate measurement

Flow rate measurement is available for field devices that are used with PACTware™ software. A flow rate conversion function is in the DTM supplied with the device. Make a selection from 6 flow profiles: Parshall (ISO9826), Venturi Rectangular (ISO4359), Venturi Trapezoidal (ISO4359), Venturi U (ISO4359), V-Notch (ISO1438) or Rectangular Notch (ISO1438).

Antenna selection

The graphs below show which antenna to select for the application based on:
 D, the measuring range,
 ϵ_r , is the dielectric constant of the product being measured

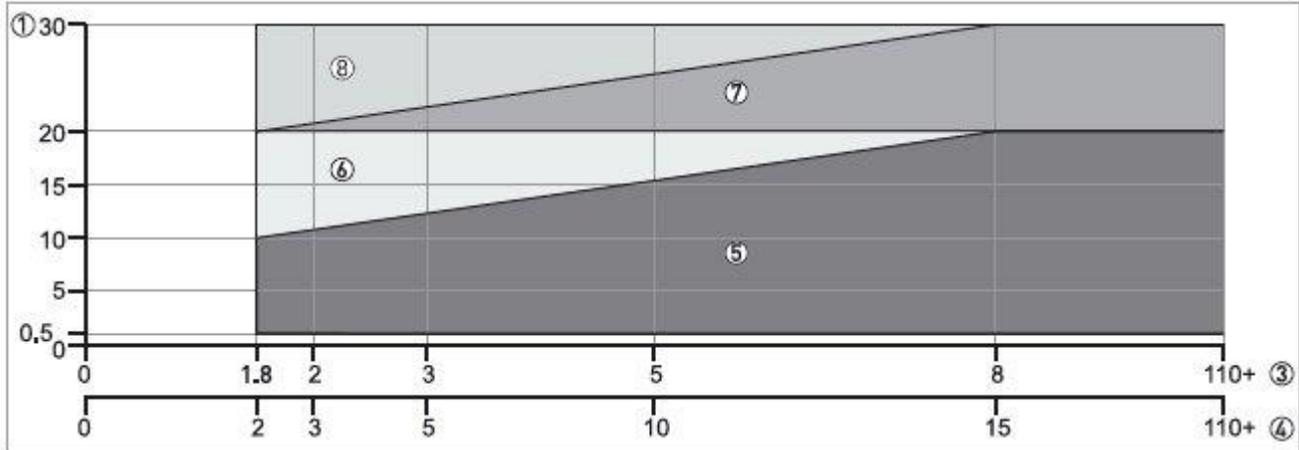


Figure 1: Selection of antenna (graph of distance in m against ϵ_r)

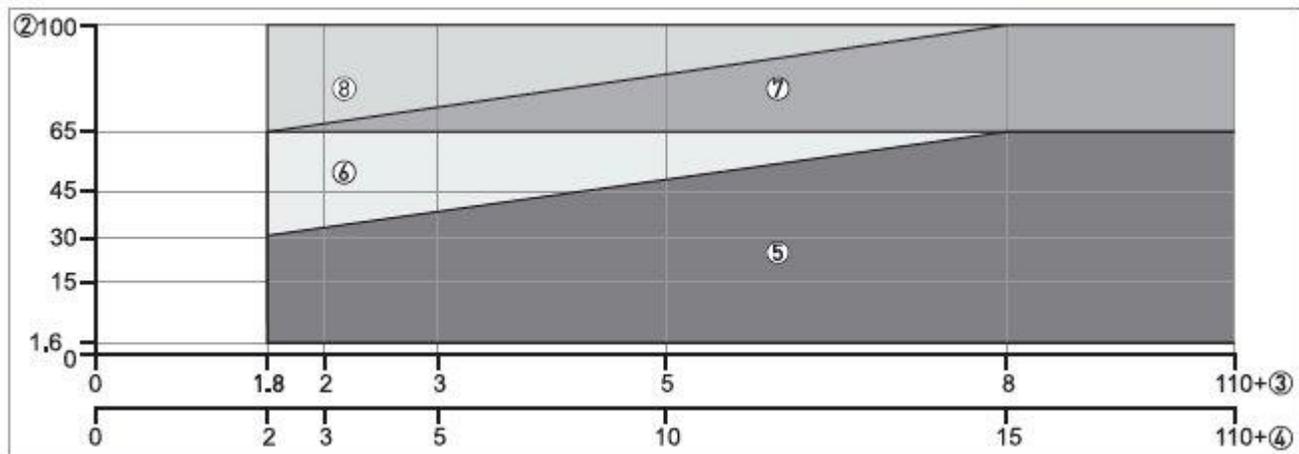


Figure 2: Selection of antenna (graph of distance in ft against ϵ_r)

1. Tank height/ Measuring range [m]
2. Tank height/ Measuring range [ft]
3. ϵ_r for storage tanks with smooth product surface
4. ϵ_r for process tanks without agitator or foam
5. All antennas:– DN150 and DN200 Metallic Horn antenna with or without a stilling well* and PTFE and PP Wave Horn antennas– DN65/2.5", DN80/3" and DN100/4" Metallic Horn antenna: only for use in a stilling well*. Maximum measuring range is 10m/ 32.81ft.– Wave Guide antenna: maximum measuring range is 6m/ 19.68ft– DN80 and DN : maximum measuring range is 6m/ 19.68ft
6. DN150 and DN200 Metallic Horn antennas with or without a stilling well* and PTFE and PP Wave Horn antennas
7. DN150/6" and DN200/8" Metallic Horn antenna with or without a stilling well*
8. DN200/8" Metallic Horn antenna with or without a stilling well*

* A stilling well is equivalent to the Wave Guide antenna option or a bypass chamber

Measuring principle

A radar signal is emitted via an antenna, reflected from the product surface and received after a time t . The radar principle used is FMCW (Frequency Modulated Continuous Wave). The FMCW-radar transmits a high frequency signal whose frequency increases linearly during the measurement phase (called the frequency sweep). The signal is emitted, reflected on the measuring surface and received with a time delay, t . Delay time, $t=2d/c$, where d is the distance to the product surface and c is the speed of light in the gas above the product.

For further signal processing the difference Δf is calculated from the actual transmitted frequency and the received frequency. The difference is directly proportional to the distance. A large frequency difference corresponds to a large distance and vice versa. The frequency difference Δf is transformed via a Fourier transformation (FFT) into a frequency spectrum and then the distance is calculated from the spectrum. The level results from the difference between the tank height and the measured distance.

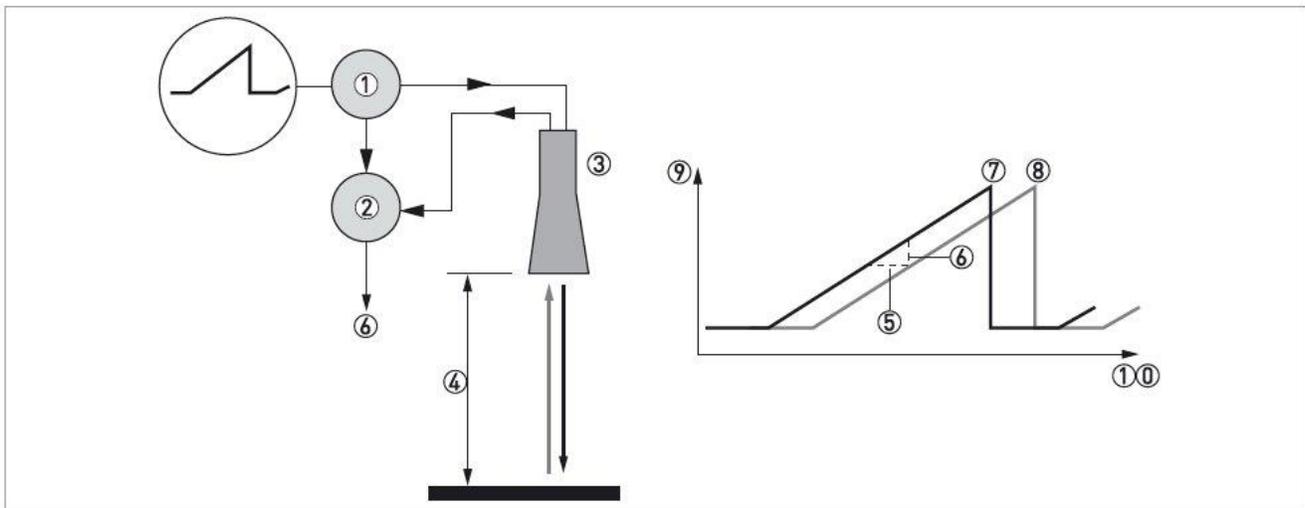


Figure 3: Measuring principle of FMCW radar

1. Transmitter
2. Mixer
3. Antenna
4. Distance to product surface, where change in frequency is proportional to distance
5. Differential time delay, Δt
6. Differential frequency, Δf
7. Frequency transmitted
8. Frequency received
9. Frequency
10. Time

Measurement modes

"Direct" mode

If the dielectric constant of the liquid is high ($\epsilon_r \geq 1.8$), the level signal is a reflection on the surface of the liquid.

"TBF Partial" mode

If the dielectric constant of the liquid is low ($\epsilon_r < 1.8$, for long-distance measurement), you must use "TBF Partial" mode to measure level correctly. "TBF Partial" is an automatic mode that lets the device make a selection between "Direct" mode and "TBF" mode. If the device finds a large radar reflection above the "tank bottom area" (the bottom 20% of the tank height), the device will use "Direct" mode. If the device finds a large radar reflection in the "tank bottom area", the device uses TBF mode. This mode can be used only in tanks with flat bottoms.

"TBF Full" mode

TBF= Tank Bottom Following. If the dielectric constant of the liquid is very low ($\epsilon_r < 1.6$), you must use "TBF Full" mode to measure level correctly. The device uses the radar reflection on the bottom of the tank (the signal goes through the liquid). This mode can be used only in tanks with flat bottoms.

"TBF FULL" AND "TBF PARTIAL" MODES

It is important to enter the correct dielectric constant value in menu item Er Product. If this value is incorrect, the device will not measure level accurately.

Technical data

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).

Measuring system

Measuring principle	2-wire loop-powered level transmitter; FMCW radar
Frequency range	X-band (8.5...10.6 GHz)
Radio frequency output power	< 41.3 dBm (outside of the tank)
Application range	Level measurement of liquids, pastes and slurries
Primary measured value	Distance and reflection
Secondary measured value	Level, volume, mass and flow rate

Design

Construction	The measurement system consists of a measuring sensor (antenna) and a signal converter Compact (C) version: Measuring sensor (antenna) attached directly to a signal converter Remote (F) version: Measuring sensor (antenna) installed on a tank and connected by a signal cable (max. length 100 m / 328 ft) to a signal converter
Options	<p>Integrated LCD display (-20...+60°C / -4...+140°F); if the ambient temperature is not in these limits, the display switches off automatically</p> <p>High-temperature (HT) extension (if the process connection temperature is more than +150°C / +302°F – Metallic Horn antenna only)</p> <p>Straight antenna extensions Max. extension length, PTFE Wave Horn antenna: 300 mm / 11.8"; Max. extension length, Metallic Horn antenna: 1000 mm / 39.4"</p> <p>S-bend antenna extension – only for DN150/6" and DN200/8" Metallic Horn antenna and Wave Guide antenna options</p> <p>L-bend (right angle) antenna extension – only for DN150/6" and DN200/8" Metallic Horn antenna and Wave Guide antenna options</p> <p>Antenna purging system (2 device options: liquid or gas) – only for DN150/6" and DN200/8" Metallic Horn antenna options</p> <p>Heating / cooling system (with or without the antenna purging system) – only for DN150/6" and DN200/8" Metallic Horn antenna options</p> <p>Signal cable for remote housing version (refer to cable properties in "Electrical connection: Remote device version")</p> <p>Weather protection – for the compact version or the antenna housing of the remote version</p>

Max. measuring range	PTFE and PP Wave Horn antennas: 20 m / 65.6 ft
	DN65 / DN80 / DN100 Metallic Horn antennas (installation only in stilling wells): 10 m / 32.8 ft
	DN150 / DN200 Metallic Horn antennas: 30 m / 98.4 ft
	Wave Guide antenna: 6 m / 19.7 ft
	Also depends on the dielectric constant of the product and the installation type. Refer also to "Antenna selection".
Min. tank height	1 m / 3.3 ft
Top dead zone	Minimum value: Antenna length + antenna extension length + 100 mm / 3.9"
Beam angle (½ angle) of antenna	PP Wave Horn: 10°
	PTFE Wave Horn: 10°
	Metallic Horn DN65 / 2.5": 20° – used only in RC W5200 reference chamber
	Metallic Horn DN80 / 3": 16° – used only in stilling wells
	Metallic Horn DN100 / 4": 12° – used only in stilling wells
	Metallic Horn DN150 / 6": 8°
	Metallic Horn DN200 / 8": 6°
Wave Guide / stilling well: n/a – the radar signal is inside the tube.	
Display and user interface	
Display	LCD display
	128 x 64 pixels in 8-step greyscale with 4-button keypad
Interface languages	3 language pack options (the language is given in the customer order): ① English, French, German and Italian ② English, French, Spanish and Portuguese ③ English, Chinese (simplified), Japanese and Russian

Measuring Accuracy

Resolution	1 mm / 0.04"
Repeatability	±1 mm / ±0.04"
Accuracy	Standard: ±10 mm / ±0.4", when distance < 10 m / 33 ft; ±0.1% of measured distance, when distance > 10 m / 33 ft Option: ±5 mm / ±0.2", when distance < 10 m / 33 ft; ±0.05% of measured distance, when distance > 10 m / 33 ft
Reference conditions acc. to EN 61298-1	
Temperature	+15...+25°C / +59...+77°F
Pressure	1013 mbara ±50 mbar / 14.69 psia ±0.73 psi
Relative air humidity	60% ±15%
Target	Metal plate in an anechoic chamber

Operating Conditions

Temperature	
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 / -58...+185°F (min. -40°C / -40°F for devices with the integrated LCD display option)
Process connection temperature (higher temperature on request)	PP Wave Horn antenna: -20...+100°C / -4...+212°F
	PTFE Wave Horn antenna: -50...+150°C / -58...+302°F
	Metallic Horn antenna / Wave Guide antenna: Standard: FKM/FPM (-40...+150°C / -40...+302°F (+200 / +392°F with an HT extension)); Options: Kalrez® 6375 (-20...+150°C / -4...+302°F (+250°C / +482°F with an HT extension)); PFA (-60°C...+130°C / -76...+266°F); EPDM (-50...+130°C / -58...+266°F)The process connection temperature must agree with the temperature limits of the gasket material. Ex: see supplementary operating instructions or approval certificates ①
Pressure	
Process pressure	PP Wave Horn antenna: -1...16 barg / -14.5...232 psig. For more data, refer to <i>Pressure ratings</i> on page 18.
	PTFE Wave Horn antenna: -1...40 barg / -14.5...580 psig. For more data, refer to <i>Pressure ratings</i> on page 18.
	Metallic Horn antenna / Wave Guide antenna: Standard: -1...40 barg / -14.5...580 psig; subject to the process connection used and the flange temperature. Higher pressure on request.
Purging system (options for gas or liquid)	Max. 6 barg / 87 psig (higher pressure on request)
Heating / cooling system (option)	Max. 6 barg / 87 psig (higher pressure on request)
Other conditions	
Dielectric constant (ϵ_r)	Direct mode: ≥ 1.8 TBF mode: ≥ 1.1 Refer also to "Technical data: Antenna selection".
Ingress protection	IEC 60529: IP66 / IP67
	NEMA 250: NEMA type 4X (housing) and type 6P (antenna)
Maximum rate of change	10 m/min / 32.8 ft/min

Installation conditions

Process connection size	The nominal diameter (DN) should be equal to or larger than the antenna diameter.
Process connection position	Make sure that there are not any obstructions directly below the process connection for the device. For more data, refer to <i>Installation</i> on page 33.
Dimensions and weights	For dimensions and weights data, refer to <i>Dimensions and weights</i> on page 24.

Materials

Housing	Standard: Polyester-coated aluminium
	Option: Stainless steel (1.4404 / 316L)
Antenna options / Wetted materials	PTFE Wave Horn antenna with a PTFE flange cladding
	PP Wave Horn antenna with a PP jacket/threaded process connection
	Stainless steel (1.4404 / 316L) Metallic Horn antenna with a PTFE process seal and an FKM/FPM, EPDM, Kalrez® 6375 or PFA O-ring gasket
	Stainless steel (1.4404 / 316L) Wave Guide antennas with a PTFE process seal and an FKM/FPM, EPDM, Kalrez® 6375 or PFA O-ring gasket
Feedthrough	PP Wave Horn antenna: this is a single-piece antenna (the feedthrough is filled with PP)
	PTFE Wave Horn antenna: this is a single-piece antenna (the feedthrough is filled with PTFE)
	Metallic Horn and Wave Guide antennas: Dual process seal system – 1st seal: PTFE with O-ring gasket, 2nd seal: Metaglas® with O-ring gasket ②
Cable gland	Standard: none
	Options: Plastic (Non-Ex: black, Ex i-approved: blue); nickel-plated brass; stainless steel
Weather protection (Option)	Stainless steel (1.4404 / 316L)

Process Connections

Thread	PP Wave Horn antenna: G 1½A...2A; 1½...2 NPT
Flange version	
EN	PTFE Wave Horn antenna: DN50...200 in PN16, PN40
	Metallic Horn and Wave Guide antennas: DN80...200 in PN16, PN40; others on request
ASME	PTFE Wave Horn antenna: 2" ... 8" in 150 lb / 300 lb
	Metallic Horn and Wave Guide antennas: 3" ... 8" in 150 lb / 300 lb; others on request
	DN65 Metallic Horn antenna: 2" 300 lb for installation on the RC W5200 reference chamber
JIS	PTFE Wave Horn antenna: 50...150A in 10K
	Metallic Horn and Wave Guide antennas: 80...200A in 10K; others on request
Other	Others on request

Electrical Connections

Power supply	Terminals output – Non-Ex / Ex i: 11.5...30 VDC; min./max. value for an output of 22 mA at the terminal
	Terminals output – Ex d: 13.5...36 VDC; min./max. value for an output of 22 mA at the terminal
Maximum current	22 mA
Current output load	Non-Ex / Ex i: $R_L [\Omega] \leq ((U_{ext} - 11.5 \text{ V})/22 \text{ mA})$. For more data, refer to <i>Minimum power supply voltage</i> on page 17.
	Ex d: $R_L [\Omega] \leq ((U_{ext} - 13.5 \text{ V})/22 \text{ mA})$. For more data, refer to <i>Minimum power supply voltage</i> on page 17.
Cable entry	Standard: M20×1.5; Option: 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

Input and output

Current output / HART®	
Output signal	4...20 mA HART® or 3.8...20.5 mA acc. to NAMUR NE 43 ③
Resolution	±3 µA
Temperature drift	Typically 50 ppm/K
Digital temperature drift	Max. ±15 mm / 0.6" for the full temperature range
Error signal	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) ④
PROFIBUS PA	
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
FOUNDATION™ fieldbus	
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

Approvals

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 60068-2-64 Metallic Horn (without antenna extension options): 5 Hz to 100 Hz: 4g Metallic Horn, PTFE or PP Wave Horn: 3.5 mm up to 8 Hz and 10 m/s ² : 1g, 8.5 to 2000 Hz
Explosion protection	
ATEX (Ex ia or Ex d or Ex tb) DEKRA 11ATEX0166 X	Compact version
	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;
	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
	Remote version, transmitter
	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
	Remote version, sensor
	II 1/2 G Ex ia IIC T6...T2 Ga/Gb or II 2 G Ex ia IIC T6...T2 Gb;
	II 1/2 D Ex ia IIIC T90°C Da/Db or II 2 D Ex ia IIIC T90°C Db;
	II 1/2 G Ex ia IIC T6...T2 Gb or II 2 G Ex ia IIC T6...T2 Gb;
II 1/2 D Ex ia IIIC T90°C Db or II 2 D Ex ia IIIC T90°C Db	
ATEX (Ex ic) DEKRA 13ATEX0051 X	Compact version
	II 3 G Ex ic IIC T6...T2 Gc;
	II 3 D Ex ic IIIC T90°C Dc
	Remote version, transmitter
	II 3 G Ex ic [ic] IIC T6...T4 Gc;
	II 3 D Ex ic [ic] IIIC T90°C Dc
	Remote version, sensor
	II 3 G Ex ic IIC T6...T2 Gc;
II 3 D Ex ic IIIC T90°C Dc	
IECEX IECEX DEK 11.0060 X	Compact version
	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
	Remote version, transmitter
	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
	Remote version, sensor
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	NEC 500 (Division ratings)
	XP-AIS / CL. I / Div. 1 / Gr. ABCD / T6–T1;
	DIP / CL. II, III / Div. 1 / Gr. EFG / T6–T1;
	IS / CL. I, II, III / Div. 1 / Gr. ABCDEFG / T6–T1;
	NI / CL. I / Div. 2 / Gr. ABCD / T6–T1
	NEC 505 (Zone ratings)
	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
	CEC Section 18 (Zone ratings)
	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
	CEC Section 18 and Annex J (Division ratings)
	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 _A T90°C IP6X Ex d ia IIC T2–T6 Gb or Ex d ia IIC T2–T6 Ga/Gb DIP A20/A21 T _A T90°C IP6X
DNV / INMETRO DNV 13.0142	Compact version 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 Remote version, transmitter 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 Remote version, sensor 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

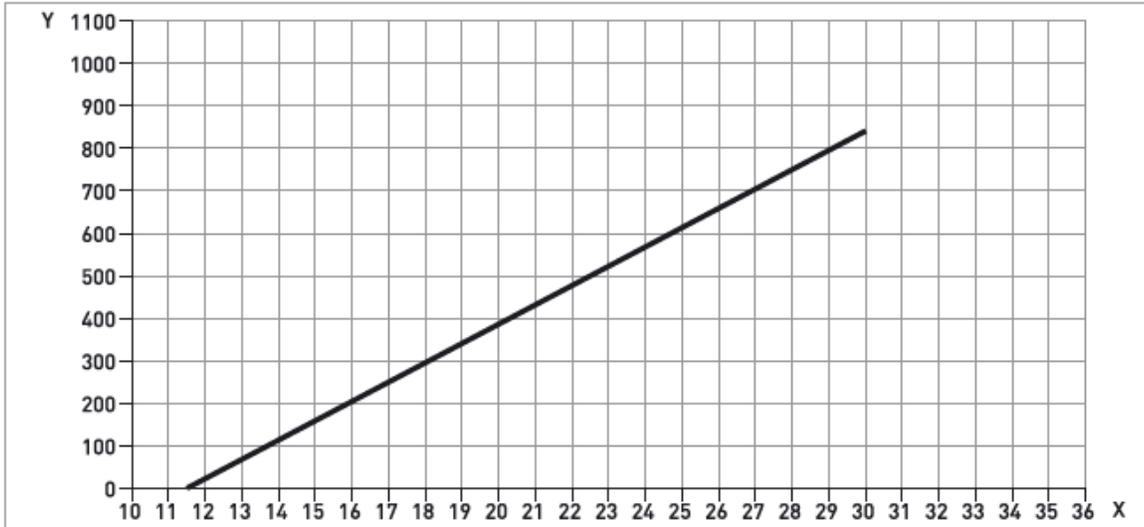
Other standards and approvals	
SIL – only for 4...20 mA output	Compact version: SIL 2 – certified according to all the requirements in EN 61508 (Full Assessment) and for high/low demand mode operation. HFT=0, SFF=94.1% (for non-Ex / Ex i devices) or 91% (for Ex d devices), type B device
EMC	Essential requirements of Electromagnetic Compatibility Directive 2014/30/EU in conjunction with EN 61326-1 (2013) SIL 2-approved devices agree with EN 61326-3-1 (2008) and EN 61326-3-2 (2008)
Radio approvals	RED Radio Equipment Directive 2014/53/EU in conjunction with ETSI EN 302 372
	FCC Rules Part 15
	Industry Canada License-exempt RSS-210
LVD	Essential requirements of Low-Voltage Directive 2014/35/EU in conjunction with EN 61010-1
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
WHG Z-65.16-546	In conformity with the German Federal Water Act, §9
CRN	This certification is applicable for all Canadian provinces and territories. For more data, refer to the website.
Construction code	Metallic Horn and Wave Guide antennas: NACE MR0175 / ISO 15156; NACE MR0103

1. If the process connection temperature is more than +150°C/ +302°F and the device has Kalrez® 6375 or FKM/FPM gaskets, the device will also have an high temperature extension between the converter and the process connection. Kalrez® is a registered trademark of DuPont Performance Elastomers L.L.C.. The process connection temperature must agree with the temperature limits of the gasket material.
2. Metaglas® is a registered trademark of Herberts Industrieglas, GMBH & Co., KG
3. HART® is a registered trademark of the HART Communication Foundation
4. Only the 3.6mA error signal is applicable to SIL-approved devices. Only the 22mA error signal is applicable to WHG-approved devices.

Minimum power supply voltage

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

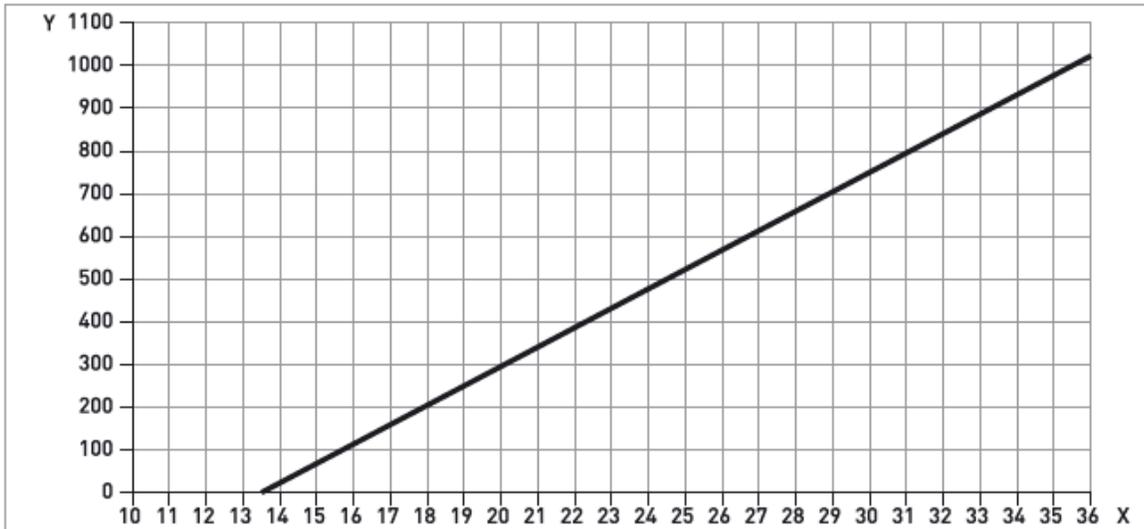
Non-Ex and Hazardous Location approved (Exi/ IS) devices



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

Figure 4: Minimum power supply voltage for an output of 22mA at the terminal (Non-Ex and Hazardous Location approval (Exi/ IS))

Hazardous Location (Exd/ XP/NI) approved devices



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

Figure 5: Minimum power supply voltage for an output of 22mA at the terminal (Hazardous Location approval (Exd/ XP/NI))

Pressure ratings

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

EN flanges: Metallic Horn, Wave Guide and PTFE Wave Horn antennas

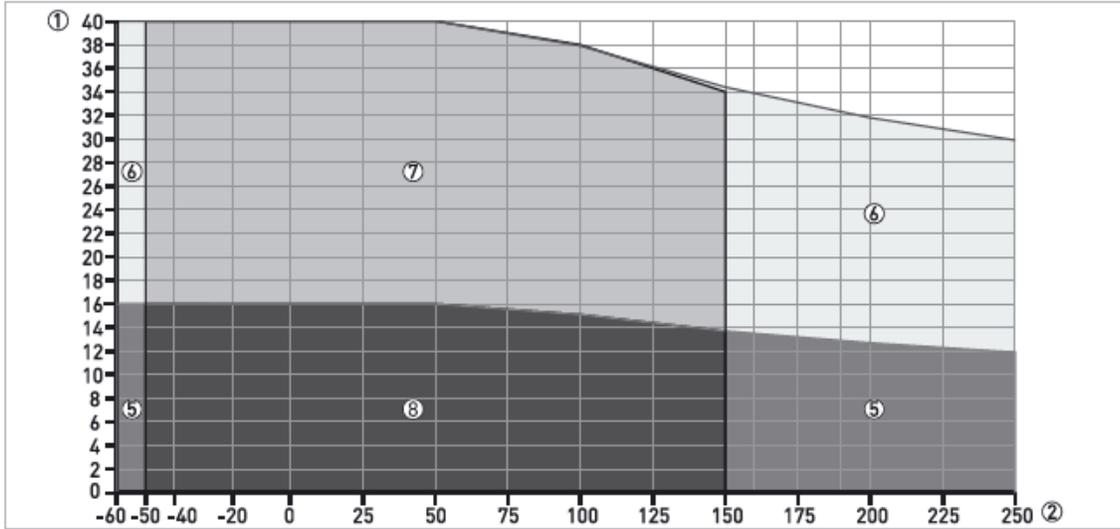


Figure 6: Pressure/ temperature rating (EN1092-1), flange connections, in °C and barg

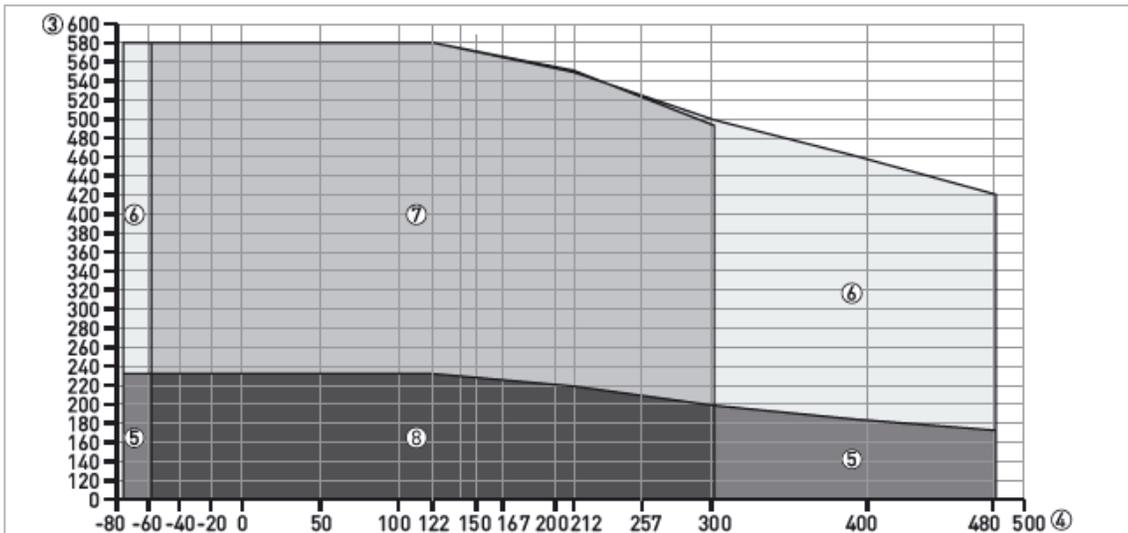


Figure 7: Pressure/ temperature rating (EN1092-1), flange connections, in °F and psig

1. p [barg]
2. T [°C]
3. p [psig]
4. T [°F]
5. Flange connection, PN16: Metallic Horn and Wave Guide antennas
6. Flange connection, PN40: Metallic Horn and Wave Guide antennas
7. Flange connection, PN40: Metallic Horn, Wave Guide and PTFE Wave Horn antennas
8. Flange connection, PN16: Metallic Horn, Wave Guide and PTFE Wave Horn antennas

ISO threaded connections: PP Wave Horn antenna

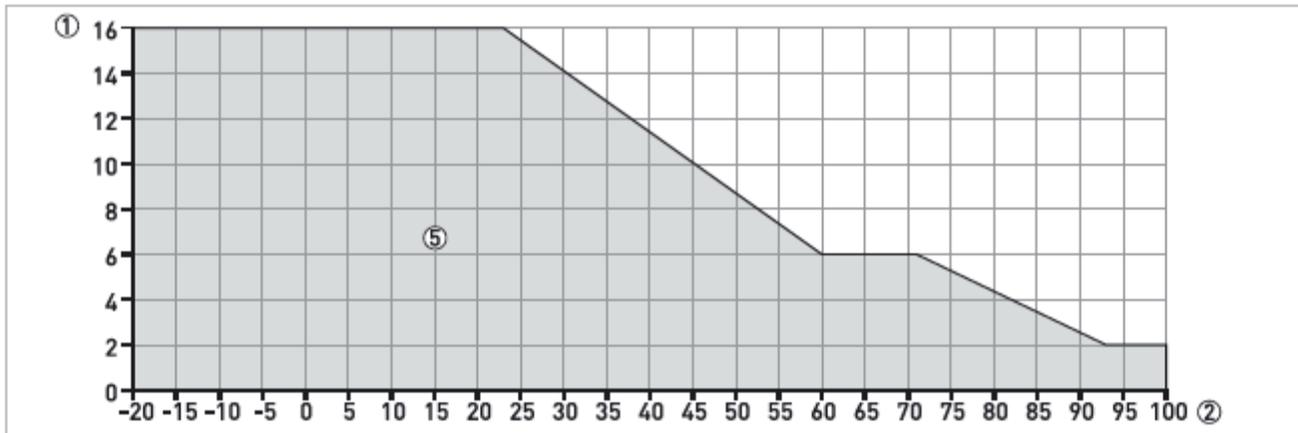


Figure 8: Pressure/ temperature rating (ISO228), threaded connection, in °C and barg

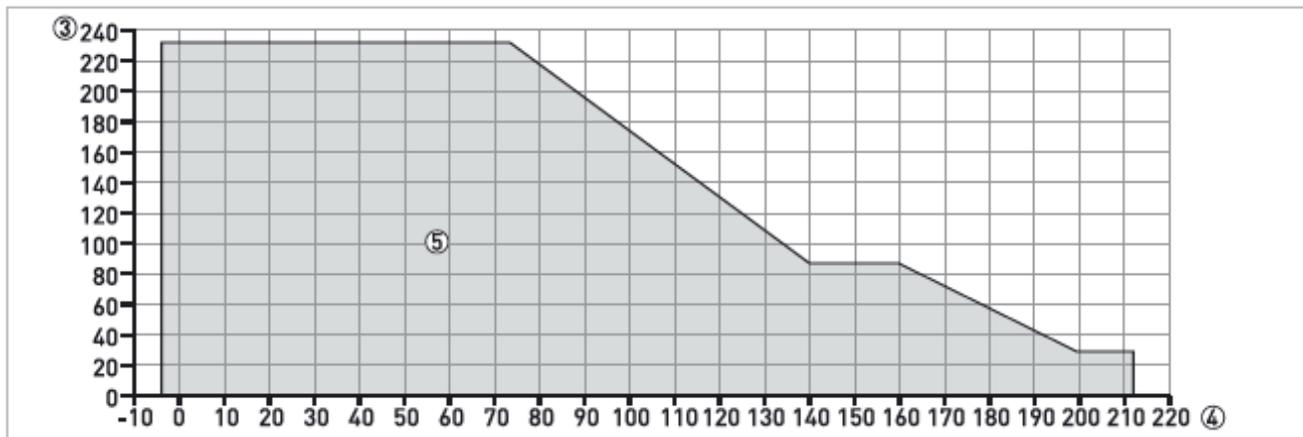


Figure 9: Pressure/ temperature rating (ISO228-1), threaded connection, in °F and psig

- 1 p [barg]
- 2 T [°C]
- 3 p [psig]
- 4 T [°F]
- 5 Threaded connection, G (ISO228-1): PP Wave Horn antenna

ASME flanges: Metallic Horn, Wave Guide and PTFE Wave Horn antennas

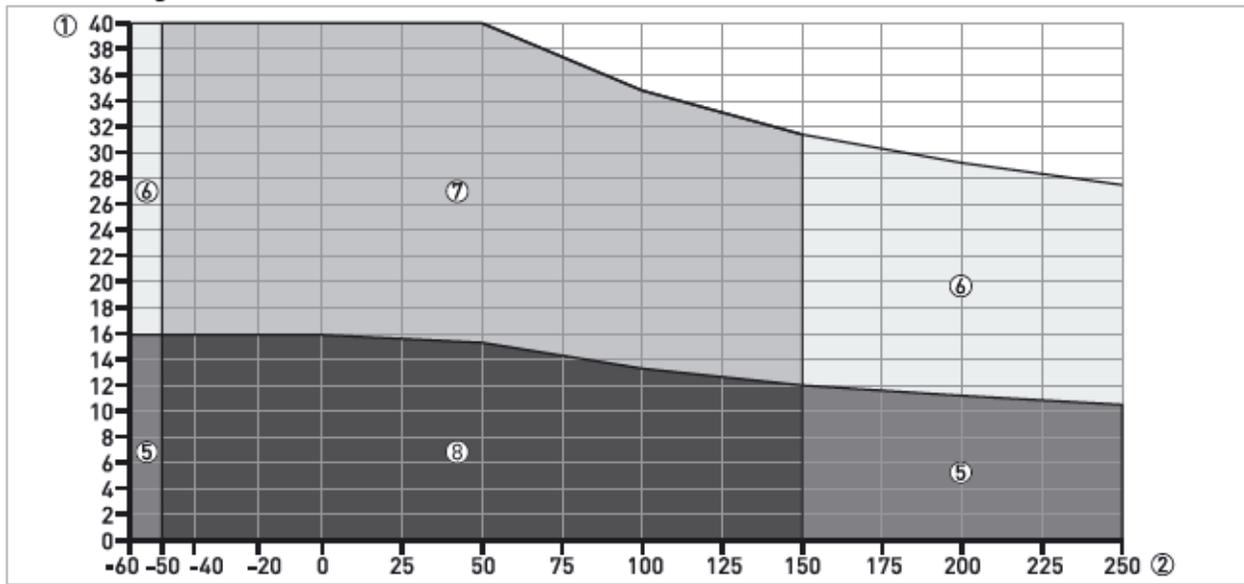


Figure 10: Pressure / temperature rating (ASME B16.5), flange and threaded connections, in °C and barg

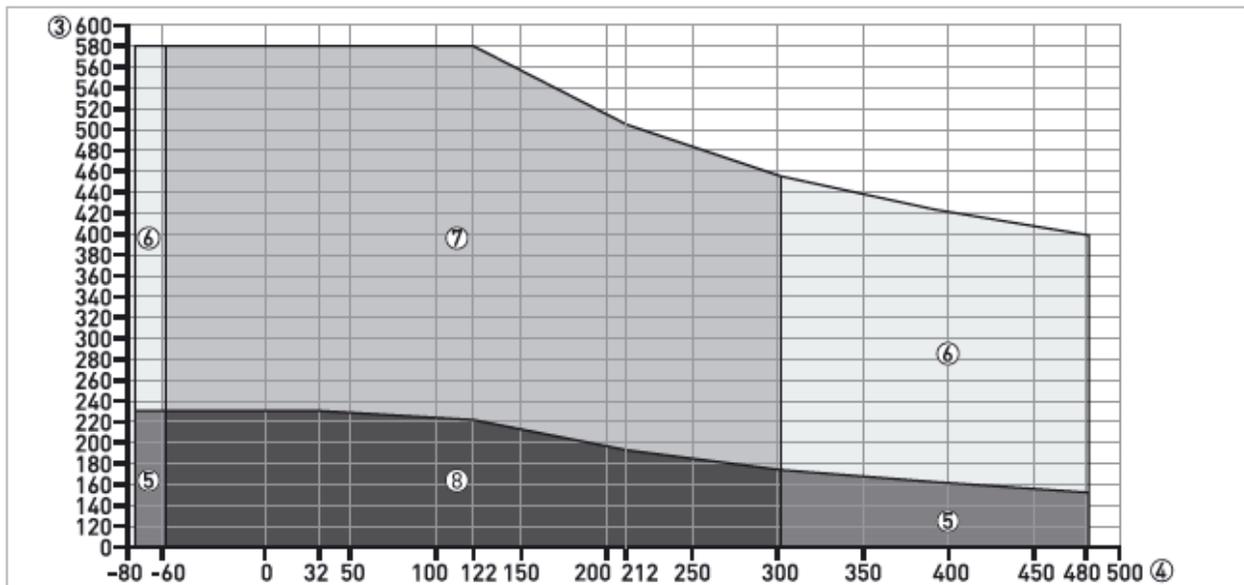


Figure 11: Pressure / temperature rating (ASME B16.5), flange and threaded connections, in °F and psig

- 1 p [barg]
- 2 T [°C]
- 3 p [psig]
- 4 T [°F]
- 5 Flange connection, Class 150: Metallic Horn and Wave Guide antennas
- 6 Flange connection, Class 300: Metallic Horn and Wave Guide antennas
- 7 Flange connection, Class 300: Metallic Horn and Wave Guide and PTFE Wave Horn antennas
- 8 Flange connection, Class 150: Metallic Horn and Wave Guide and PTFE Wave Horn antennas

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.

ASME flanges for CRN-approved devices: Metallic Horn, Wave Guide and PTFE Wave Horn antennas

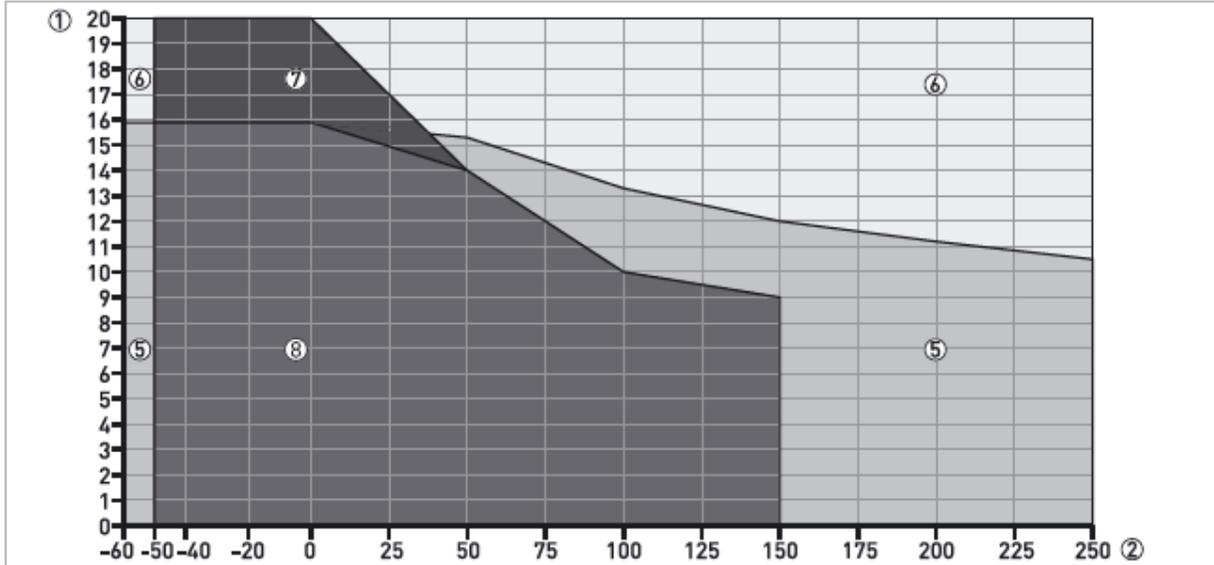


Figure 12: Pressure / temperature rating (ASME B16.5), flange and threaded connections, in °C and barg

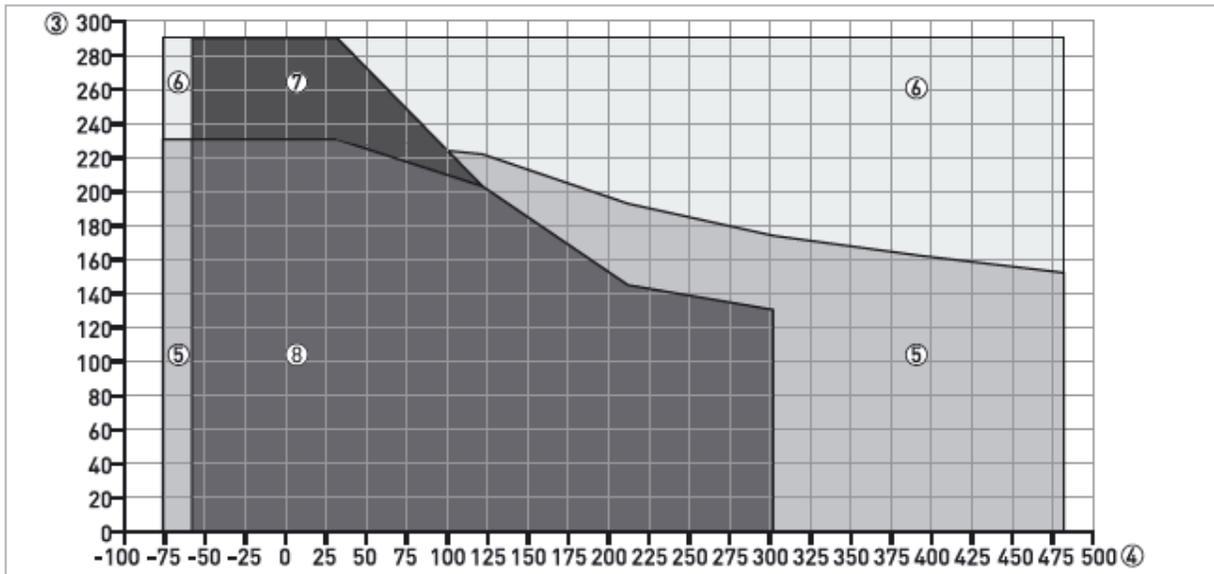


Figure 13: Pressure / temperature rating (ASME B16.5), flange and threaded connections, in °F and psig

- 1 p [barg]
- 2 T [°C]
- 3 p [psig]
- 4 T [°F]
- 5 Flange connection, Class 150: Metallic Horn and Wave Guide antennas
- 6 Flange connection, Class 300: Metallic Horn and Wave Guide antennas
- 7 Flange connection, Class 300: Metallic Horn and Wave Guide and PTFE Wave Horn antennas
- 8 Flange connection, Class 150: Metallic Horn and Wave Guide and PTFE Wave Horn antennas

ASME threaded connections: PP Wave Horn antenna

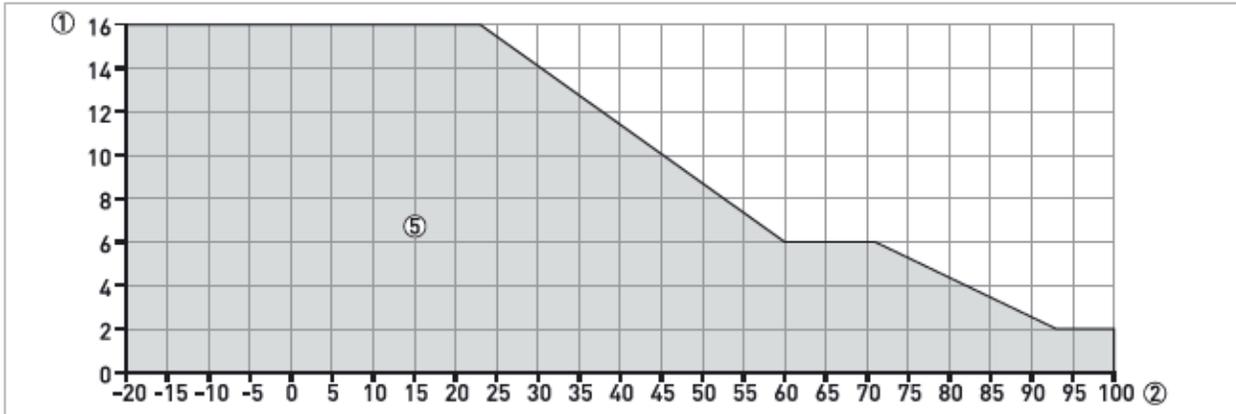


Figure 14: Pressure/ temperature rating (ASME B1.20.1), threaded connection, in °C and barg

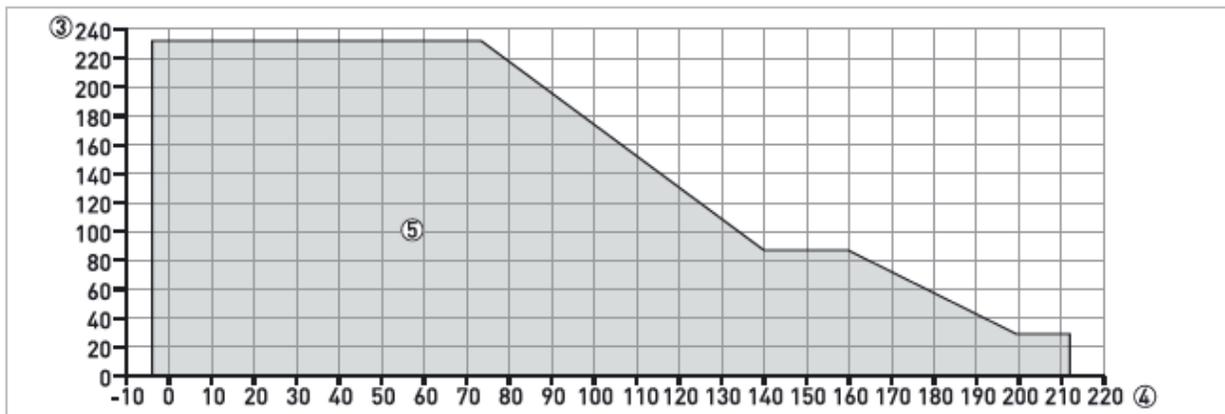


Figure 15: Pressure/ temperature rating (ASME B1.20.1), threaded connection, in °F and psig

- 1 p [barg]
- 2 T [°C]
- 3 p [psig]
- 4 T [°F]

Threaded connection, NPT (ASME B1.20.1): PP Wave Horn antenna

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.

ASME threaded connections for CRN-approved devices: PP Wave Horn antenna

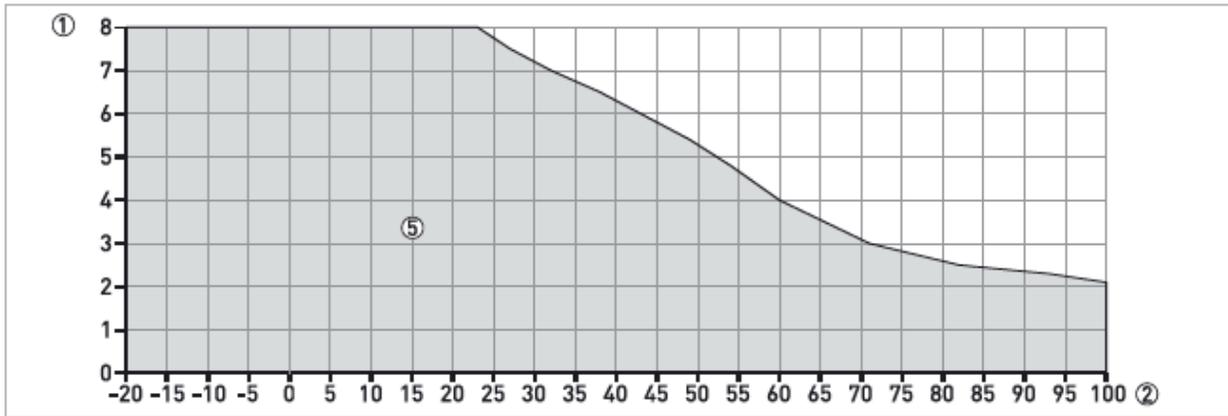


Figure 16: Pressure/ temperature rating (ASME B1.20.1), threaded connection, in °C and barg

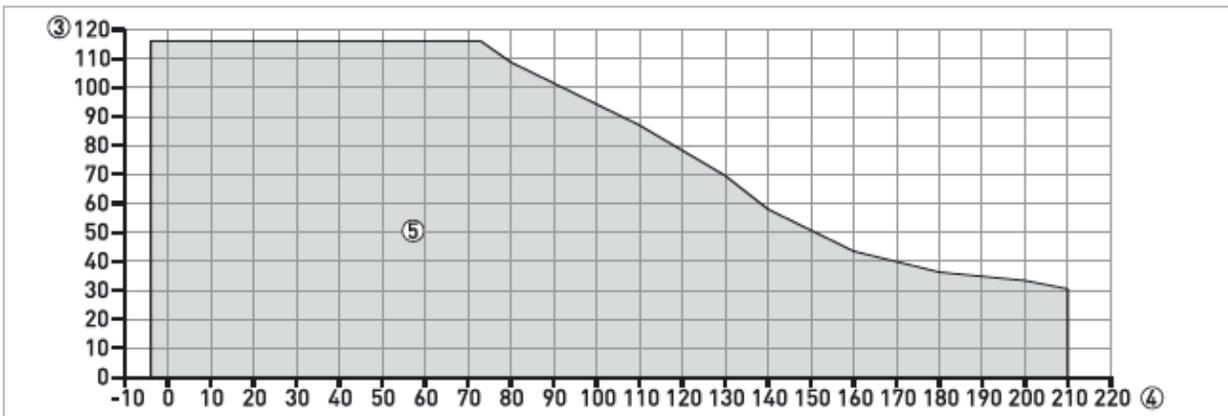


Figure 17: Pressure/ temperature rating (ASME B1.20.1), threaded connection, in °F and psig

- 1 p [barg]
- 2 T [°C]
- 3 p [psig]
- 4 T [°F]
- 5 Threaded connection, NPT (ASME B1.20.1): PP Wave Horn antenna

Dimensions and weights

Housing, process connection and antenna options

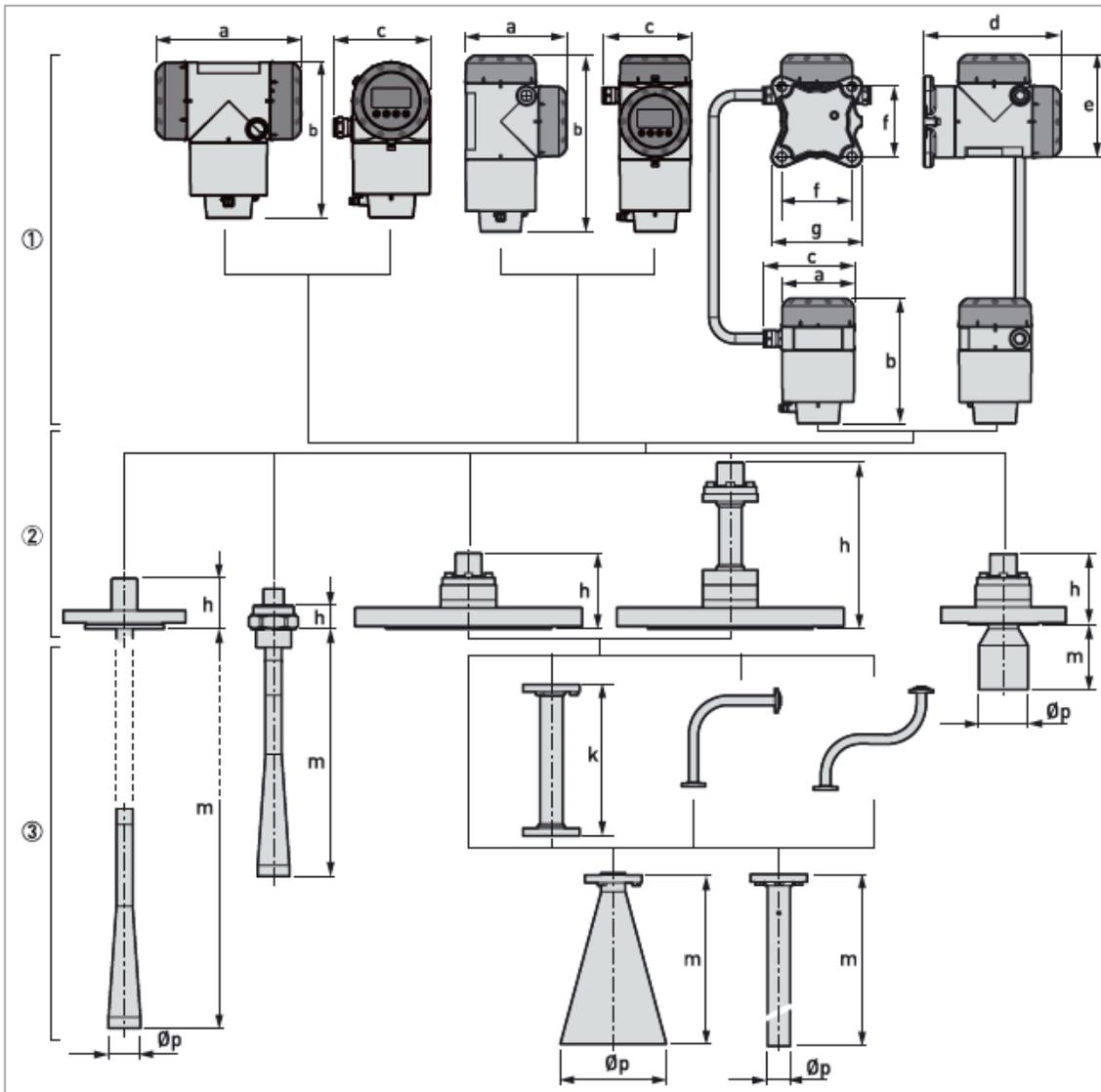


Figure 18: Housing, process connection and antenna options

- 1 Housing options. Housing options. Housing options. Housing options. From left to right: compact converter with horizontal housing, compact converter with vertical housing, and remote converter (top) and antenna housing (bottom)
- 2 Process connection options. Process connection options. Process connection options. Process connection options. From left to right: flange connection for PTFE Wave Horn antenna, threaded connection for PP Wave Horn antenna, flange connection for Metallic Horn and Wave Guide antennas, flange connection with a high-temperature (HT) extension for Metallic Horn and Wave Guide antennas, flange connection for DN65 Metallic Horn antenna
- 3 Antenna options. Antenna options. Antenna options. Antenna options. From left to right: PTFE Wave Horn antenna, PP Wave Horn antenna, Metallic Horn antenna (with or without an antenna extension option: straight, L-bend or S-bend extension), Wave Guide antenna, DN65 horn antenna with 2" 300lb RF (ASME B16.5) flange for reference chamber (on request)

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

Housing options: Dimensions in mm and inches

Dimensions	Compact – horizontal		Compact – vertical		Remote	
	Non-Ex or Ex i (Ex d)		Non-Ex or Ex i (Ex d)		Non-Ex or Ex i (Ex d)	
	[mm]	[inches]	[mm]	[inches]	[mm]	[inches]
a	191 (258)	7.5 (10.2)	147 (210)	5.79 (8.27)	104 (104)	4.09 (4.09)
b	214 (214)	8.43 (8.43)	258 (258)	10.16 (10.16)	181 (181)	7.13 (7.13)
c	127 (127)	5.00 (5.00)	127 (127)	5.00 (5.00)	129 (129)	5.08 (5.08)
d	—	—	—	—	195 (195)	7.68 (7.68)
e	—	—	—	—	146 (209)	5.75 (8.23)
f	—	—	—	—	100 (100)	3.94 (3.94)
g	—	—	—	—	130 (130)	5.12 (5.12)

Process connection and antenna options: Dimensions in mm

Dimensions [mm]	PTFE Wave Horn	PP Wave Horn	Metallic Horn					Wave Guide	
			DN65	DN80	DN100	DN150	DN200		
h	68	33	100 (220 for the HT extension) ①						
k	—	—	—	100, 200, 300, 400, 500, 1000 ②					
m	296 ③	322	86	112	148.5	223	335	1000...6000	
∅p	43	43	65	80	100	140	200	30	

1. The HT extension is only for Metallic Horn and Wave Guide antennas. It is attached between the signal converter and the flange if the process connection temperature is +150...+250°C.
2. These are the length options for the straight antenna extension. For data about the dimensions of S-bend and L-bend extensions, refer to the illustrations that follow.
3. Other antenna lengths are available: 396, 496 or 596mm. These options are for tanks with long nozzles.

Process connection and antenna options: Dimensions in inches

Dimensions [inches]	PTFE Wave Horn	PP Wave Horn	Metallic Horn					Wave Guide	
			2.5"	3"	4"	6"	8"		
h	2.68	1.30	3.94 (8.66 for the HT extension) ①						
k	—	—	—	3.94, 7.87, 11.81, 15.75, 19.68 or 39.37 ②					
m	11.65 ③	12.68	3.39	4.41	5.85	8.78	13.19	39.4...236.2	
∅p	1.69	1.69	2.56	3.15	3.94	5.51	7.87	1.18	

1. The HT extension is only for Metallic Horn and Wave Guide antennas. It is attached between the signal converter and the flange if the process connection temperature is +302...+482°F.
2. These are the length options for the straight antenna extension. For data about the dimensions of S-bend and L-bend extensions, refer to the illustrations that follow.
3. Other antenna lengths are available: 15.59", 19.53" or 23.46". These options are for tanks with long nozzles.

Special antenna extensions for tanks with obstructions (DN150/ 6" and DN200/ 8" Metallic Horn antenna options only)

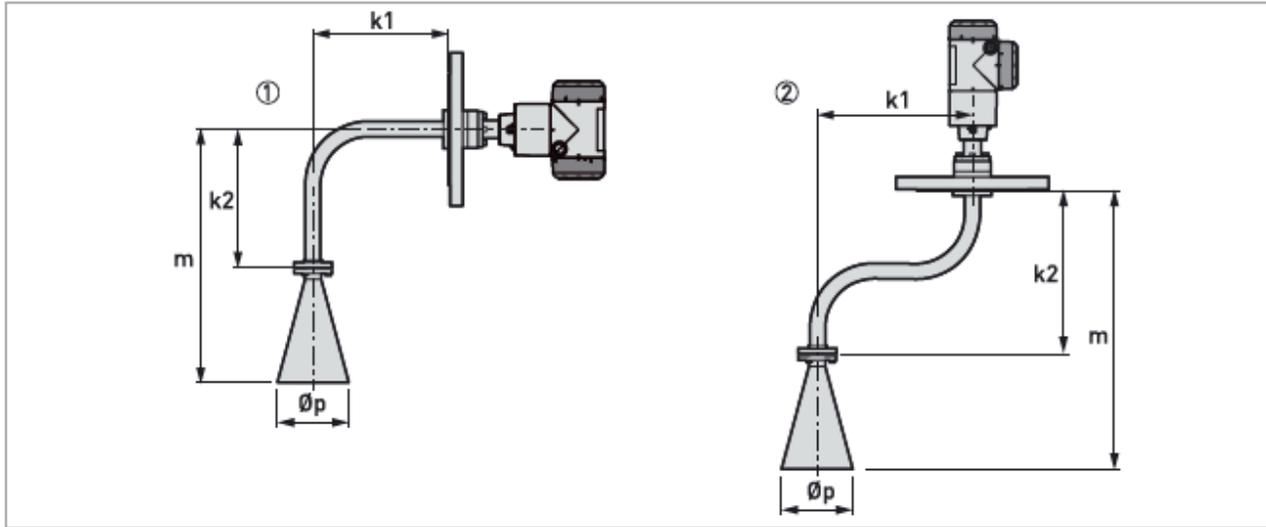


Figure 19: Special antenna extensions for tanks with obstructions (DN150/ 6" and DN200/ 8" Metallic Horn antenna options only)

- 1 L-bend (right angle) antenna extension
- 2 S-bend antenna extension

Special antenna extensions: Dimensions in mm

Dimensions [mm]	Metallic Horn antenna			
	With L-bend (right angle) extension		With S-bend extension	
	DN150 / 6"	DN200 / 8"	DN150 / 6"	DN200 / 8"
k1	271		300	
k2	271		322	
m	494	606	545	657
Øp	140	200	140	200

Special antenna extensions: Dimensions in inches

Dimensions [inches]	Metallic Horn antenna			
	With L-bend (right angle) extension		With S-bend extension	
	DN150 / 6"	DN200 / 8"	DN150 / 6"	DN200 / 8"
k1	10.67		11.81	
k2	10.67		12.68	
m	19.45	23.86	21.46	25.87
Øp	5.51	7.87	5.51	7.87

Purging and heating/cooling system options

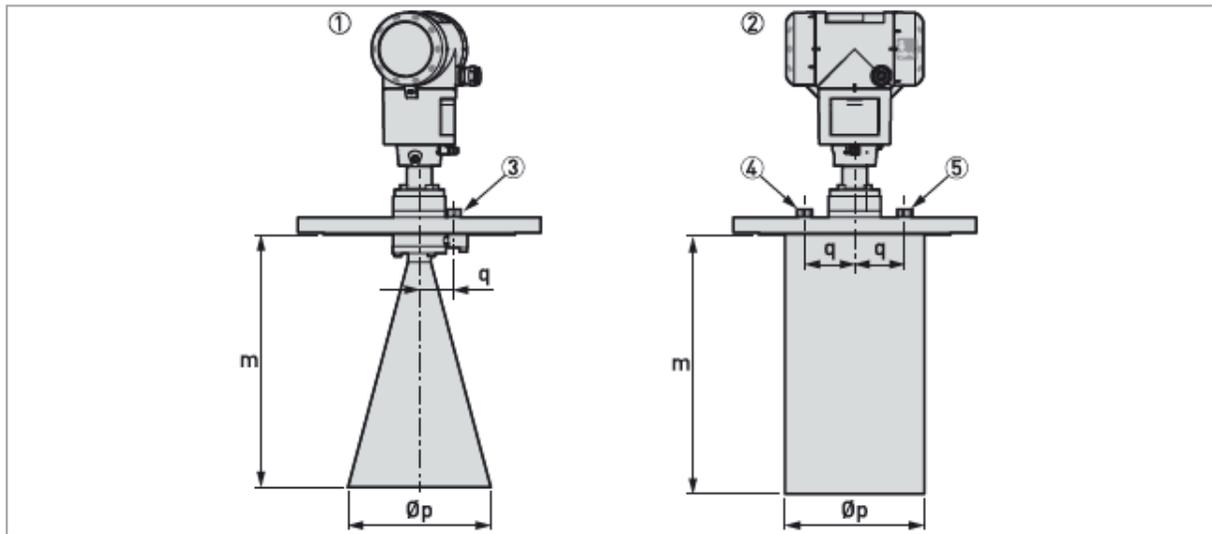


Figure 20: Purging and heating/cooling system options

- 1 Flange connection with purging option
- 2 Flange connection with heating/cooling system option
- 3 G³/₄ threaded connection for purging system (the plug is supplied by the manufacturer)
- 4 G³/₄ threaded connection for the heating/cooling system outlet (the plug is supplied by the manufacturer)
- 5 G³/₄ threaded connection for the heating/cooling system inlet (the plug is supplied by the manufacturer)

Purging system and heating/cooling system: Dimensions in mm

Dimensions [mm]	Metallic Horn antenna			
	Purging system		Heating/cooling system	
	DN150 / 6"	DN200 / 8"	DN150 / 6"	DN200 / 8"
m	223	351	202	360 ①
Øp	140	200	139.7	195
q	34	34	53	70

1 This is the standard length. Longer on request.

Purging system and heating/cooling system: Dimensions in inches

Dimensions [inches]	Metallic Horn antenna			
	Purging system		Heating/cooling system	
	DN150 / 6"	DN200 / 8"	DN150 / 6"	DN200 / 8"
m	8.78	13.82	8.0	14.17 ①
Øp	5.51	7.87	5.5	7.68
q	1.34	1.34	2.1	2.76

1 This is the standard length. Longer on request.

All wetted parts (flange, antenna and heating/cooling jacket) of the heating/cooling system option are made of 316L/ 1.4404.

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

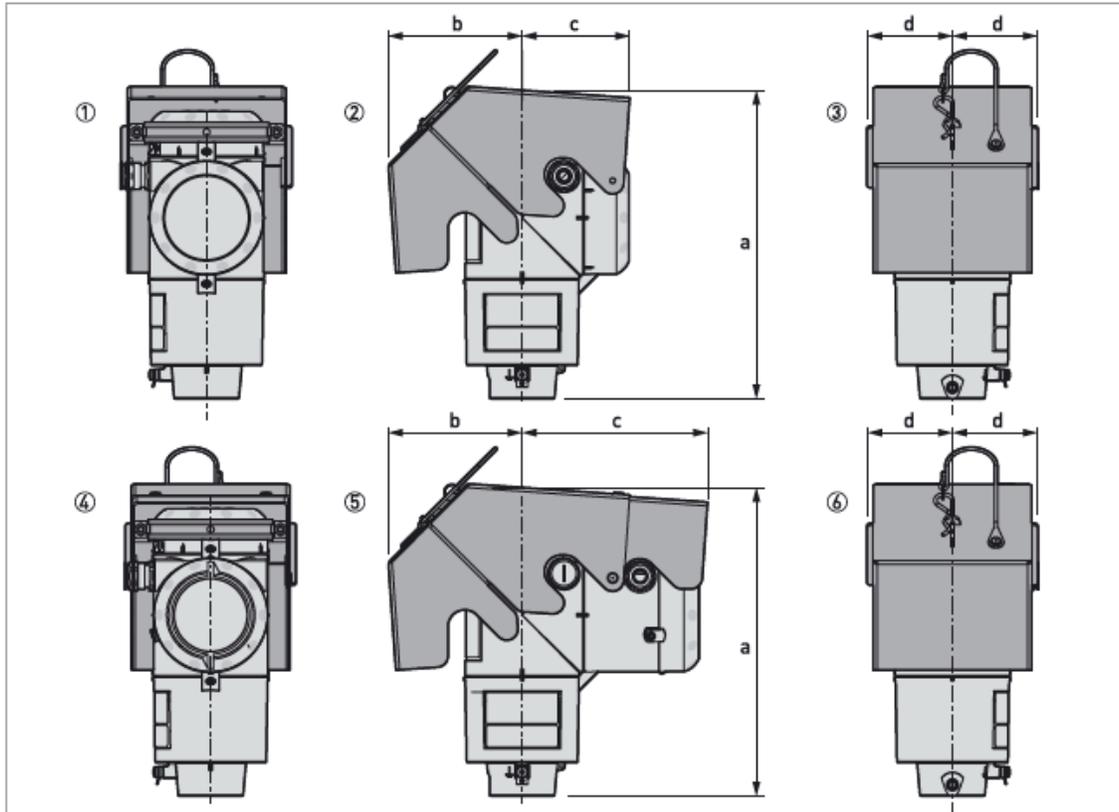


Figure 21: Weather protection option for vertical signal converter versions (compact version only)

- 1 Non-Ex/ Exi/ IS: Rear view (with weather protection closed)
- 2 Non-Ex/ Exi/ IS: Right side (with weather protection closed)
- 3 Non-Ex/ Exi/ IS: Front view (with weather protection closed)
- 4 Exd/ XP: Rear view (with weather protection closed)
- 5 Exd/ XP: Right side (with weather protection closed)
- 6 Exd/ XP: Front view (with weather protection closed)

Dimensions and weights in mm and kg

Weather protection	Version	Dimensions [mm]				Weights [kg]
		a	b	c	d	
Vertical signal converter	Non-Ex / Ex i / IS	277	120	96	77	1.3
	Ex d / XP	277	120	166	77	1.5

Dimensions and weights in inches and lb

Weather protection	Version	Dimensions [mm]				Weights [kg]
		a	b	c	d	
Vertical signal converter	Non-Ex / Ex i / IS	10.9	4.7	3.8	3.0	2.9
	Ex d / XP	10.9	4.7	6.5	3.0	3.3

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

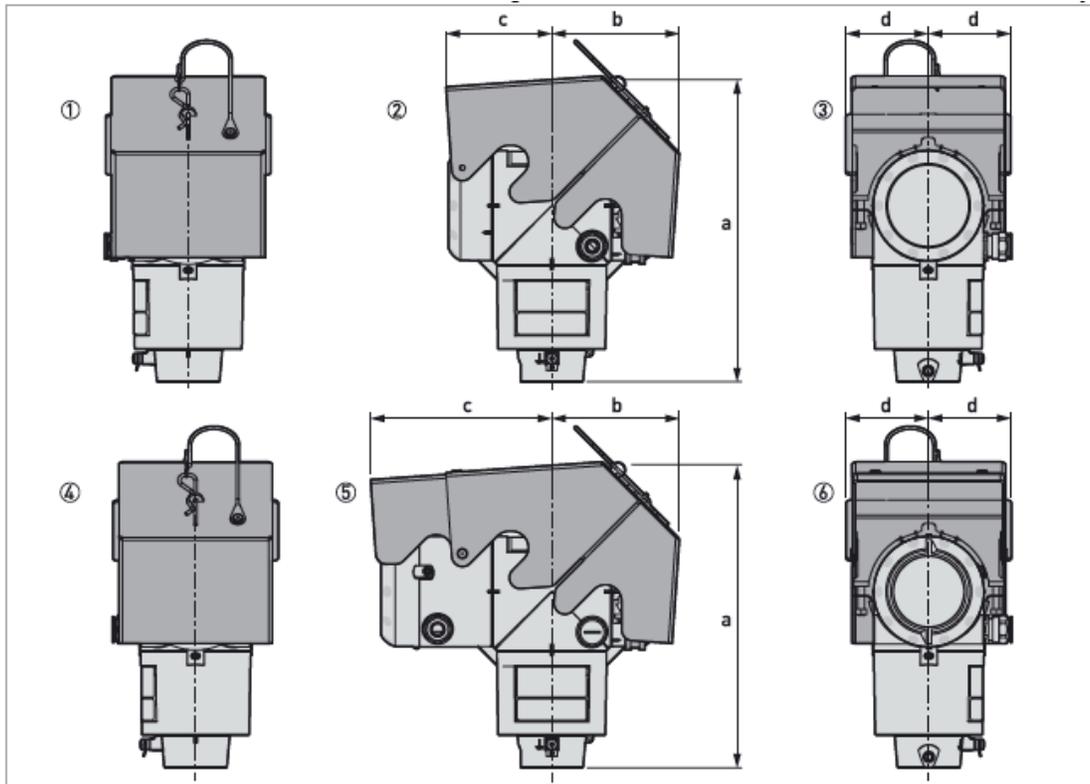


Figure 22: Weather protection option for horizontal signal converter versions (compact version only)

- 1 Non-Ex/ Exi/ IS: Front view (with weather protection closed)
- 2 Non-Ex/ Exi/ IS: Left side (with weather protection closed)
- 3 Non-Ex/ Exi/ IS: Rear view (with weather protection closed)
- 4 Exd/ XP: Front view (with weather protection closed)
- 5 Exd/ XP: Left side (with weather protection closed)
- 6 Exd/ XP: Rear view (with weather protection closed)

Dimensions and weights in mm and kg

Weather protection	Version	Dimensions [mm]				Weights [kg]
		a	b	c	d	
Horizontal signal converter	Non-Ex / Ex i / IS	279	120	96	77	1.3
	Ex d / XP	279	120	166	77	1.5

Dimensions and weights in inches and lb

Weather protection	Version	Dimensions [inches]				Weights [lb]
		a	b	c	d	
Horizontal signal converter	Non-Ex / Ex i / IS	11.0	4.7	3.8	3.0	2.9
	Ex d / XP	11.0	4.7	6.5	3.0	3.3

Weather protection option (antenna housing – for the remote version only)

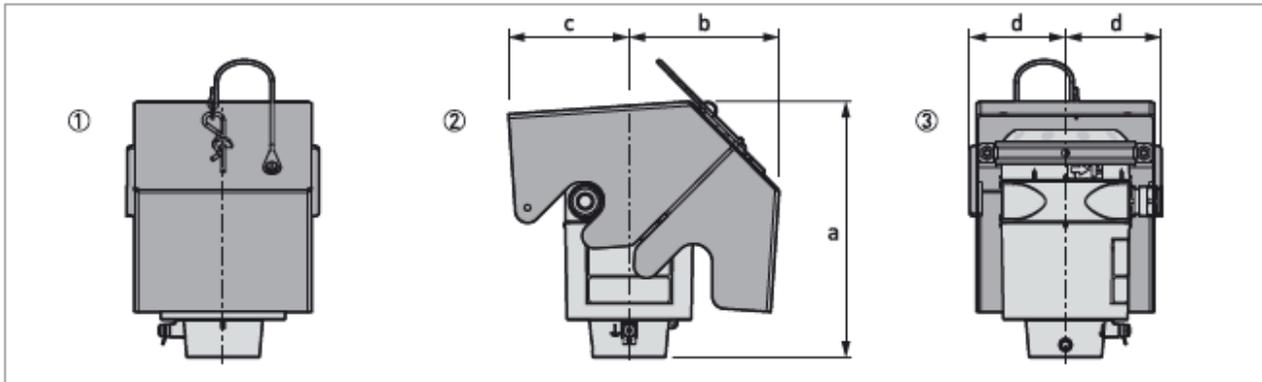


Figure 23: Weather protection option for the antenna housing (remote converter version only)

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

Dimensions and weights in mm and kg

Weather protection	Dimensions [mm]				Weights [kg]
	a	b	c	d	
Antenna housing	204	120	96	77	1.3

Dimensions and weights in inches and lb

Weather protection	Dimensions [inches]				Weights [lb]
	a	b	c	d	
Antenna housing	8.0	4.7	3.8	3.0	2.9

Converter and antenna housing weights

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

Non-Ex/ intrinsically-safe (Exi/ IS)

Compact converter	3.0	6.6	6.6	14.6
Remote converter ①	2.5	5.5	5.9	13.0
Antenna housing ①	2.0	4.4	4.1	9.0

Explosion proof (Exd/ XP)

Compact converter	3.2	7.1	7.5	16.5
Remote converter ①	2.9	6.40	7.1	15.65
Antenna housing ①	2.0	4.4	4.1	9.0

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

Antenna option weights

Antenna options	Min./Max. weights	
	[kg]	[lb]

Standard options, without converter

PTFE Wave Horn antenna with flange connection	3.7	8.2
PTFE Wave Horn antenna with flange connection, with 100 mm / 3.94" antenna extension	3.78	8.3
PTFE Wave Horn antenna with flange connection, with 200 mm / 7.87" antenna extension	3.86	8.5
PTFE Wave Horn antenna with flange connection, with 300 mm / 11.81" antenna extension	3.94	8.7
PP Wave Horn antenna with threaded connection	0.7	1.5
DN65 / 2.5" Metallic Horn antenna with flange connection – only for the RC W5200 reference chamber	5.35	11.8
DN80 / 3" Metallic Horn antenna with flange connection, standard length	5.6...37.1	12.3...81.8
DN100 / 4" Metallic Horn antenna with flange connection, standard length	9.1...37.2	20.1...82
DN150 / 6" Metallic Horn antenna with flange connection, standard length	13.6...37.5	30...82.7
DN200 / 8" Metallic Horn antenna with flange connection, standard length	14.0...37.8	30.9...83.3
Wave Guide antenna with flange connection, 1...6 m / 3.28...19.68 ft	1.6...9.9	3.5...21.8

Antenna extension options

Straight extension, length 100 mm / 3.94" ①	+0.76	+1.68
Straight extension, length 200 mm / 7.87" ①	+0.94	+2.07
Straight extension, length 300 mm / 11.81" ①	+1.12	+2.47
Straight extension, length 400 mm / 15.75" ①	+1.30	+2.87
Straight extension, length 500 mm / 19.69" ①	+1.48	+3.26
Straight extension, length 1000 mm / 39.37" ①	+2.38	+5.25

Antenna options	Min./Max. weights	
	[kg]	[lb]
S-bend extension ①	+1.56	+3.44
L-bend (right-angle) extension ①	+1.48	+3.26

Other options

HT extension ②	+0.98	+2.16
----------------	-------	-------

1 This option is for Metallic Horn and Wave Guide antenna options

2 This component is only for the Metallic Horn and Wave Guide antennas. It is attached between the signal converter and the flange if the process connection temperature is +150...+250°C/ +302...+482°F.

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 radar level transmitter measures distance, level, mass, volume, flow rate (in open channels) and reflectivity of liquids, pastes and slurries. It does not touch the measured product.

Installation

Pressure and temperature ranges

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

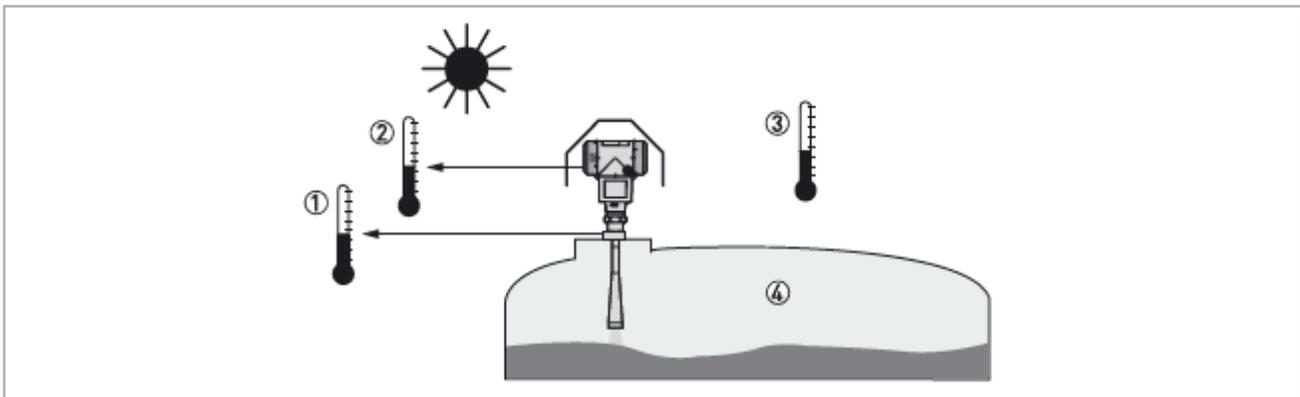


Figure 24: Pressure and temperature ranges

- 1 Temperature at the process connection.
Non-Ex devices: The temperature range depends on the type of antenna, process connection and the seal material. Refer to the table that follows.
Devices with Hazardous Location approvals: see supplementary instructions
- 2 Ambient temperature for operation of the display
-20...+60°C/ -4...+140°F
If the ambient temperature is not between these limits, the display screen switches off automatically. The device continues to operate.
- 3 Ambient temperature
Non-Ex devices: refer to the ambient temperature/ flange temperature graphs in this section
Devices with Hazardous Location approvals: see supplementary instructions
- 4 Process pressure
Depends on the type of antenna and process connection. Refer to the table that follows.

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

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

1 Higher temperature on request

2 Higher pressure on request

For more data on pressure ratings, refer to Pressure ratings on page 18

PP Wave Horn: compact and remote versions

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

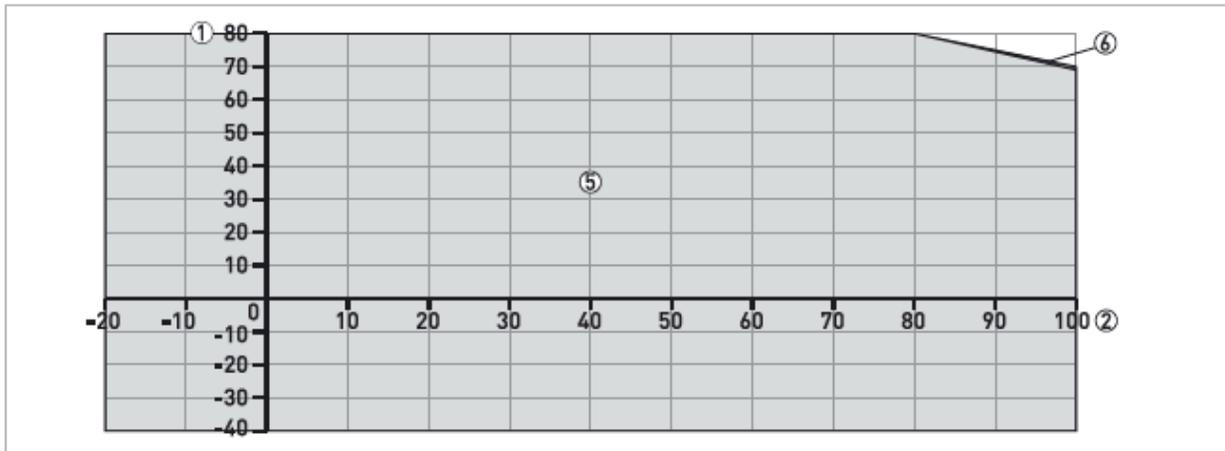


Figure 25: Ambient temperature/ flange temperature, flange and threaded connection, in °C

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

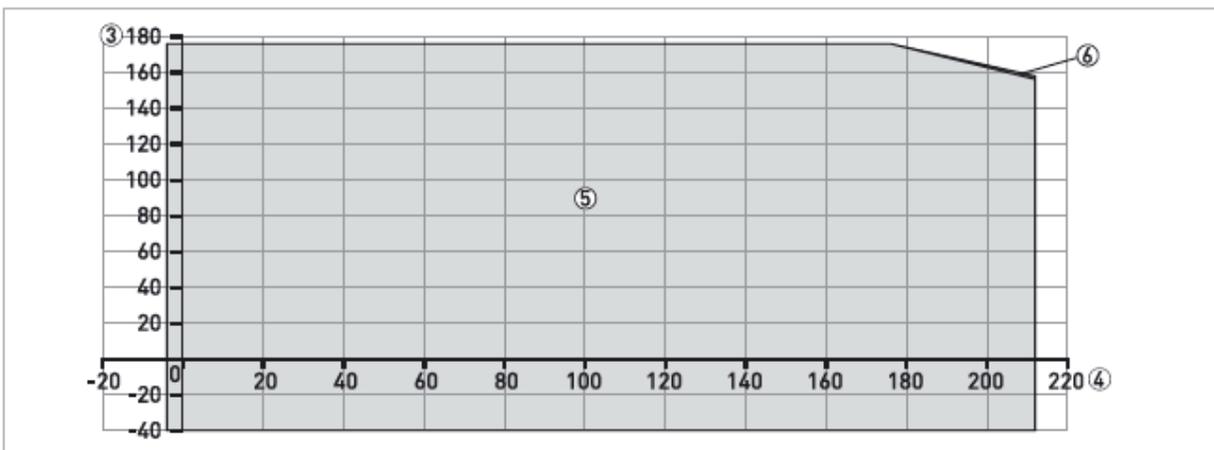


Figure 26: Ambient temperature/ flange temperature, flange and threaded connection, in °F

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

PTFE Wave Horn: compact and remote versions

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

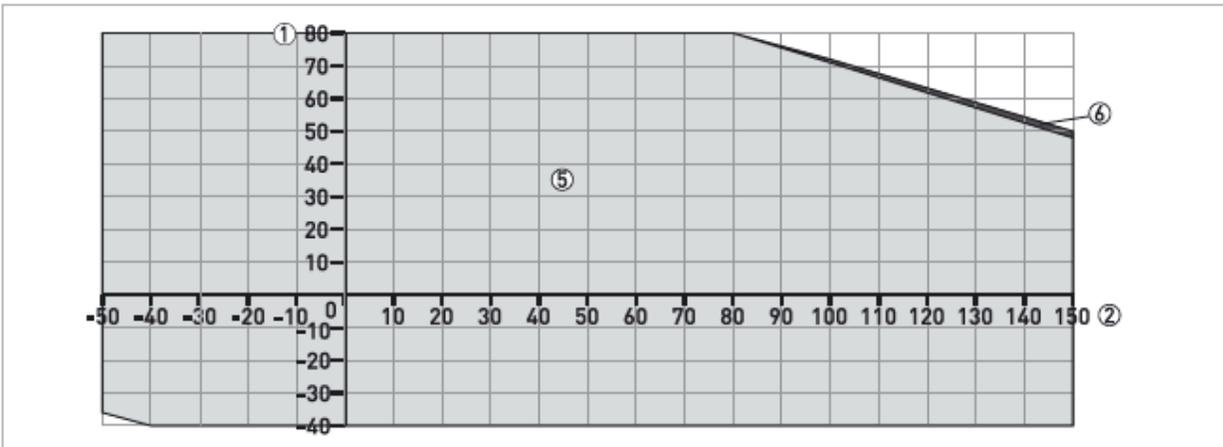


Figure 27: Ambient temperature/ flange temperature, flange and threaded connection, in °C

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

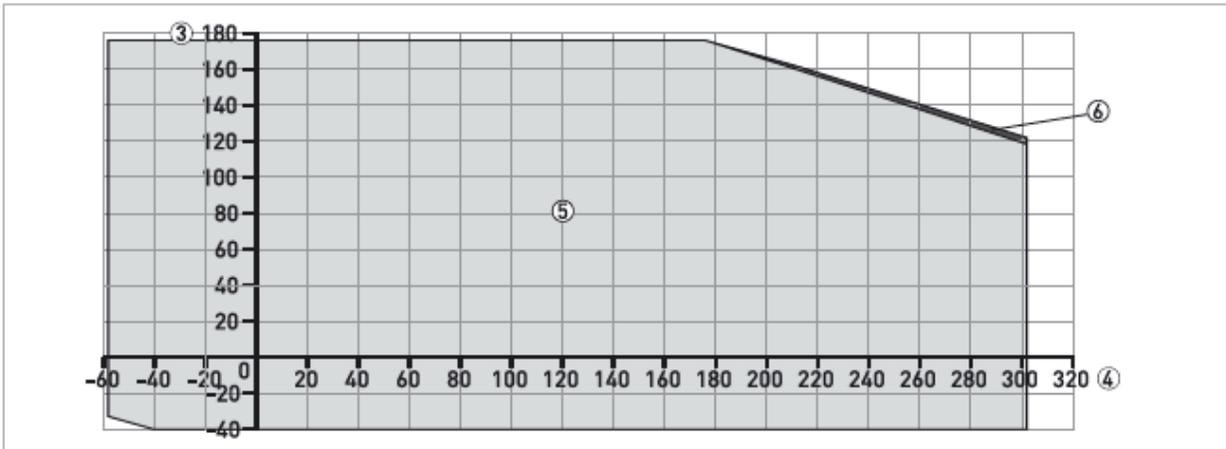


Figure 28: Ambient temperature/ flange temperature, flange and threaded connection, in °F

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

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

Metallic Horn and Wave Guide: compact and remote versions

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

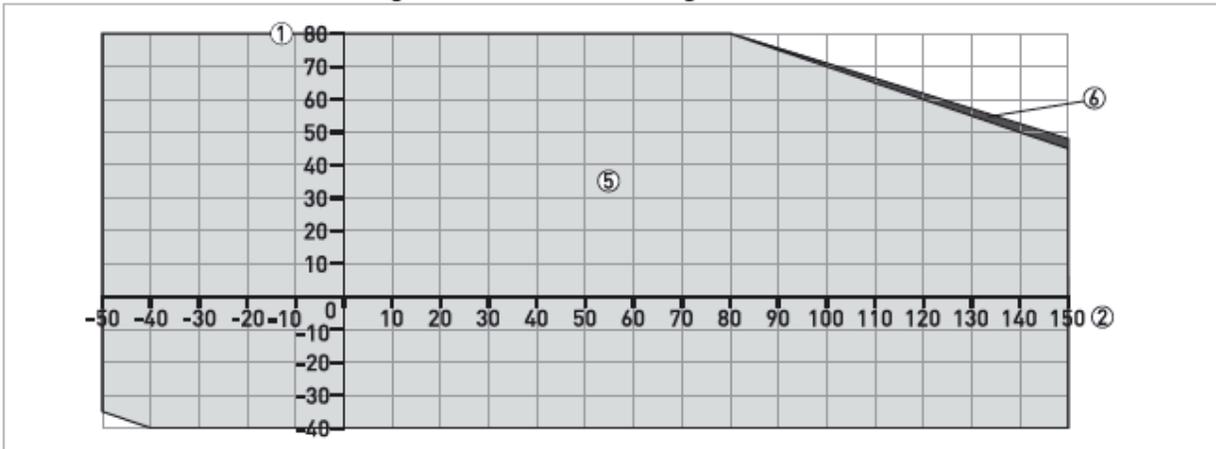


Figure 29: Ambient temperature/ flange temperature, flange and threaded connection, in °C

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

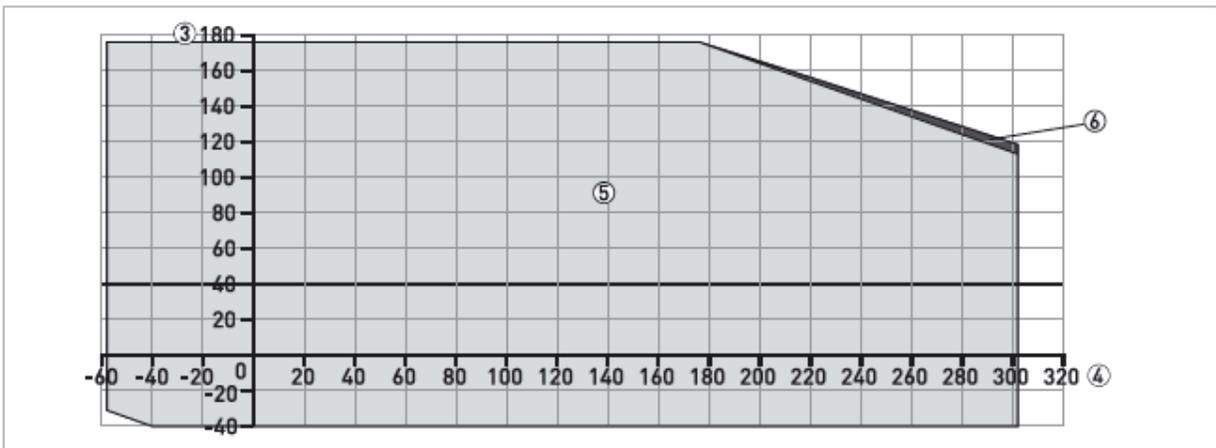


Figure 30: Ambient temperature/ flange temperature, flange and threaded connection, in °F

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

When the process temperature is -50°C/ -58°F and the device has an EPDM gasket, there is a de-rating for the ambient temperature. The minimum ambient temperature is -35°C/ -31°F.

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

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

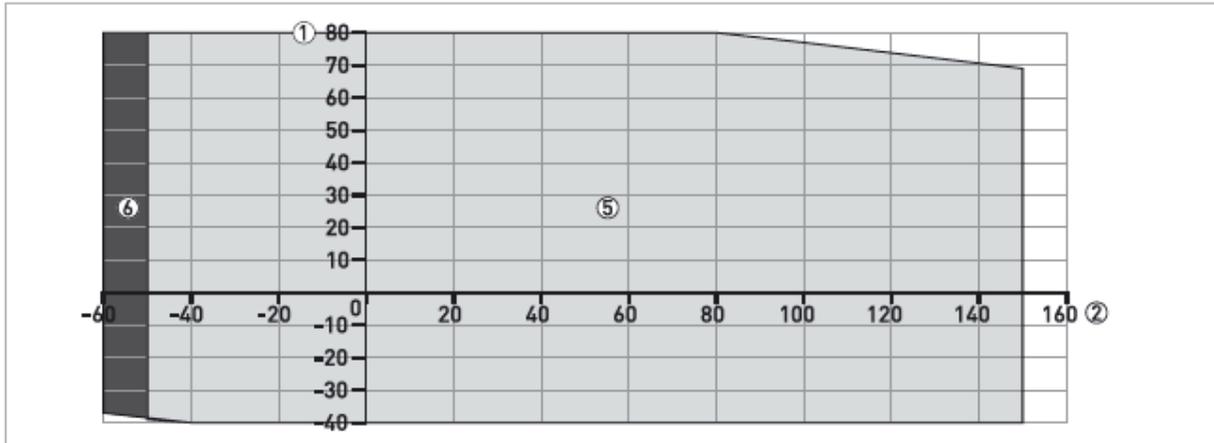


Figure 31: Ambient temperature/ flange temperature, flange and threaded connection, in °C

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

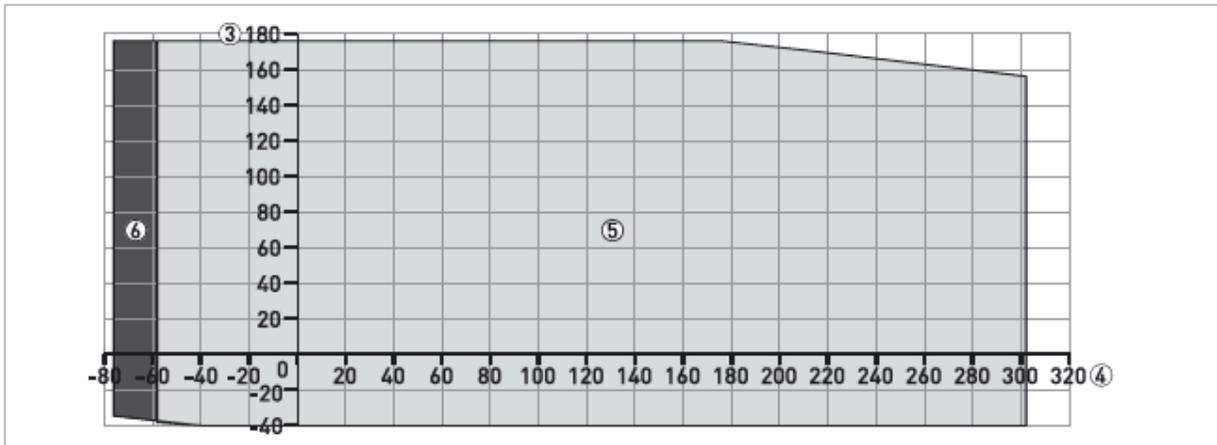


Figure 32: Ambient temperature/ flange temperature, flange and threaded connection, in °F

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

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

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

Recommended mounting position

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

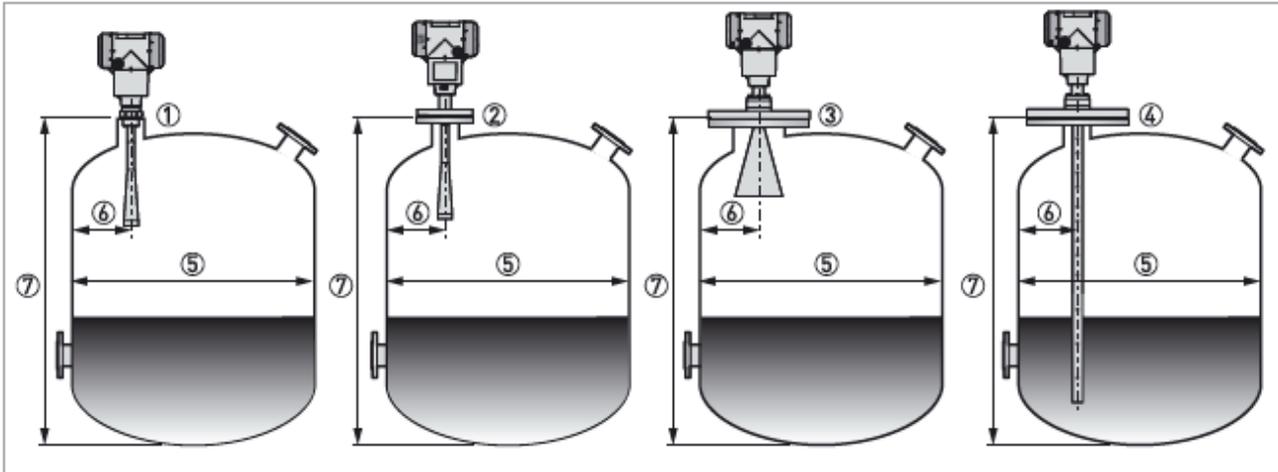


Figure 33: Recommended mounting position for liquids, pastes and slurries

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

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

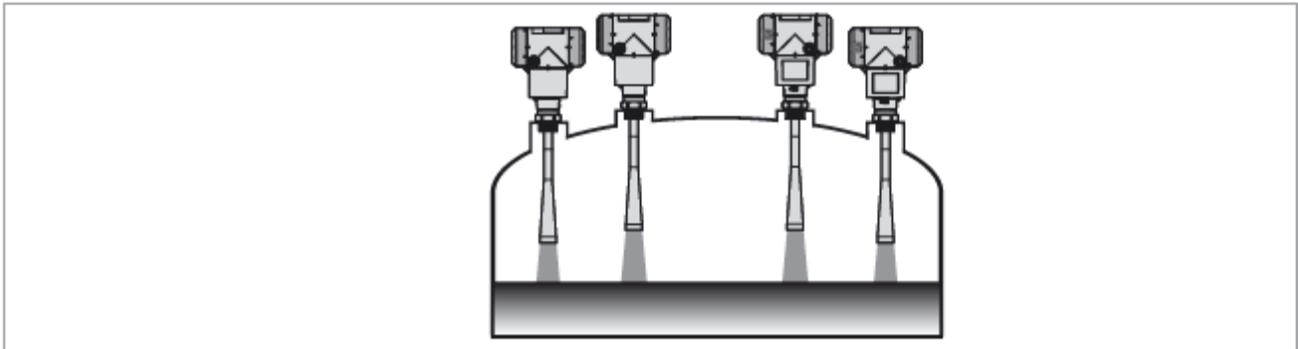


Figure 34: A maximum of 4 FMCW radar level meters can be operated in a tank

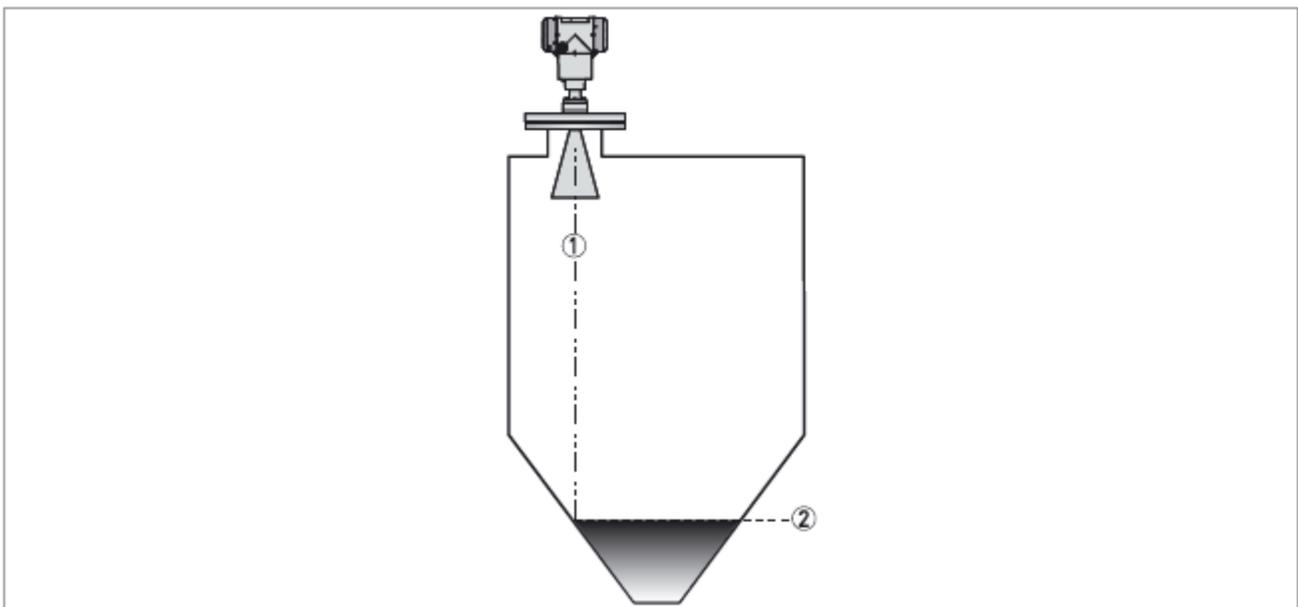


Figure 35: Tanks with dish-shaped or conical bottoms

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

- 1 Axis of radar beam
- 2 Minimum level reading

Mounting restrictions

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

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

Mounting restrictions: General data

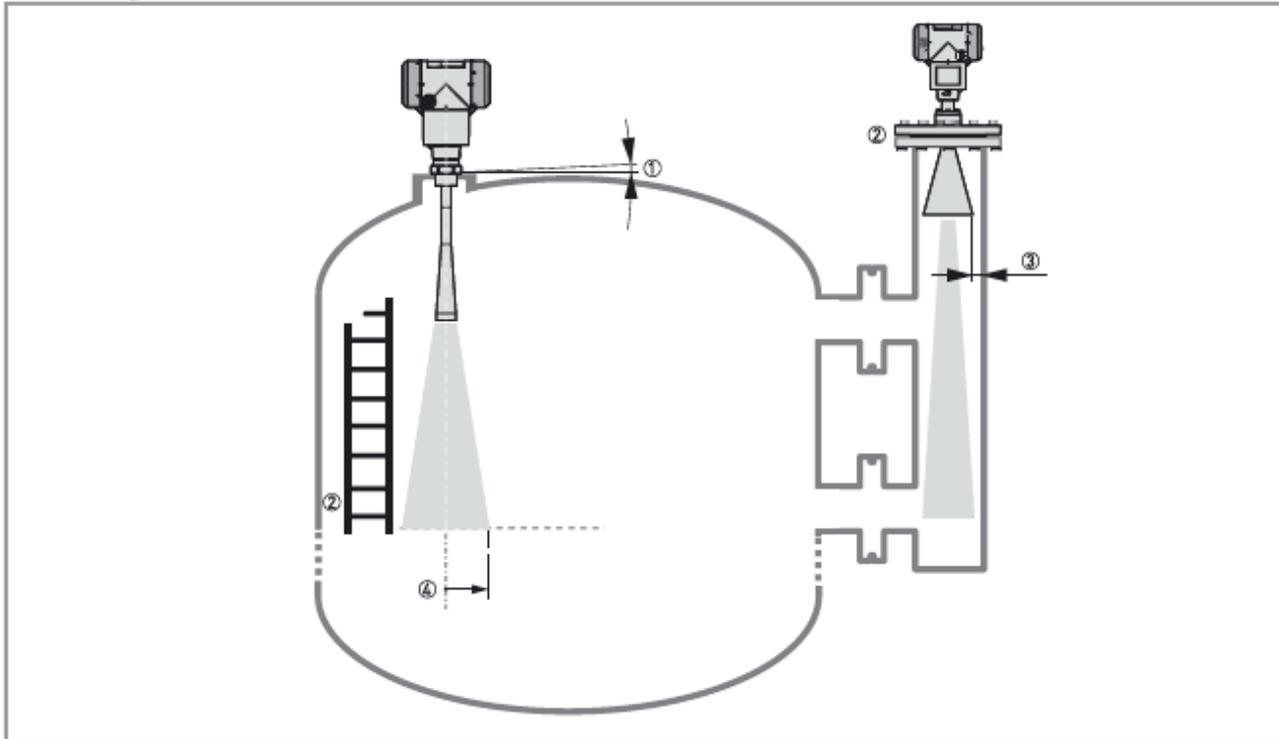


Figure 36: Mounting restrictions: General data

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

Obstacles in the tank

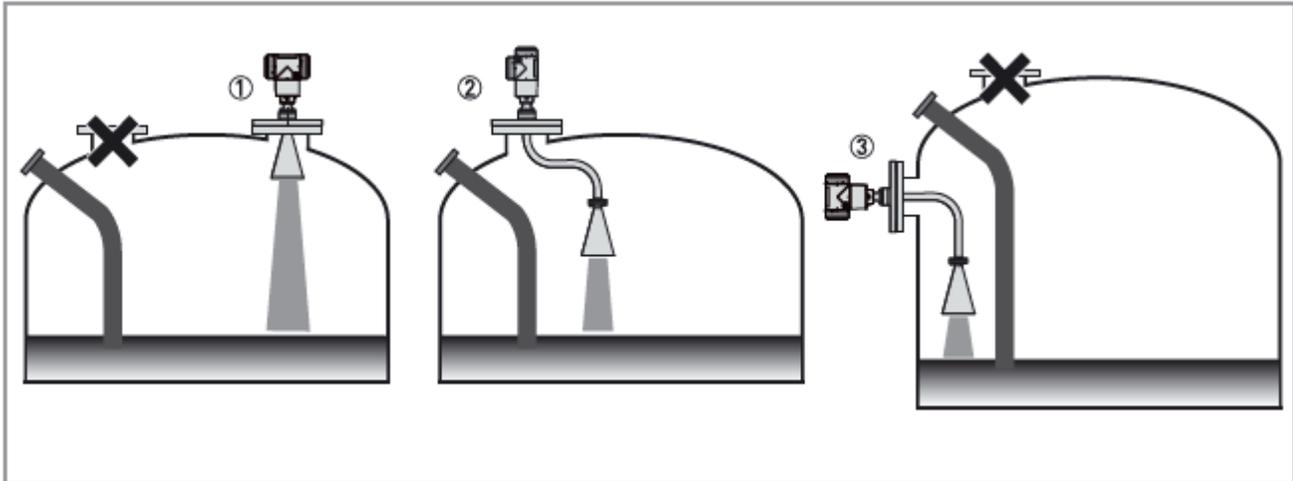


Figure 37: Obstacles in the tank

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

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

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

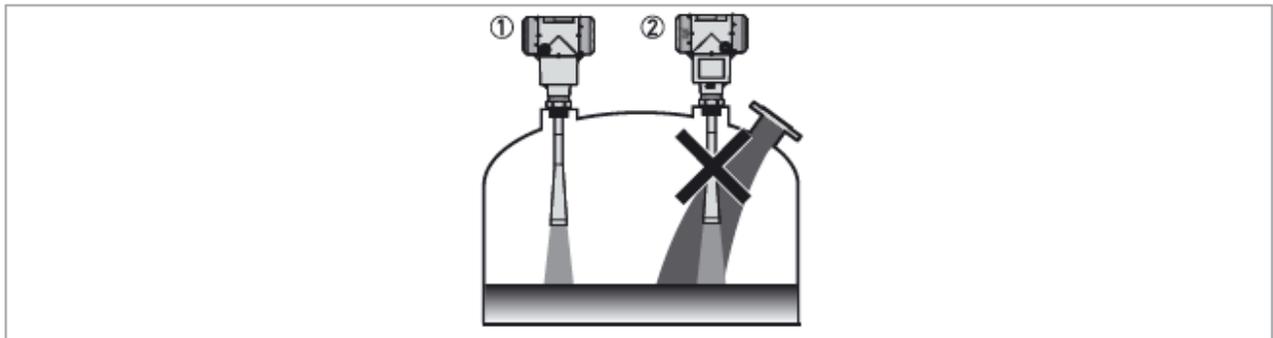


Figure 38: Product inlets

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

Devices with Metallic Horn antenna

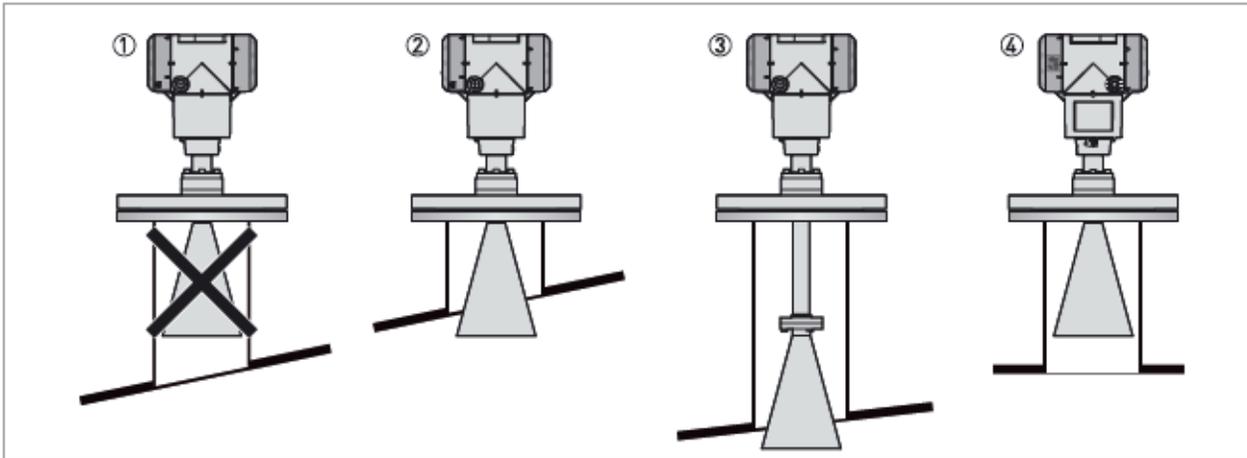


Figure 39: Devices with Metallic Horn antenna

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

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

Devices with PTFE or PP Wave Horn antenna

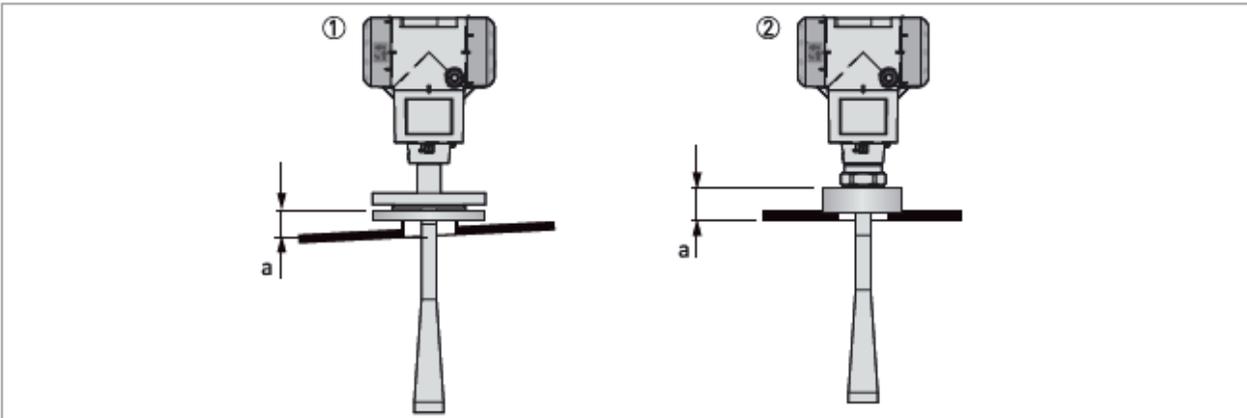


Figure 40: Devices with PTFE or PP Wave Horn antenna

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

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

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

*If there are parasitic signals, the device will not measure correctly. Parasitic signals are caused by:
 Objects in the tank.
 Sharp corners that are perpendicular to the path of the radar beam.
 Sudden changes in tank diameter in the path of the radar beam.*

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

Standpipes (stilling wells and bypass chambers)

Use a standpipe if:

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

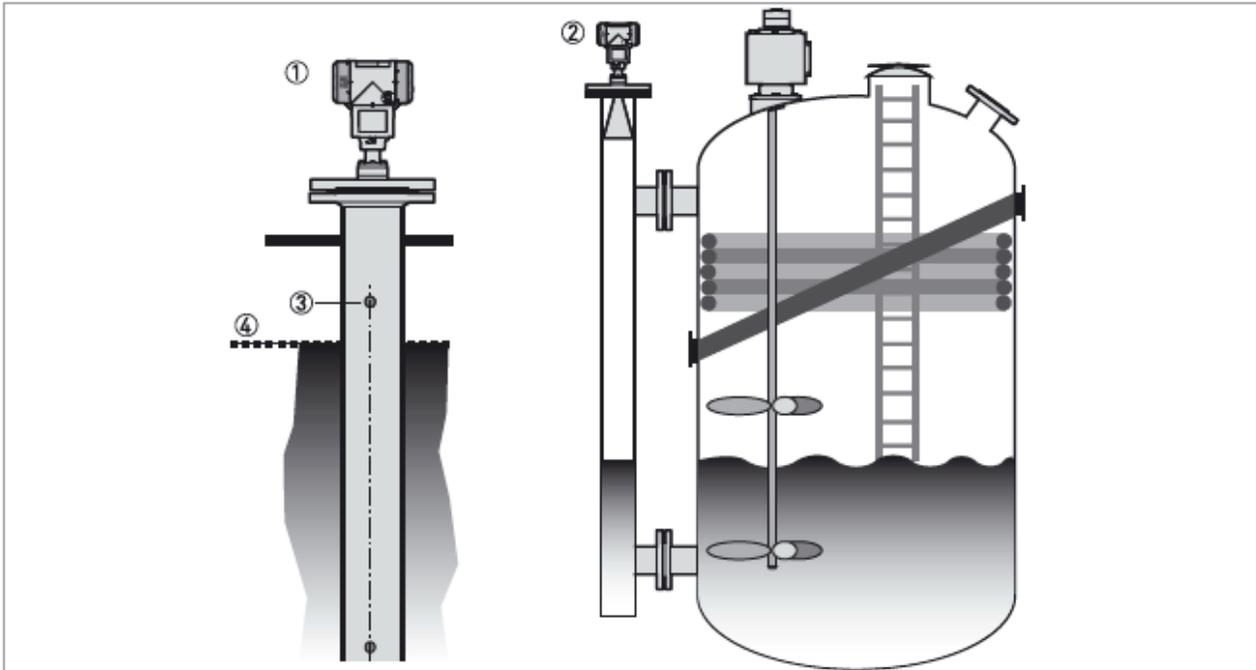


Figure 41: Installation recommendations for standpipes (stilling wells and bypass chambers)

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

- The standpipe must be electrically conductive.
- The inside diameter of the standpipe must not be more than 5mm/ 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 1mm/ 0.04".
- The standpipe must be vertical.
- Recommended surface roughness: $<\pm 0.1\text{mm}/ 0.004"$. •Make sure that there are no deposits at the bottom of the standpipe.
- Make sure that there is liquid in the standpipe.

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

Installation in tanks containing one liquid and foam

- Drill an air circulation hole (max. $\varnothing 10\text{mm}/0.4''$) in the stilling well above the maximum level.
- Remove the burr from the hole.

Installation in tanks containing one liquid or more without foam

- Drill an air circulation hole (max. $\varnothing 10\text{mm}/0.4''$) in the stilling well above the maximum level.
- Drill 1 or more liquid circulation holes in the stilling well (if there is more than 1 liquid in the tank)
- These holes help the liquid to move freely between the stilling well and the tank.
- Remove the burr from the hole.

Stilling wells – reference point

We recommend that you attach a flat cruciform target at the bottom of the stilling well. It must have a width of $1/3$ of the internal diameter of the stilling well tube. This target is the limit of the measuring range in the stilling well.

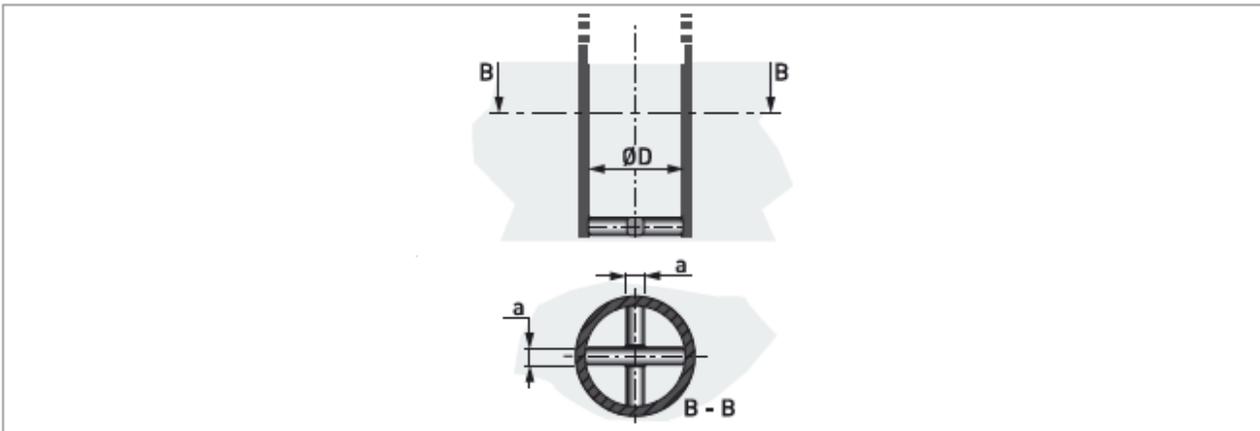


Figure 42: Reference point in the stilling well

$$a \geq 1/3 \times \varnothing D$$

Stilling wells: floating roofs

If the device must be installed on a tank with a floating roof, install it in a stilling well.

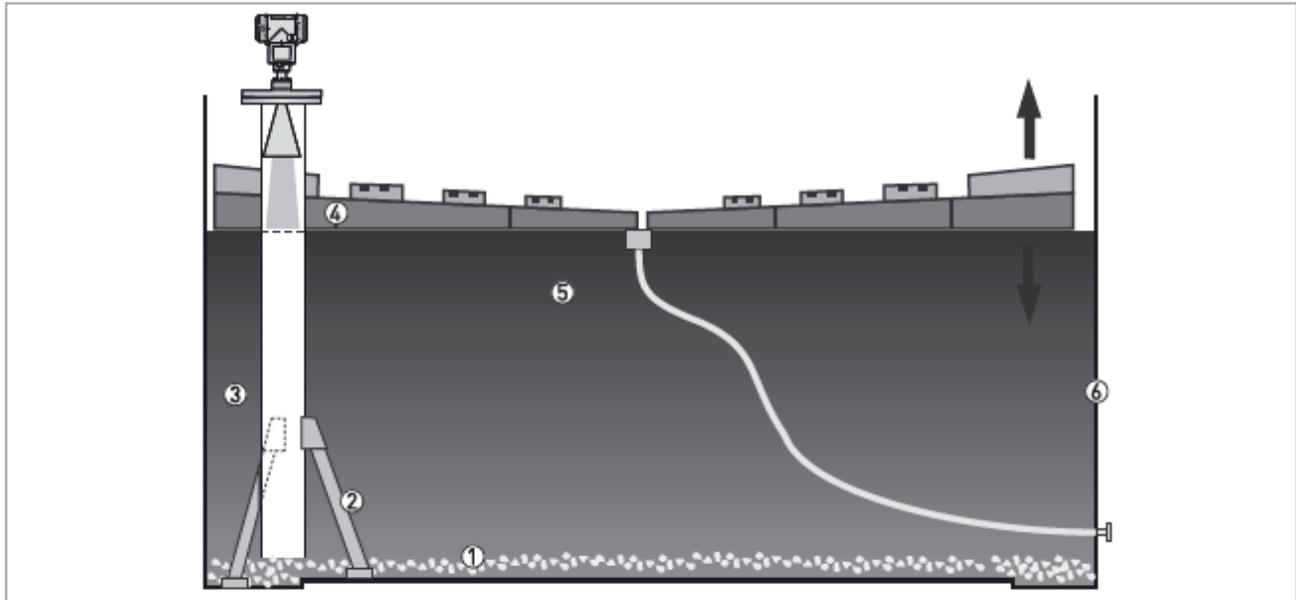


Figure 43: Floating roofs

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

Stilling wells: horizontal cylindrical tanks

We recommend that you install the device in a stilling well if the device:

- is for a horizontal cylindrical tank,
- is in a metallic tank,
- measures a product with a high dielectric constant and
- is on the centerline of the tank.

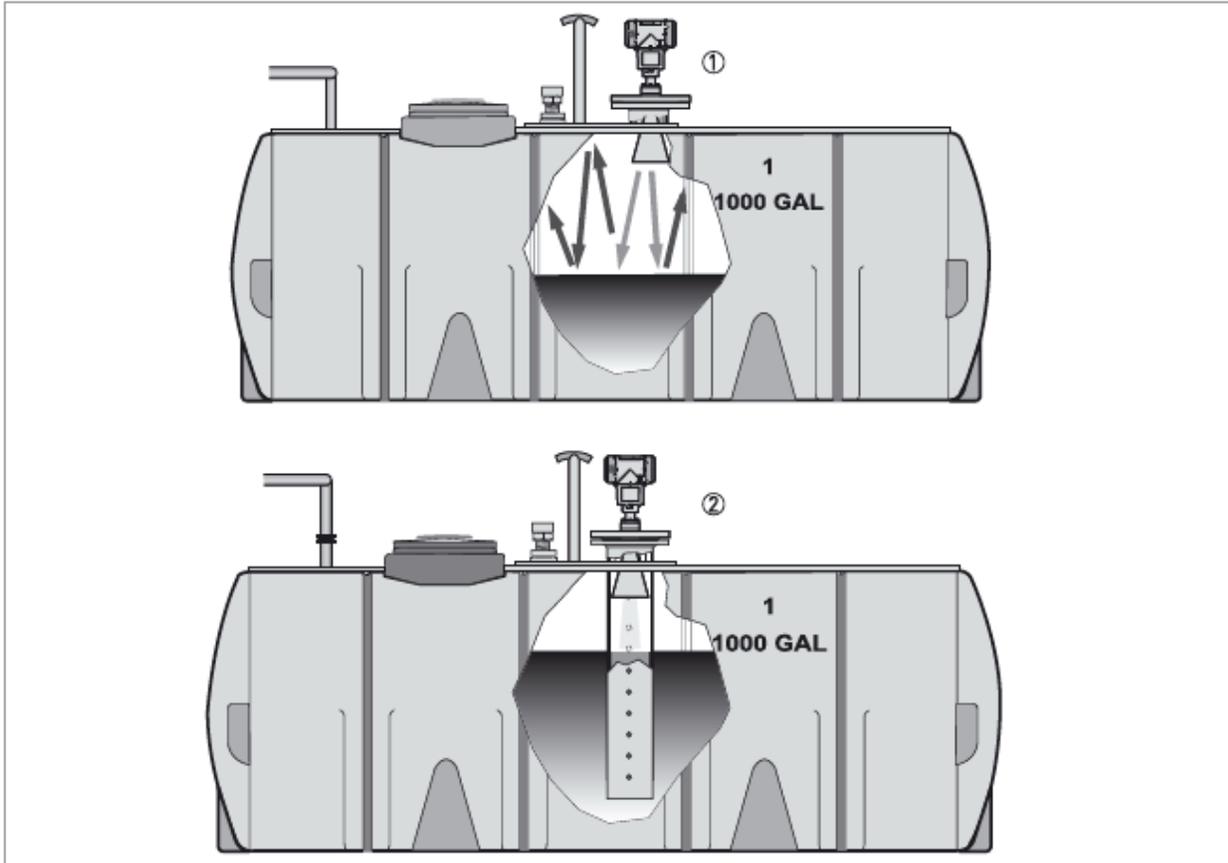


Figure 44: Horizontal cylindrical tanks

- 1 The device is installed without a stilling well. There are multiple reflections. Refer to the CAUTION! that follows.
- 2 The device is installed in a stilling well and measures correctly.

If the device is installed in horizontal cylindrical tank that contains a high dielectric constant liquid without a stilling well, do not put it on the tank centerline. This will cause multiple reflections and the device will not measure accurately. Use the Multiple Reflections function in Supervisor > Basic Parameters to keep the effects of multiple reflections to a minimum. For more data, refer to "Function description" in the handbook.

Bypass chambers

Installation next to tanks containing one liquid and foam

- The top process connection of the bypass chamber must be above the maximum level of liquid.
- The bottom process connection of the bypass chamber must be below the lowest measured level of liquid.

Installation next to tanks containing more than one liquid

- The top process connection of the bypass chamber must be above the maximum level of liquid.
- The bottom process connection of the bypass chamber must be below the lowest measured level of liquid.
- Additional process connections are necessary for the liquids to circulate freely along the length of the bypass chamber.

Electrical Connections

Electrical installation: 2-wire, loop-powered

Compact version

Terminals for electrical installation

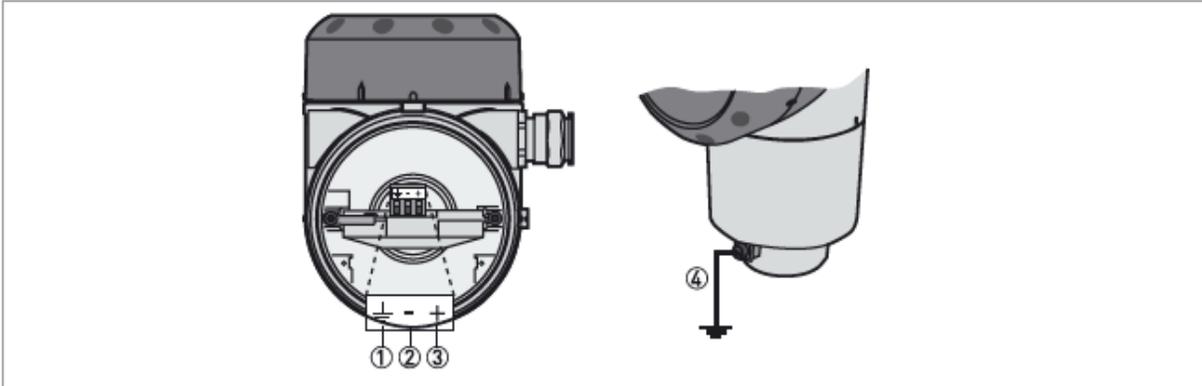


Figure 45: Terminals for electrical installation

- 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.

Remote version

Terminals for electrical installation

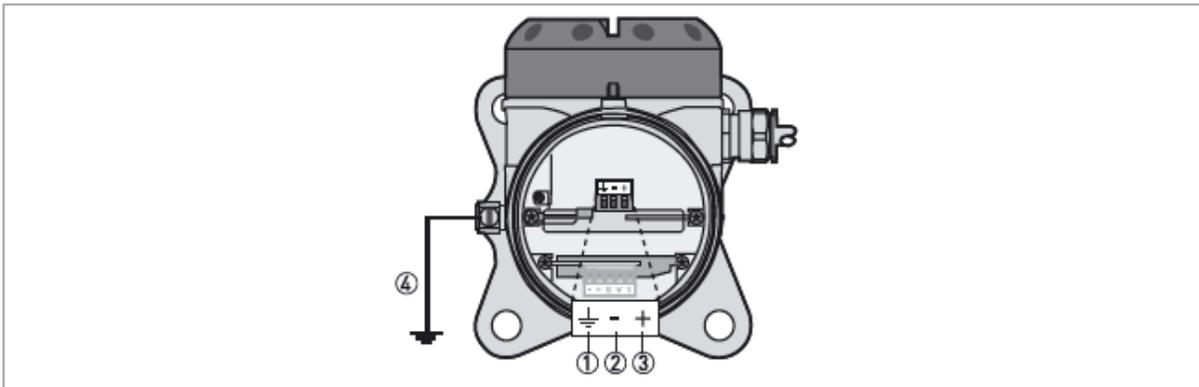


Figure 46: Terminals for electrical installation

- 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 antenna housing

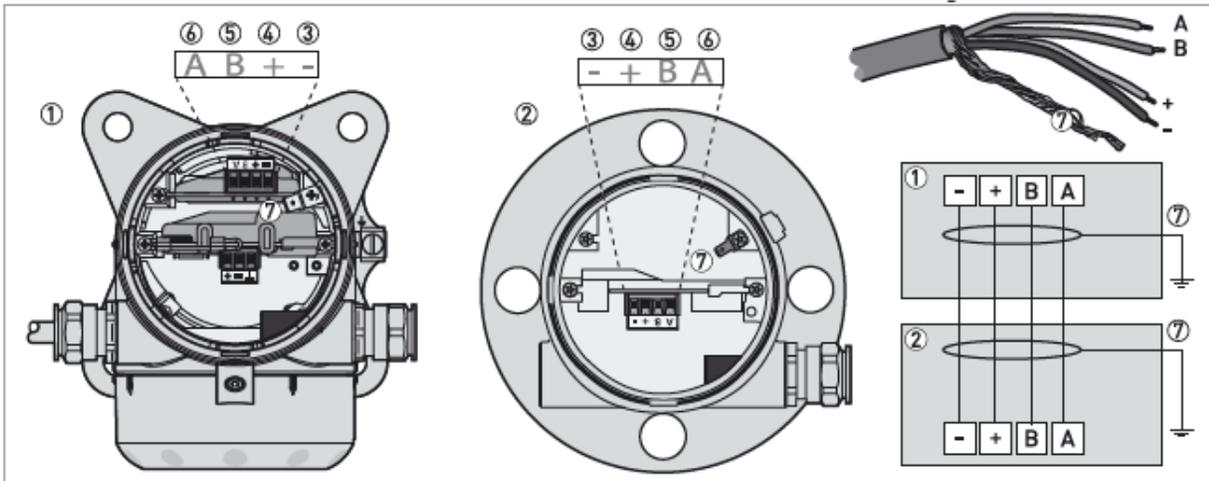


Figure 47: Connections between the remote converter and the antenna housing

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

For more electrical installation data, refer to Compact version on page 49.

Non-Ex devices

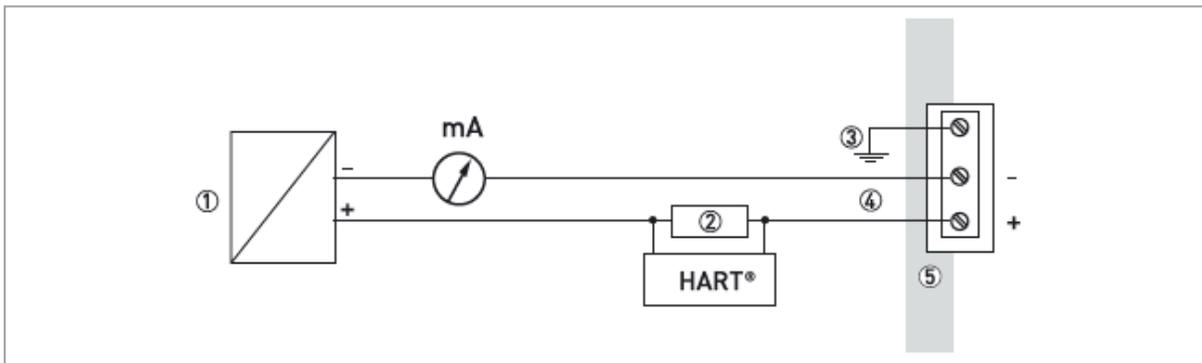


Figure 48: Electrical connections for non-Ex devices

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

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, etc.). 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).

Networks

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.

Point-to-point connection

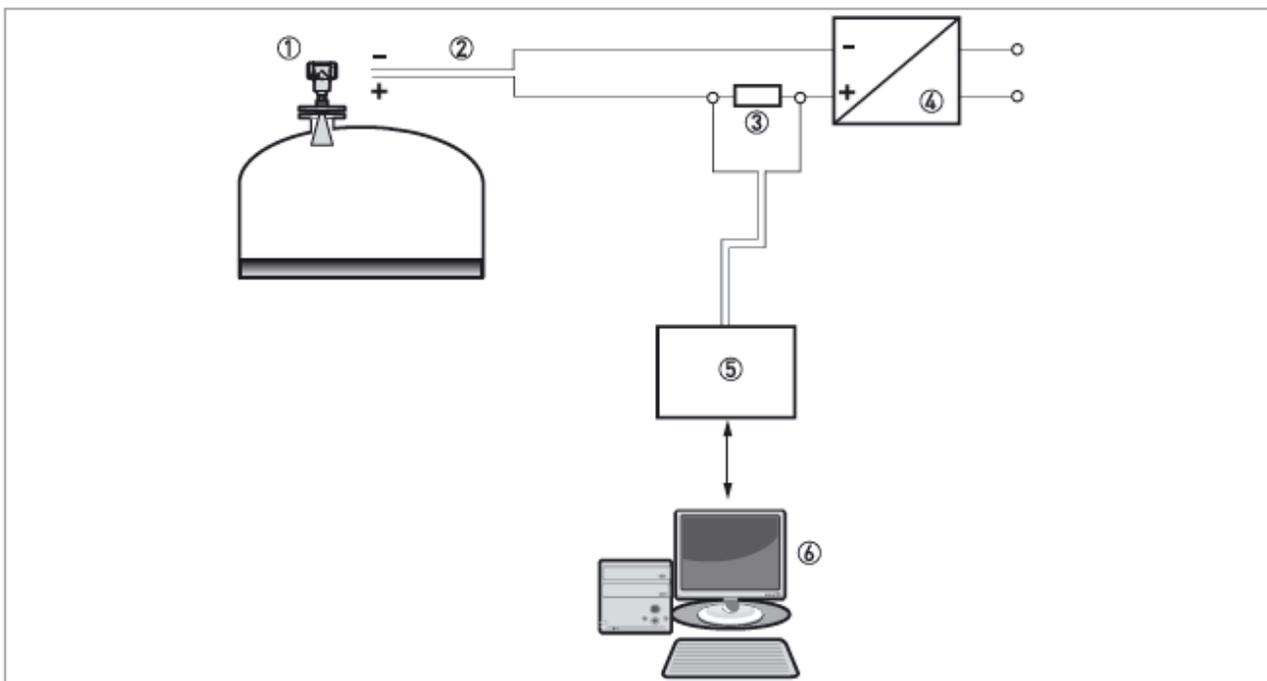


Figure 49: Point-to-point connection (non-Ex)

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

Multi-drop networks

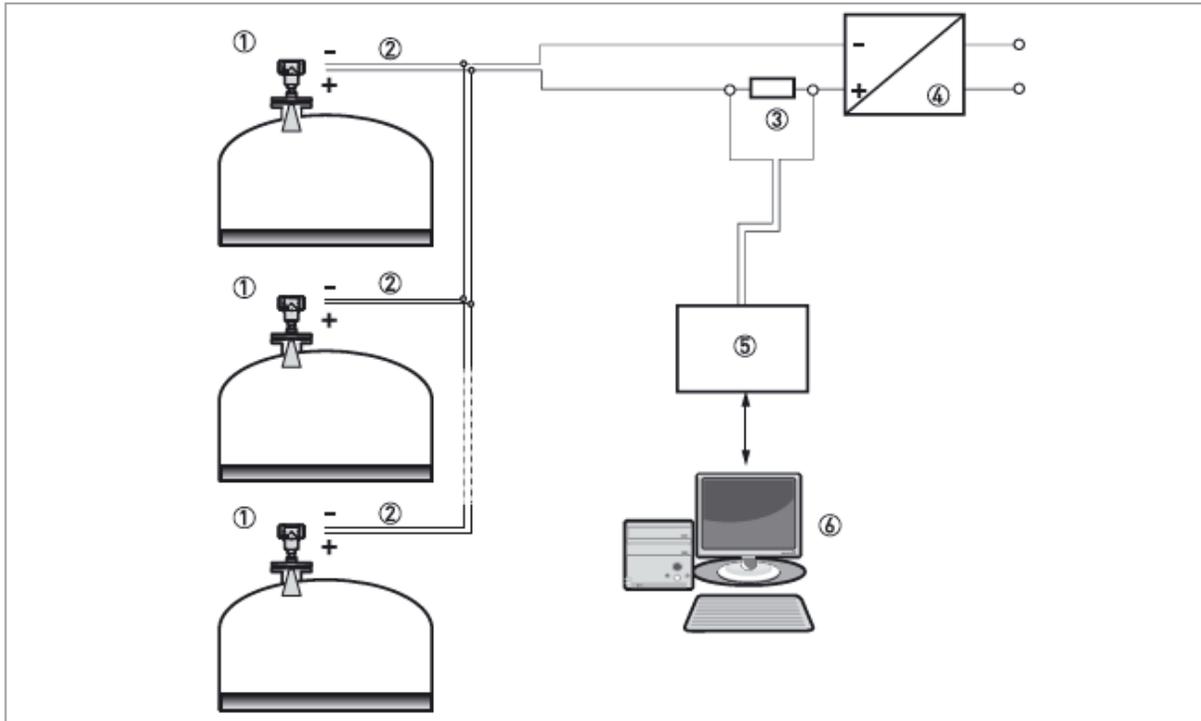


Figure 50: Multi-drop network (non-Ex)

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

Fieldbus networks

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

FOUNDATION™ fieldbus network (non-Ex)

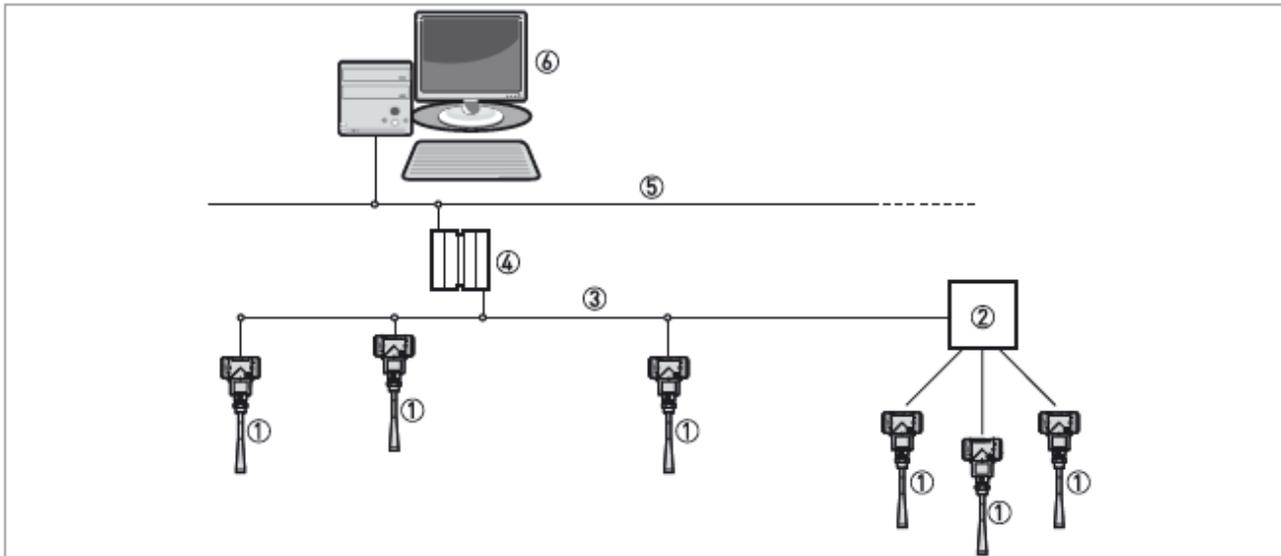
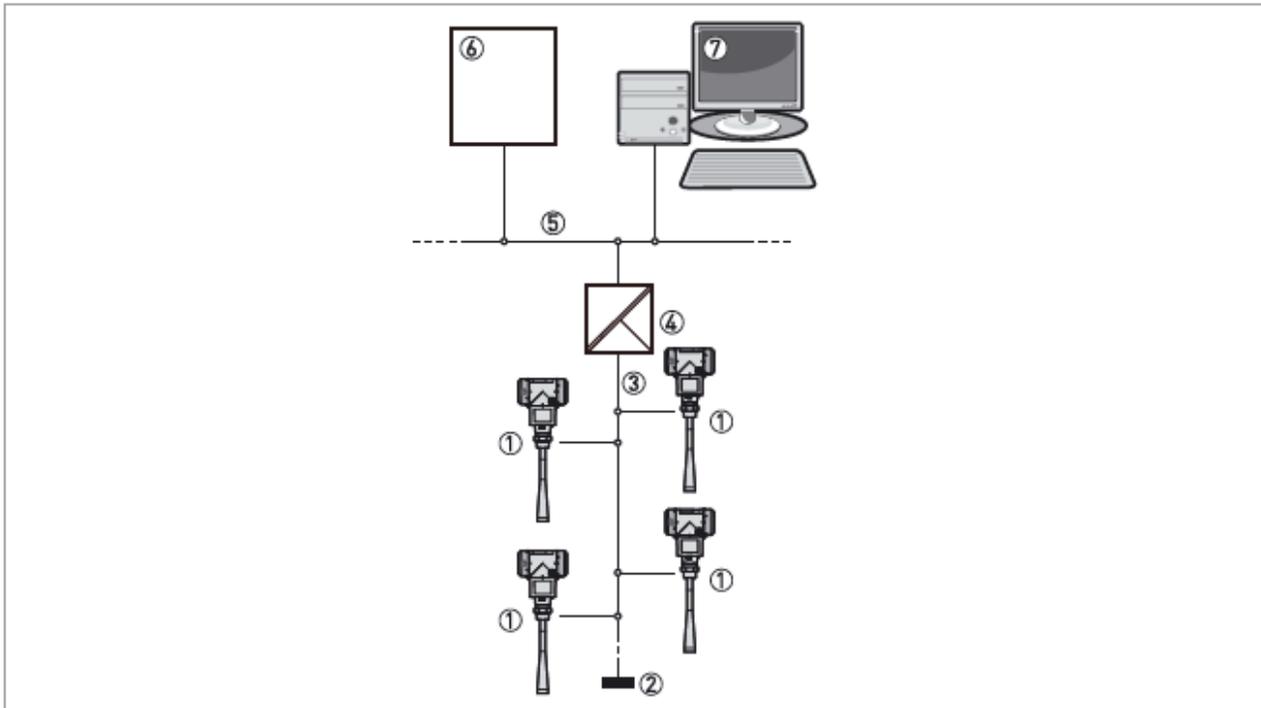
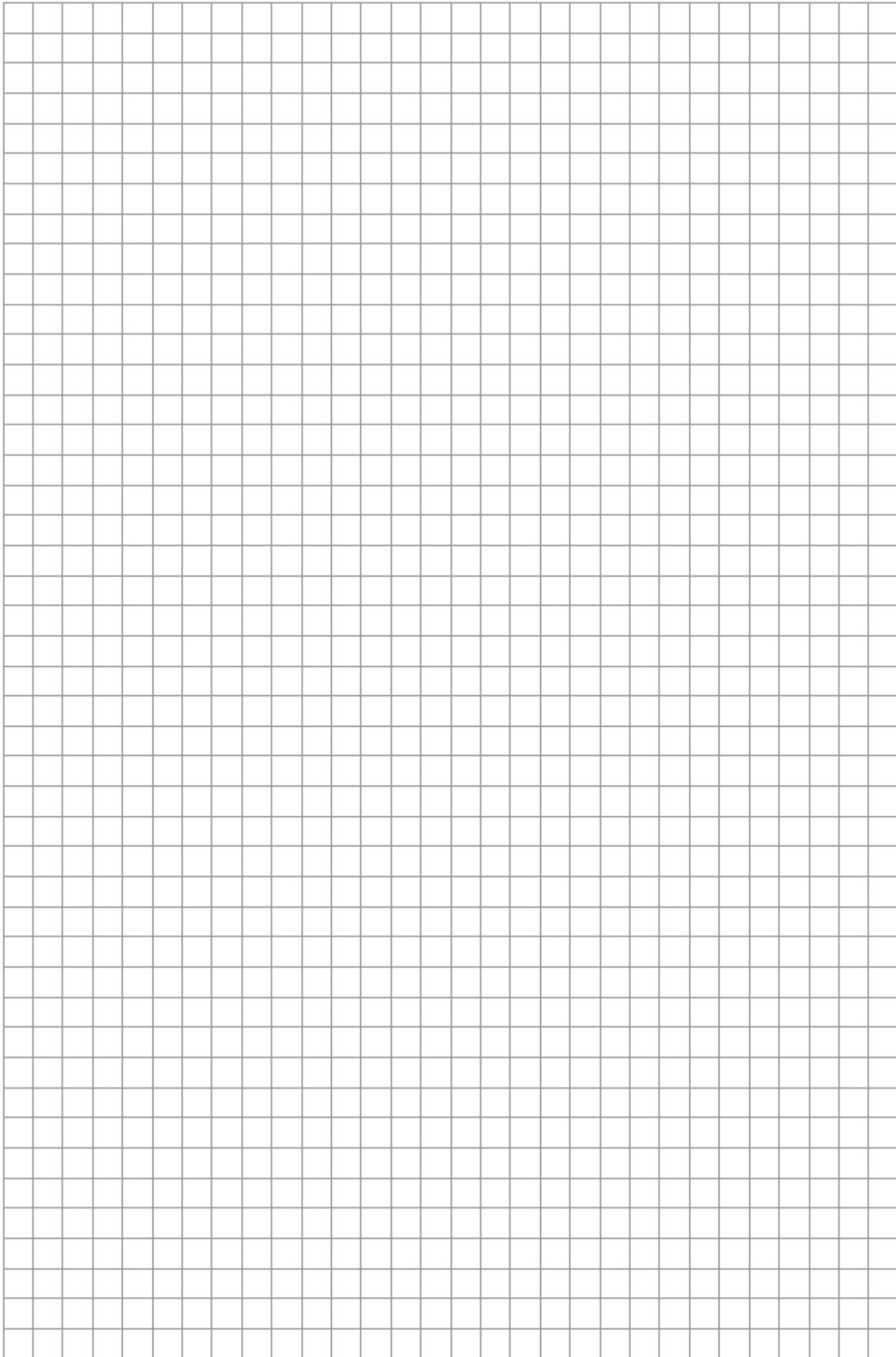


Figure 51: FOUNDATION™ fieldbus network (non-Ex)

- 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 52: 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)



Sales and Service

For application assistance, current specifications, pricing, or name of the nearest Authorized Distributor, contact one of the offices below.

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