Reference Manual
00809-0100-4408, Rev CE
March 2023

Rosemount™ 5408 and 5408:SIS Level Transmitters

Non-Contacting Radar with HART® Protocol

HART COMMUNICATION PROTOCOL

ROSEMOUNT™

EMERSON™

Safety messages

NOTICE

Read this manual before working with the product. For personal and system safety, and for optimum product performance, make sure you thoroughly understand the contents before installing, using, or maintaining this product.

For technical assistance, contacts are listed below:

Customer Central

Technical support, quoting, and order-related questions.

- United States - 1-800-999-9307 (7:00 am to 7:00 pm CST)
- Asia Pacific- 65 777 8211

North American Response Center

Equipment service needs.

- 1-800-654-7768 (24 hours a day — includes Canada)
- Outside of these areas, contact your local Emerson representative.

⚠ WARNING

Failure to follow safe installation and servicing guidelines could result in death or serious injury.

Ensure the transmitter is installed by qualified personnel and in accordance with applicable code of practice.

Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment.

For installations in hazardous locations, the transmitter must be installed according to the Rosemount 5408 Product Certifications document and System Control Drawing.

⚠ WARNING

Explosions could result in death or serious injury.

Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.

Before connecting a handheld communicator in an explosive atmosphere, ensure that the instruments are installed in accordance with intrinsically safe or non-incendive field wiring practices.

In Explosion-proof/Flameproof and Non-Incendive/Type n installations, do not remove the transmitter covers when power is applied to the unit.

Both transmitter covers must be fully engaged to meet Explosion-proof/Flameproof requirements.

⚠ WARNING

Electrical shock could cause death or serious injury.

In Explosion-proof/Flameproof and Non-Incendive/Type n installations, avoid contact with the leads and terminals. High voltage that may be present on leads can cause electrical shock.

Ensure the mains power to the transmitter is off and the lines to any other external power source are disconnected or not powered while wiring the transmitter.

⚠ WARNING

Process leaks could result in death or serious injury.

Ensure that the transmitter is handled carefully. If the process seal is damaged, gas might escape from the tank.

⚠ WARNING

Any substitution of non-recognized parts may jeopardize safety. Repair (e.g. substitution of components) may also jeopardize safety and is not allowed under any circumstances.

Unauthorized changes to the product are strictly prohibited as they may unintentionally and unpredictably alter performance and jeopardize safety. Unauthorized changes that interfere with the integrity of the welds or flanges, such as making additional perforations, compromise product integrity and safety. Equipment ratings and certifications are no longer valid on any products that have been damaged or modified without the prior written permission of Emerson. Any continued use of product that has been damaged or modified without the written authorization is at the customer's sole risk and expense.

⚠ WARNING

Physical access

Unauthorized personnel may potentially cause significant damage to and/or misconfiguration of end users' equipment. This could be intentional or unintentional and needs to be protected against.

Physical security is an important part of any security program and fundamental in protecting your system. Restrict physical access by unauthorized personnel to protect end users' assets. This is true for all systems used within the facility.

⚠ CAUTION

The products described in this document are NOT designed for nuclear-qualified applications.

Using non-nuclear qualified products in applications that require nuclear-qualified hardware or products may cause inaccurate readings.

For information on Rosemount nuclear-qualified products, contact your local Rosemount Sales Representative.

⚠ CAUTION

Hot surfaces

The flange and process seal may be hot at high process temperatures. Allow to cool before servicing.

Contents

1 Introduction

1.1 Using this manual

The sections in this manual provide information on installing, operating, and maintaining the Rosemount™ 5408 and 5408:SIS Level Transmitters – Non-Contacting Radar.

The sections are organized as follows:

Transmitter overview provides an introduction to theory of operation, a description of the transmitter, information on typical applications, and process characteristics.

Mechanical installation contains mechanical installation instructions.

Electrical installation contains electrical installation instructions.

Configuration provides instructions on configuration of the transmitter.

Operation contains operation and maintenance techniques.

Service and troubleshooting provides troubleshooting techniques for the most common operating problems.

Specifications and reference data supplies reference and specification data, as well as ordering information for spare parts and accessories.

Configuration parameters provides extended information about the configuration parameters.

1.2 NAMUR NE 53 revision history

The Rosemount 5408 meets the NAMUR recommendation NE 53. Table 1-1 provides the information necessary to ensure you have the correct device driver for your device.

Table 1-1: Identification and Compatibility According to NAMUR NE 53

Release date	Device identification			FDI, DD, and DTM identification		Release note
	NAMUR hardware revision(1)	NAMUR software revision(1)	Device software revision(2)	HART® universal revision(3)	Device revision(4)	
March-17	1.0.xx	1.0.xx	1.Axx	6	1	Initial release
				7	1	
May-19	1.1.xx	1.1.xx	1.Axx	6	1	Updated design of the cone antenna (PEEK seal) and new device software to support the change
				7	1	
September-21	1.1.xx	1.1.xx	1.Cxx	6	1	Added Smart Echo Level Test functionality
				7	1	

(1) NAMUR Revision is located on the transmitter label. Differences in level 3 changes, signified above by xx, represent minor product changes as defined per NE53. Compatibility and functionality are preserved and product can be used interchangeably.

*(2) Device software revision is located on the transmitter label, e.g. 1.A3. It can also be found in Rosemount Radar Master Plus (select **Overview** → **Device Information** → **Revisions**).*

(3) HART Revision 6 and 7 can be switched in field. Default HART universal revision from factory is located on the transmitter head label, e.g. PROTOCOL 6.

(4) Device revision is located on the transmitter label, e.g. DEVICE REV 1.

Related information

Confirm correct device driver

1.3 Product certifications

See the Rosemount 5408 Product Certifications document for detailed information on the existing approvals and certifications.

1.4 Product recycling/disposal

Recycling of equipment and packaging should be taken into consideration and disposed of in accordance with local and national legislation or regulations.

2 Transmitter overview

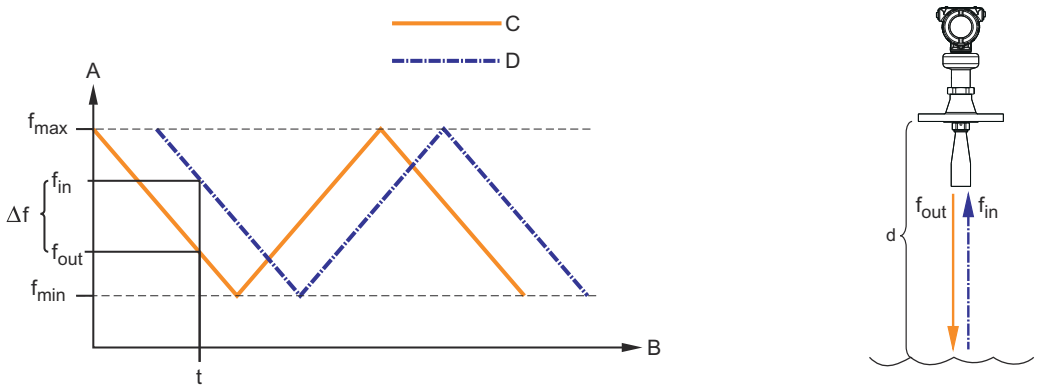
2.1 Measurement principle

The Rosemount 5408 is a two-wire transmitter for continuous level measurements using fast-sweep Frequency Modulated Continuous Wave (FMCW) technology.

The transmitter continuously emits signal sweeps with a constantly varying frequency towards the product surface. Since the transmitter continuously changes the frequency of the transmitted signal, there will be a difference in frequency between the transmitted and the reflected signals (see Figure 2-1).

The frequency of the reflected signal is subtracted from the frequency of the signal transmitted at that moment, resulting in a low frequency signal which is proportional to the distance to the product surface. This signal is further processed to obtain fast, reliable, and highly accurate level measurements.

Figure 2-1: FMCW-method



Δf∼d=distance

A. Frequency (GHz)
B. Time (s)
C. Transmitted signal
D. Reflected signal

2.2 Process characteristics

2.2.1 Dielectric constant

A key parameter for measurement performance is reflectivity. A high dielectric constant of the media provides better reflection and enables a longer measuring range.

2.2.2 Foam and turbulence

Foaming liquids or turbulence may cause weak and varying surface echo amplitudes. The effects of turbulence are usually minor, but in the most challenging conditions, the

transmitter may be mounted in a still pipe. In addition, measurement performance can be optimized by configuring the appropriate process conditions settings.

Measurement in foamy applications depends largely on the foam properties. When the foam is light and airy, the actual product level is measured. For heavy and dense foam, the transmitter may measure the level of the foam's upper surface.

The Double Surface Handling function allows the user to select if the foam layer or product surface should be used as output.

Related information

Process conditions
Double surface handling

2.2.3 Dust

Dust is often present in solids applications, and even if the non-contacting radar is not affected by the dust in the vapor space, dust can be sticky and create a layer on the antenna. If this layer becomes too thick, it may affect the measurement. This is best managed by using air purging.

2.2.4 Solid surface

Solids have some common characteristics which may cause weak and varying surface reflections. The surface is rarely flat or horizontal, the angle of the sloping surface differs during filling and emptying, and the dielectric constant of many solids is fairly low. Table 2-1 presents common characteristics of some solids applications.

The parabolic antenna is ideal for applications with weak surface reflections. A larger diameter concentrates the radar beam and ensures maximum antenna gain. The parabolic antenna comes with a swivel connection that adjusts for angled tank roofs.

Table 2-1: Common Characteristics of Solids Applications

Applications	Common characteristics				
	Particle size			Vapor space	
	Dust or powder	Small (<1 in.)	Larger (>1 in.)	Dust	Steam or condensation
Wood chip bins	Yes	Yes	Yes	Yes	Possible
Grain silo - small kernel grains	Yes	Yes	No	Yes	No
Grain silo - large kernel grains	No	Yes	No	No	No
Lime stone silo	No	Yes	Yes	Possible	No
Cement - raw mill silo	Yes	Yes	No	Yes	No
Cement - finished product silo	Yes	Yes	No	Yes	No
Coal bin	Yes	Yes	Yes	Yes	Yes
Saw dust	Yes	Yes	No	Yes	No
High consistency - pulp stock	No	No	No	No	Yes
Alumina	Yes	Yes	No	Yes	No
Salt	No	Yes	Yes	No	No

2.3 Vessel characteristics

2.3.1 In-tank obstructions

The transmitter should be mounted so that objects such as heating coils, ladders, and agitators are not in the radar signal path. These objects may cause false echoes resulting in reduced measurement performance. However, the transmitter has built-in functions designed to reduce the influence from disturbing objects where such objects cannot be totally avoided.

Vertical and inclined structures cause minimal effect since the radar signal is scattered rather than directed back to the antenna.

2.3.2 Tank shape

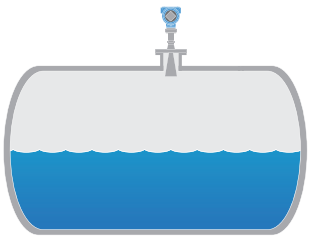
The shape of the tank bottom affects the measurement signal when the product surface is close to the tank bottom. The transmitter has built-in functions which optimize measurement performance for various bottom shapes.

2.4 Application examples

The Rosemount 5408 and 5408:SIS are ideal for level measurements over a broad range of liquid and solids applications. The transmitters are virtually unaffected by changing density, temperature, pressure, media dielectric, pH, and viscosity. Non-contacting radar level is ideal for harsh conditions such as corrosive and sticky media, or when internal tank obstructions are a limiting factor.

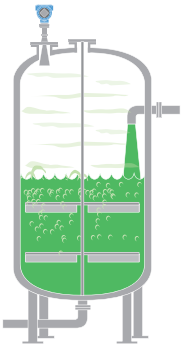
Storage and buffer tanks

The Rosemount 5408 provides accurate and reliable level measurement for both metallic or non-metallic vessels containing almost any liquid (e.g. oil, gas condensate, water, chemicals).



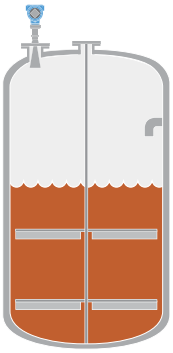
Reactors

The Rosemount 5408 is ideal for the most challenging applications, including reactors where there can be agitation, foaming, and condensation, as well as high temperatures and pressures.



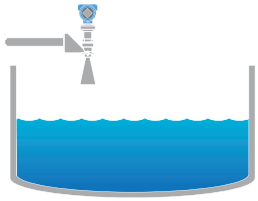
Blenders and mixers

The Rosemount 5408 can help you withstand the rigors of blenders and mixing tanks. Easy to install and commission, it is also unaffected by virtually any fluid property change.



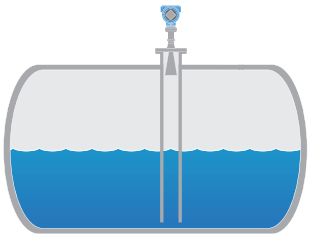
Open atmospheric applications

The Rosemount 5408 measures reliably in open applications, from short range sumps or ponds to long range dams.



Still pipe and chamber installations

The Rosemount 5408 is a great choice for level measurement in tanks with small diameter still pipes. It may also be used in chambers, but guided wave radar is generally the best fit for these applications.

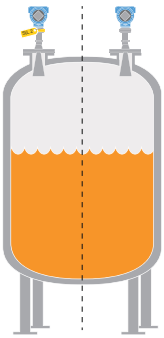


Bulk solids

The Rosemount 5408 is the ideal solution for small- to medium-sized silos with rapid level changes. The narrow beam avoids internal obstructions while still keeping good level measurement.

Safety applications

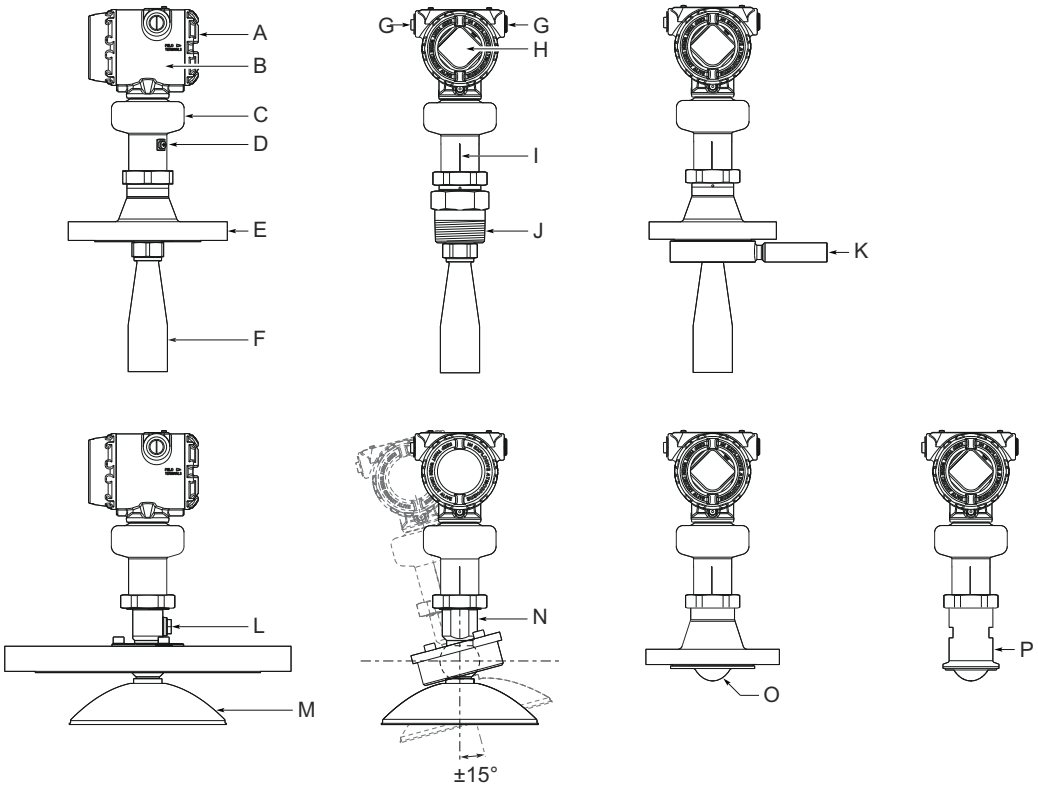
The Rosemount 5408:SIS is the ideal choice for safety functions such as overfill prevention, level deviation monitoring or dry-run prevention.



2.5 Components of the transmitter

Figure 2-2 shows the different components of the transmitter. There are different antenna types and sizes available for various applications.

Figure 2-2: Components



A. Terminal compartment
B. Transmitter housing (aluminum or stainless steel)
C. Sensor module with signal processing electronics
D. External ground screw
E. Flanged process connection
F. Cone antenna
G. Two cable/conduit entries (½-14 NPT, M20 x 1.5, or G½); Optional adapters: eurofast™ and minifast™
H. LCD display (optional)
I. Alignment marker (one per side)
J. Threaded process connection (NPT or BSPP (G))
K. Air purge ring (option code PC1 for cone antenna)
L. Integrated air purge connection
M. Parabolic antenna
N. Parabolic antenna with swivel mount
O. Process seal antenna
P. Tri Clamp process connection

2.6 System integration

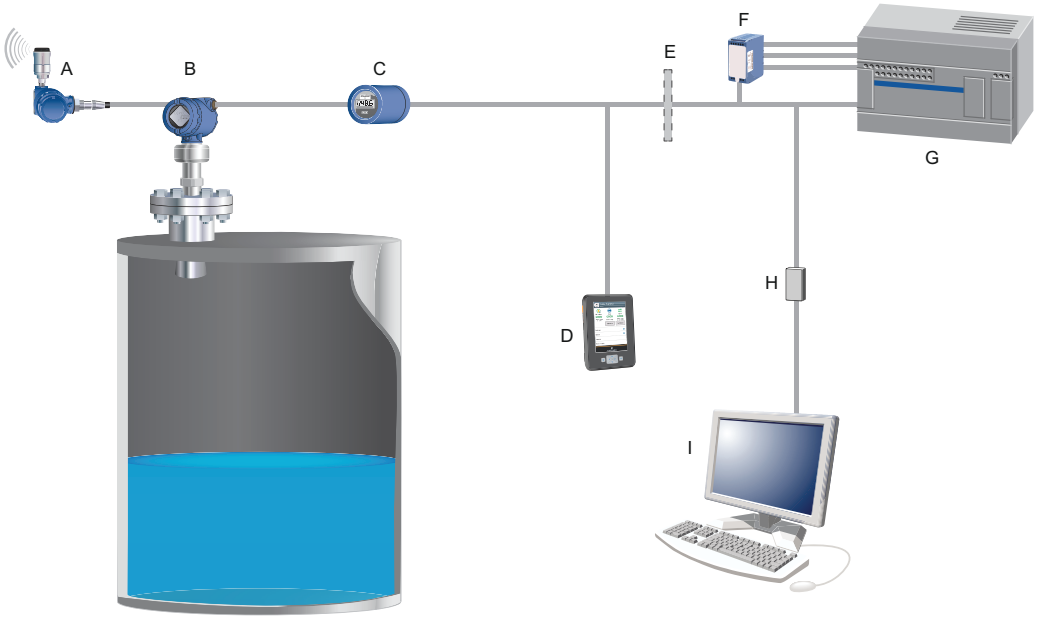
The transmitter is loop-powered, and uses the same two wires for power supply and output signal. The output is a 4-20 mA analog signal superimposed with a digital HART® signal. The transmitter can be configured for either HART Revision 6 or 7. The HART Revision can be switched in field.

By using the optional Rosemount 333 HART Tri-Loop™, the digital HART signal can be converted into three additional 4-20 mA analog signals.

With the HART protocol, multidrop configuration is possible. In this case, communication is restricted to digital, since current is fixed to the 4 mA minimum value.

The transmitter can be combined with the Emerson Wireless 775 THUM™ Adapter to wirelessly communicate HART data with IEC 62591 (*Wireless*HART®) technology. In addition, the transmitter can be connected to a Rosemount 751 Field Signal Indicator, or it can be equipped with an integral display.

Figure 2-3: System Architecture



A. Emerson Wireless 775 THUM Adapter
B. Rosemount 5408
C. Rosemount 751
D. Handheld communicator
E. Approved IS barrier (for Intrinsically Safe installations only)
F. Rosemount 333
G. Host/DCS system
H. HART modem
I. PC with Rosemount Radar Master Plus

The Rosemount 5408 is compliant with NAMUR NE 107 Field Diagnostics for standardized device diagnostic information.

3 Mechanical installation

3.1 Safety messages

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that potentially raises safety issues is indicated by a warning symbol (⚠). Refer to the following safety messages before performing an operation preceded by this symbol.

⚠ WARNING

Failure to follow safe installation and servicing guidelines could result in death or serious injury.

Ensure the transmitter is installed by qualified personnel and in accordance with applicable code of practice.

Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment.

For installations in hazardous locations, the transmitter must be installed according to the Rosemount 5408 Product Certifications document and System Control Drawing.

⚠ WARNING

Process leaks could result in death or serious injury.

Ensure that the transmitter is handled carefully. If the process seal is damaged, gas might escape from the tank.

⚠ WARNING

Explosions could result in death or serious injury.

Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.

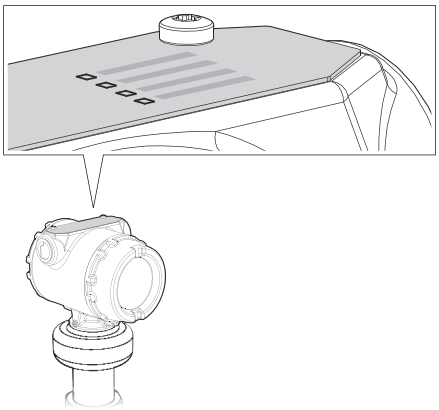
3.2 Confirm approval type

For hazardous locations transmitters labeled with multiple approval types:

Procedure

Permanently mark the checkbox of the selected approval type.

Figure 3-1: Label with Multiple Approval Types



3.3 Installation considerations

Before installing the transmitter, follow recommendations for mounting position, sufficient free space, nozzle requirements, etc.

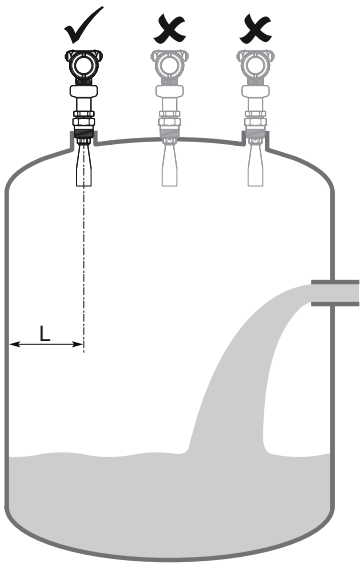
3.3.1 Mounting position

When finding an appropriate location on the tank for the transmitter, the conditions of the tank must be carefully considered.

Consider the following guidelines when mounting the transmitter:

- For optimal performance, the transmitter should be installed in locations with a clear and unobstructed view of the product surface.
- The transmitter should be mounted with as few internal structures as possible within the signal beam.
- Do not install the transmitter in the center of the tank.
- Do not mount close to or above the inlet stream.
- Multiple Rosemount 5408 transmitters can be used in the same tank without interfering with each other.

Figure 3-2: Recommended Mounting Position



3.3.2 Free space requirements

If the transmitter is mounted close to a wall or other tank obstruction such as heating coils and ladders, noise might appear in the measurement signal. See Table 3-1 for recommended clearance.

For easy access to the transmitter, mount it with sufficient service space (see Table 3-2).

Figure 3-3: Free Space Requirements

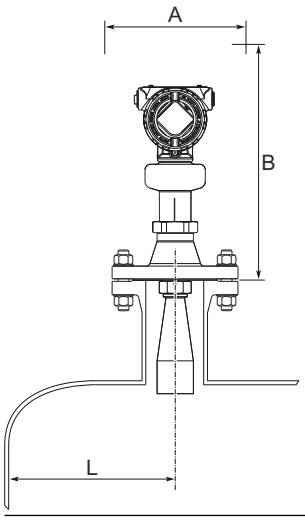


Table 3-1: Distance to Tank Wall (L)

Application	Minimum	Recommended
Liquids	8 in. (200 mm)	½ of tank radius
Solids	8 in. (200 mm)	⅔ of tank radius

Table 3-2: Free Space Requirements

Description	Distance
Service space width (A)	20 in. (500 mm)
Service space height (B)	24 in. (600 mm)

3.3.3 Antenna size

Choose as large antenna diameter as possible. A larger antenna diameter concentrates the radar beam and ensures maximum antenna gain. Increased antenna gain permits greater margin for weak surface echoes.

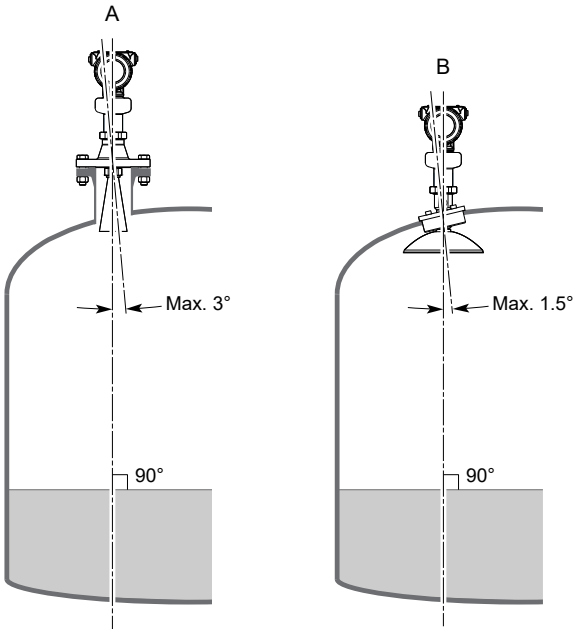
In addition, a larger antenna diameter results in a smaller beam angle and thereby, less interference from any internal structures in the tank.

3.3.4 Antenna inclination

Ensure the antenna is aligned perpendicular to the product surface (see Figure 3-4). The parabolic antenna comes with a swivel connection that adjusts for angled tank roofs.

Note that if the surface echo is weak in solids applications, then a small inclination of the parabolic antenna toward the surface slope may improve the performance.

Figure 3-4: Inclination



A. Cone antenna/process seal antenna
B. Parabolic antenna

3.3.5 Non-metallic tanks

Nearby objects outside the tank may cause disturbing radar echoes. Wherever possible, the transmitter should be positioned so that objects close to the tank are kept outside the signal beam.

3.3.6 Beam width and beam angle

The transmitter should be mounted with as few internal structures as possible within the signal beam. Refer to Table 3-3 for beam angle and Table 3-4 for beam width at different distances.

Figure 3-5: Beam Angle and Beam Width

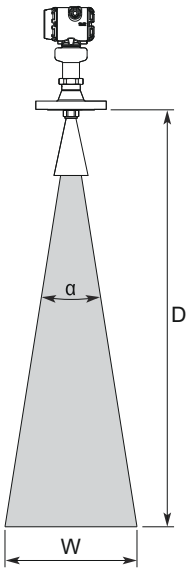


Table 3-3: Beam Angle

Antenna size	Beam angle (α)
1½-in. (DN 40) cone	22°
2-in. (DN50) cone/process seal	18°
3-in. (DN80) cone/process seal	14°
4-in. (DN100) cone/process seal	10°
8-in. (DN200) parabolic	4.5°

Table 3-4: Beam Width, ft. (m)

Distance (D)	Beam width (W)				
	1½-in. cone	2-in. cone/ process seal	3-in. cone/ process seal	4-in. cone/ process seal	Parabolic
16 (5)	6.2 (1.9)	5.2 (1.6)	4.0 (1.2)	2.9 (0.9)	1.3 (0.4)
33 (10)	12.8 (3.9)	10.4 (3.2)	8.1 (2.5)	5.7 (1.8)	2.6 (0.8)
49 (15)	19.0 (5.8)	15.6 (4.8)	12.1 (3.7)	8.6 (2.6)	3.9 (1.2)
66 (20)	25.6 (7.8)	20.8 (6.3)	16.1 (4.9)	11.5 (3.5)	5.2 (1.6)
82 (25)	31.8 (9.7)	26.0 (7.9)	20.1 (6.1)	14.3 (4.4)	6.4 (2.0)
98 (30)	38.4 (11.7)	31.2 (9.5)	24.2 (7.4)	17.2 (5.3)	7.7 (2.4)
131 (40)	51.2 (15.6)	41.6 (12.7)	32.2 (9.8)	23.0 (7.0)	10.3 (3.1)
197 (60)	N/A	N/A	N/A	34.5 (10.5)	15.4 (4.7)
262 (80)	N/A	N/A	N/A	45.9 (14.0)	20.7 (6.3)
328 (100)	N/A	N/A	N/A	57.4 (17.5)	25.9 (7.9)
492 (150)	N/A	N/A	N/A	86.0 (26.2)	38.7 (11.8)

3.3.7 Nozzle requirements

To allow the microwaves to propagate undisturbed, the nozzle dimensions should be kept within the specified limits as given in Table 3-5, Table 3-6, and Table 3-7.

Nozzle requirements for cone antenna

For best performance, the cone antenna should extend at least 0.4 in. (10 mm) below the nozzle. If required, use the extended cone antenna versions (option code S1 or S2).

However, the antenna can be recessed in smooth nozzles up to 4 ft. (1.2 m). Note that if the inside of the nozzle has irregularities (e.g. due to bad welding, rust, or deposit), then use the extend cone antenna.

Figure 3-6: Mounting of the Cone Antenna

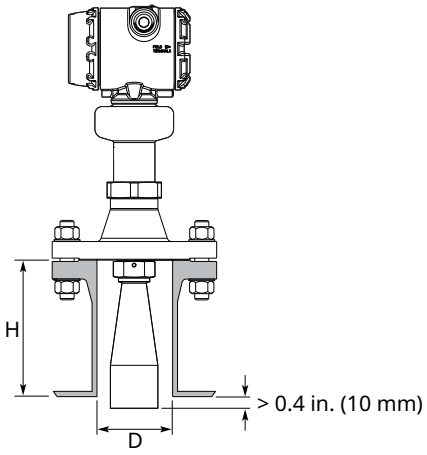


Table 3-5: Nozzle Requirements for Cone Antenna, in Inches (Millimeters)

Antenna size	Minimum nozzle diameter (D)(1)	Recommended maximum nozzle height (H)(2)(3)	
		Antenna	Antenna with air purge ring (code PC1)
1½-in. (DN 40)	1.50 (38.1)	5.59 (142)	N/A
2-in. (DN50)	1.94 (49.3)	5.71 (145)	4.69 (119)
3-in. (DN80)	2.80 (71.0)	5.63 (143)	4.61 (117)
4-in. (DN100)	3.78 (96.0)	6.54 (166)	5.51 (140)

(1) The antennas are sized to fit within schedule 80 or lower schedules.
(2) The values are valid for cone antennas without antenna extension.
(3) For liquid applications, the cone antenna can be recessed in smooth nozzles up to 4 ft. (1.2 m), but note that the accuracy may be reduced in the region close to the nozzle.

Nozzle requirements for process seal antenna

The antenna can be used on nozzles up to 4 ft. (1.2 m). Disturbing objects inside the nozzle may impact the measurement, and should therefore be avoided.

Figure 3-7: Mounting of the Process Seal Antenna

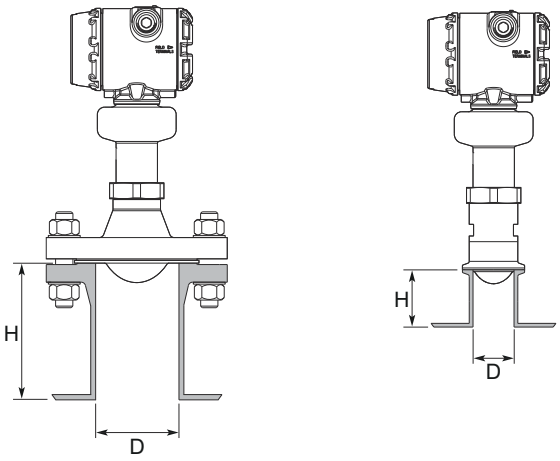


Table 3-6: Nozzle Requirements for Process Seal Antenna

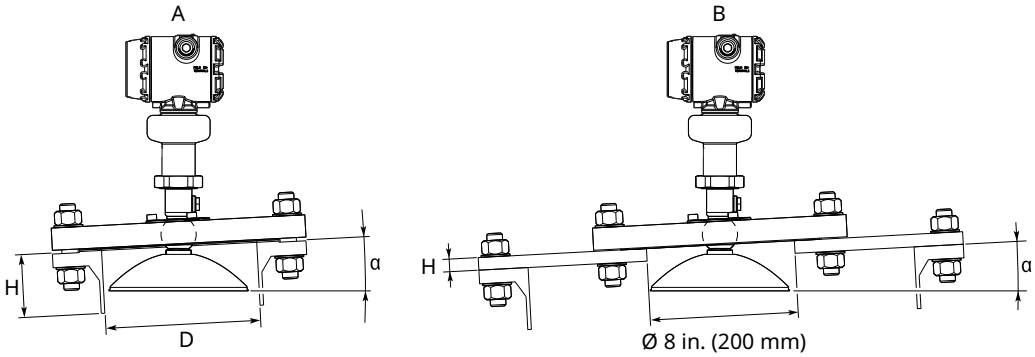
Antenna size	Minimum nozzle diameter (D)(1)	Recommended maximum nozzle height (H)(2)
2-in. (DN50)	1.77 in. (45 mm)	4 ft. (1.2 m)
3-in. (DN80)	2.76 in. (70 mm)	4 ft. (1.2 m)
4-in. (DN100)	2.76 in. (70 mm)	4 ft. (1.2 m)

(1) The antennas are sized to fit within schedule 120 or lower schedules.
(2) For hygienic applications, the nozzle height (H) must not exceed two times the nozzle diameter (D) to ensure cleanability. Maximum nozzle height is 5 in. (127 mm).

Nozzle requirements for parabolic antenna

See Table 3-7 for nozzle height recommendations at different inclination angle.

Figure 3-8: Mounting of the Parabolic Antenna



A. Nozzle mounting
B. Flange mounting in manhole cover

Table 3-7: Nozzle Requirements for Parabolic Antenna, in Inches (Millimeters)

Nozzle size (D)	Inclination angle (α)	Maximum nozzle height (H)(1)
Pipe schedule std, Ø 8 in. (200 mm)	0°	6.1 (155)
	3°	3.4 (85)
	6°	1.6 (40)
	9°	1.2 (30)
	12°	1.0 (25)
	15°	0.6 (15)
Pipe schedule std, Ø10 in. (250 mm)	0°	17.2 (440)
	3°	10.2 (260)
	6°	7.1 (180)
	9°	5.1 (130)
	12°	3.9 (100)
	15°	3.0 (75)

(1) Note that the inside of the nozzle must be smooth (i.e. avoid bad welding, rust, or deposit).

3.3.8 Still pipe/chamber installations

Installation in still pipe/chamber is recommended for tanks where there are excessive foaming or turbulence. Still pipe/chamber may also be used to avoid disturbing objects in the tank.

Still pipe

Consider the following still pipe requirements:

Pipe

- Pipes should be an all-metal material.
- Pipe should have a constant inside diameter.

- The inner surface must be smooth and clear of any rough edges. (Smooth pipe joints are acceptable, but may reduce accuracy.)
- The end of the pipe must extend beyond the zero level.

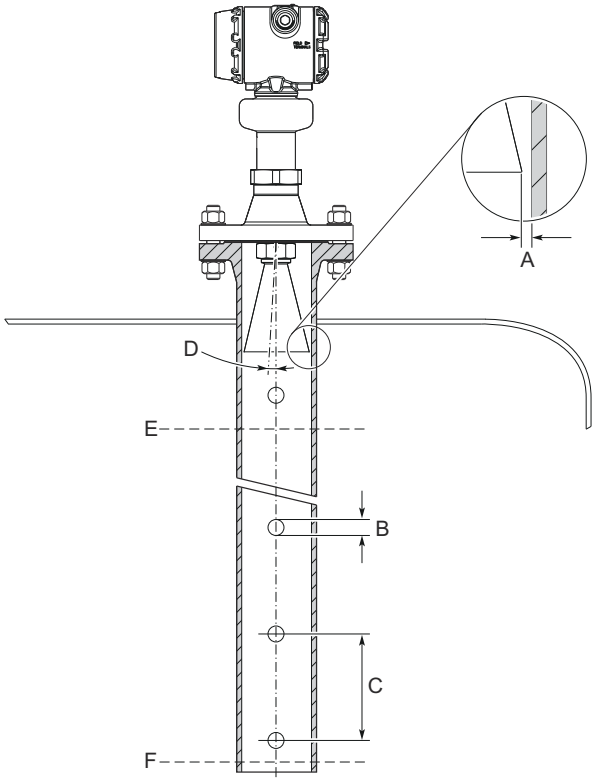
Holes

- Maximum hole diameter is 1 in. (25 mm).
- Minimum distance between holes is 6 in. (150 mm).
- Holes should be drilled on one side only and deburred.
- Drill one hole above maximum product surface.

Antenna

- All cone/process seal antenna sizes can be used for still pipe/chamber installations.
- The gap between the cone antenna and the still pipe should be maximum 0.2 in. (5 mm)(1). Larger gaps may result in inaccuracies. If required, order a larger antenna and cut on location.

Figure 3-9: Still Pipe Requirements



A. Maximum 0.2 in. (5 mm)
B. Maximum 1 in. (25 mm)
C. Minimum 6 in. (150 mm)
D. Maximum 1°
E. Level = 100%
F. Level = 0%

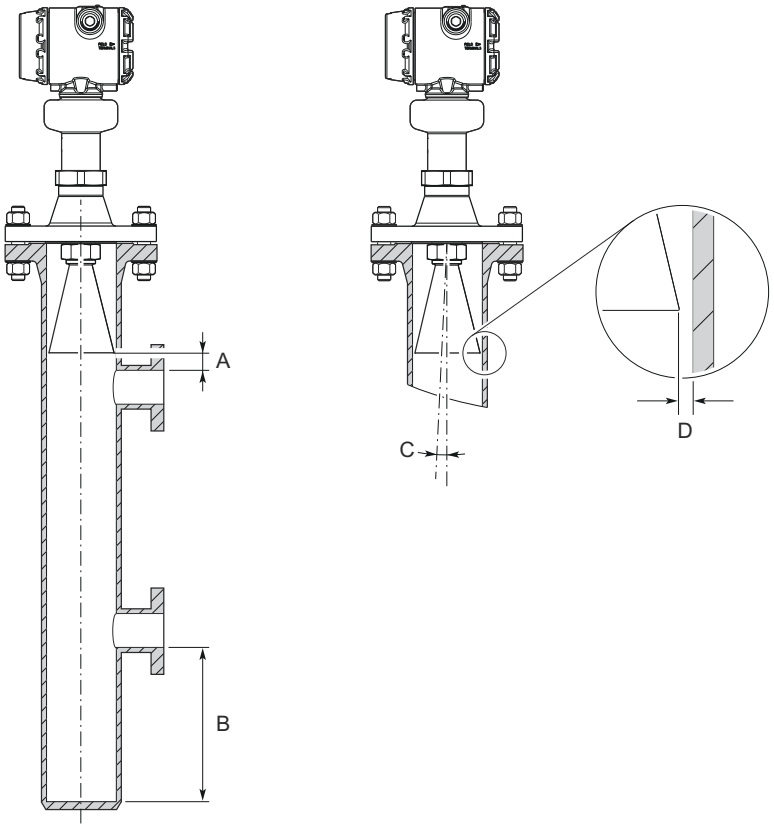
(1) A larger gap is inevitable for the 4-in. cone antenna in pipes with a diameter larger than 4 in.

Chamber

Consider the following chamber requirements:

- Pipes should be an all-metal material.
- Pipe should have a constant inside diameter.
- Inlet pipes should not protrude into the inside of the stand pipe.
- The inner surface must be smooth and clear of any rough edges. (Smooth pipe joints are acceptable, but may reduce accuracy.)
- The gap between the cone antenna and the stand pipe should be maximum 0.2 in. (5 mm)[1]. Larger gaps may result in inaccuracies. If required, order a larger antenna and cut on location.

Figure 3-10: Chamber Requirements



A. Minimum 0.4 in. (10 mm)
B. Minimum 6 in. (150 mm)
C. Maximum 1°
D. Maximum 0.2 in. (5 mm)

Related information

Best Practices for Using Radar in Still Pipes and Chambers Technical Note

3.3.9 Ball valve installation

The transmitter can be isolated from the process by using a valve:

- Use a full-port ball valve.
- Ensure there is no edge between the ball valve and the nozzle or still pipe, the inside should be smooth.
- Valves can be combined with still pipes.
- The ball valve should have the same inner diameter as the still pipe.

3.3.10 Shipboard installations

Transmitters with aluminum housing are not approved for open deck installations; for use only in engine room, pump room, etc.

For application conditions and limitations refer to the applicable shipboard approval.

3.4 Mounting preparations

3.4.1 Assemble the segmented cone antenna

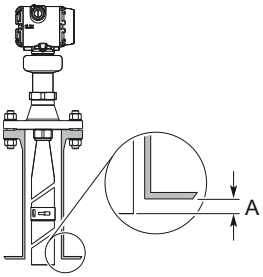
Prerequisites

This section applies to the segmented cone antenna (option code S2). Use only one segment; the total antenna length should not exceed 47.2 in. (1200 mm).

Procedure

1. Determine the antenna length.

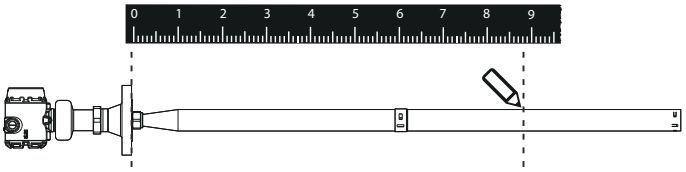
Figure 3-11: Installation Recommendation



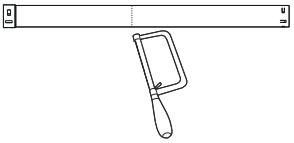
A. Min. 0.4 in. (10 mm)

2. Insert the segment into the cone antenna until it bottoms.

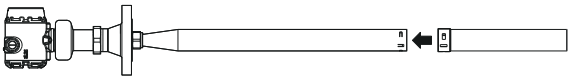
3. Mark where to cut the segment.



4. Remove and cut the segment at the marking.

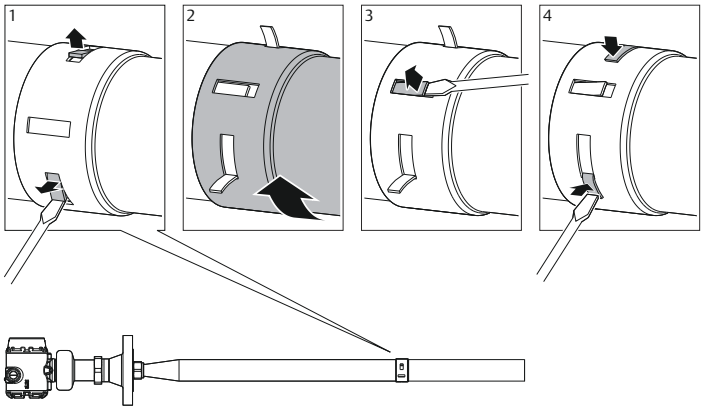


5. Remove any burrs.
6. Insert the segment into the cone antenna until it bottoms.



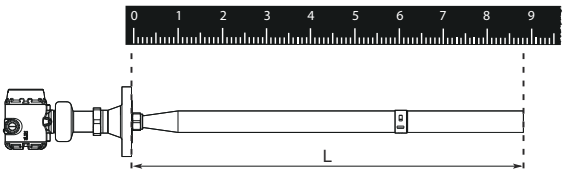
7. Secure the segment to the antenna.

Note
Be careful of sharp edges. Wear protective gloves!



8. Measure the Antenna Extension Length (L).

Antenna Extension Length (L):



9. Update the transmitter configuration to the new Antenna Extension Length (L).
   Select **Configure** → **(Manual Setup)** → **Level Setup** → **Antenna**.

3.4.2 Shorten the extended cone antenna

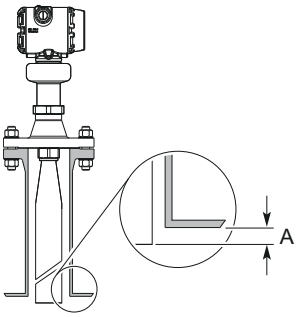
Prerequisites

This section only applies to the extended cone antenna (option code S1).

Procedure

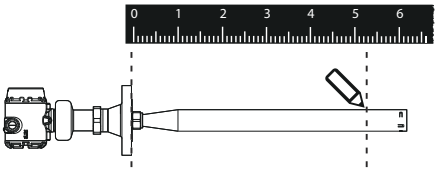
1. Determine the antenna length.

Figure 3-12: Installation Recommendation

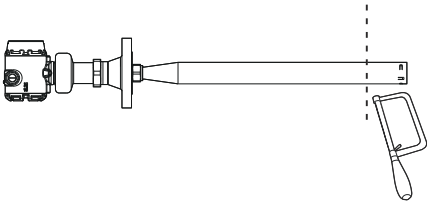


A. Min. 0.4 in. (10 mm)

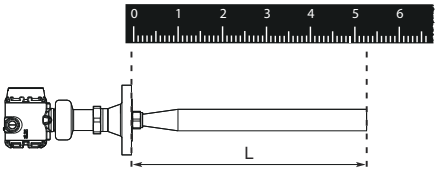
2. Mark where to cut the antenna.



3. Cut the antenna at the marking.



4. Remove any burrs.
5. Measure the Antenna Extension Length (L).



6. Update the transmitter configuration to the new Antenna Extension Length (L).
   Select **Configure** → **(Manual Setup)** → **Level Setup** → **Antenna**.

3.4.3 Replace the transmitter head nut

When mounting on a legacy Rosemount 5402 antenna, the transmitter head nut must be changed from size M50 to M52.

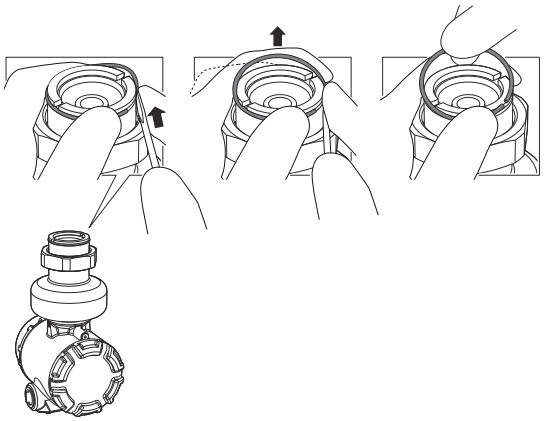
Prerequisites

Applies only to transmitters ordered with the option code A1.

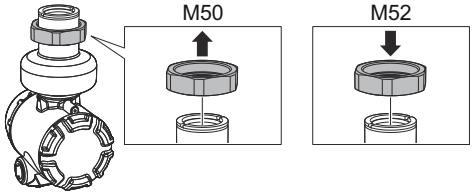
Procedure

1. Remove the stop ring using a flat head screwdriver.

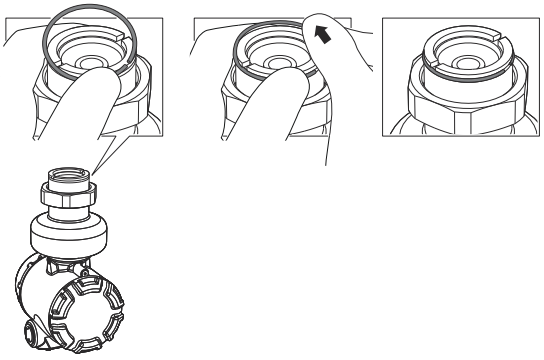
   Tip
   Wear gloves to increase grip when using the tool!



2. Replace the transmitter head nut.



3. Mount the stop ring.
   Use the new stop ring supplied with the kit.



Postrequisites

Ensure to set the Antenna Type to Legacy (Rosemount 5402), and then set the User Defined Antenna Options parameters.

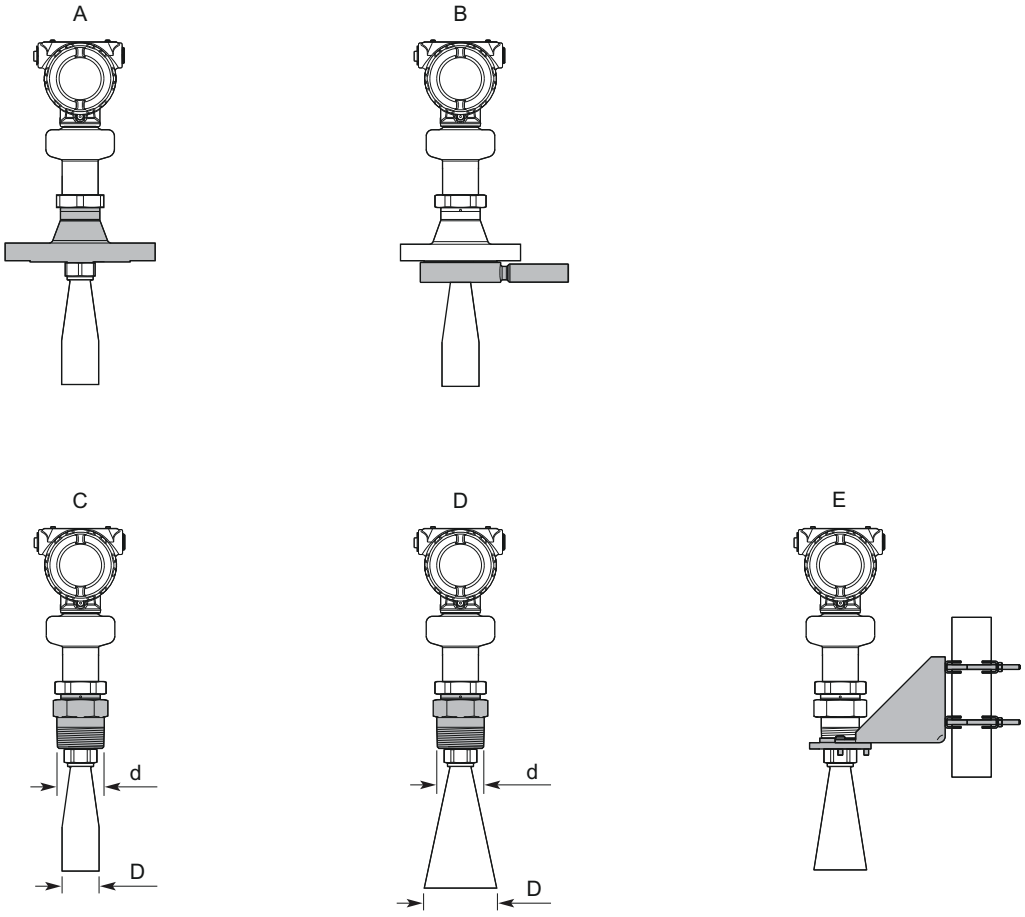
Related information

User defined antenna options

3.5 Mount the cone antenna

3.5.1 Overview

Figure 3-13: Overview

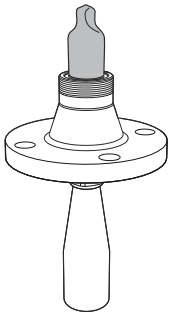


A. *Flanged version (see page 32)*
B. *Flanged version with air purge ring (see page 33)*
C. *Threaded version, D < d (see page 35)*
D. *Threaded version, D > d (see page 37)*
E. *Bracket mounting (see page 40)*

3.5.2 Protective cap

For spare antennas, keep the protective cap in place until installing the transmitter head. The cap protects the process seal from dust and water.

Figure 3-14: Protective Cap



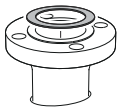
3.5.3 Flanged version

Prerequisites

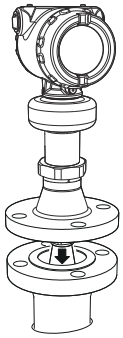
If applicable, assemble the segmented cone antenna.

Procedure

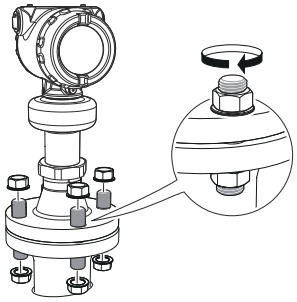
1. Place a suitable gasket on the tank flange.



2. Lower transmitter with antenna and flange into the nozzle.



3. Tighten bolts and nuts with sufficient torque for the flange and gasket choice.



Postrequisites

Align the transmitter head.

Related information

Assemble the segmented cone antenna
Align transmitter head

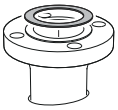
3.5.4 Flanged version with air purge ring (option code PC1)

Prerequisites

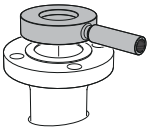
If applicable, assemble the segmented cone antenna.

Procedure

1. Place a suitable gasket on the tank flange.

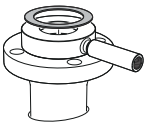


2. Place the purge ring over the gasket.

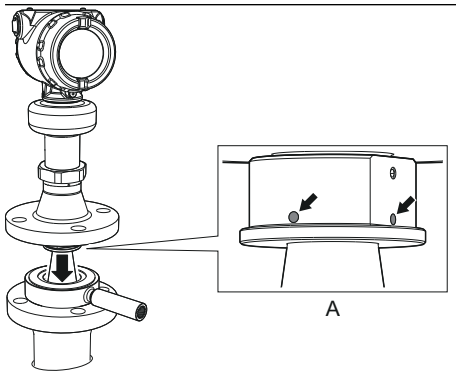


3. Place a suitable gasket over the purge ring.

Note
A minimum gasket thickness of 0.125 in. (3.2 mm) is required for flanges with protective plate design.

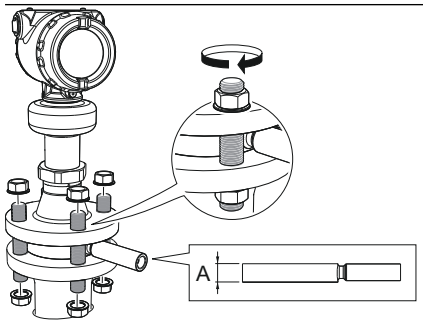


4. Lower transmitter with antenna and flange into the nozzle.



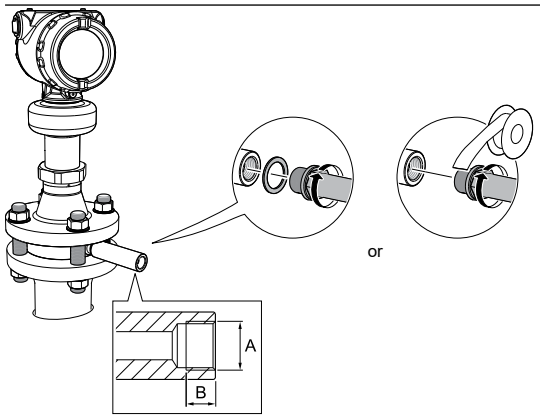
A. Antenna with air purge holes

5. Tighten bolts and nuts with sufficient torque for the flange and gasket choice.



A. 1.0 in. (25.5 mm)

6. Connect the air purging system. Use thread sealant or suitable gasket according to your site procedures.



A. G⅜-in.
B. 0.4 in. (10 mm)

Postrequisites

Align the transmitter head.

Related information

Assemble the segmented cone antenna
Align transmitter head
Incoming air supply specification

3.5.5 Threaded version, antenna diameter smaller than thread diameter

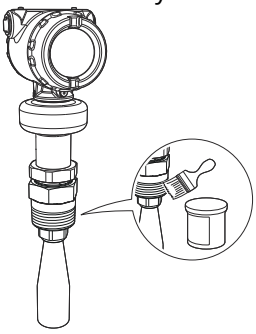
Threaded tank connection

Prerequisites

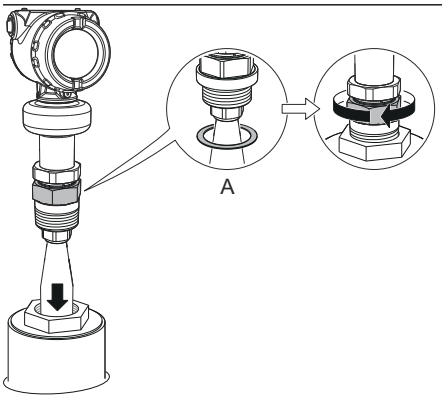
If applicable, assemble the segmented cone antenna.

Procedure

1. Apply anti-seize paste or PTFE tape on threads according to your site procedures.
   ⚠ Gasket may be used as a sealant for adapters with 1½- or 2-in. BSPP (G) threads.



2. Mount the transmitter on the tank.



A. Gasket (for 1½-in. and 2-in. BSPP (G) threads only)

Postrequisites

Align the transmitter head.

Related information

Assemble the segmented cone antenna
Align transmitter head

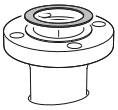
Flanged tank connection

Prerequisites

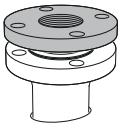
If applicable, assemble the segmented cone antenna.

Procedure

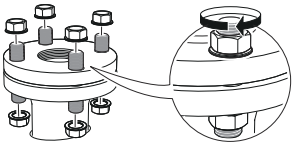
1. Place a suitable gasket on the tank flange.



2. Place the customer supplied flange over the gasket.

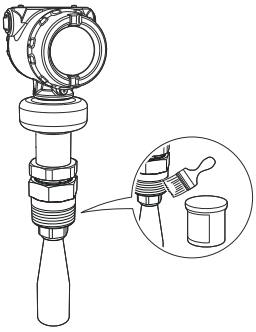


3. Tighten the bolts and nuts with sufficient torque for the flange and gasket choice.

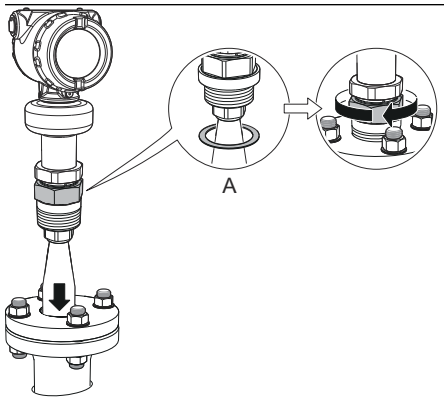


4. Apply anti-seize paste or PTFE tape on threads according to your site procedures.

   ⚠ Gasket may be used as a sealant for adapters with 1½- or 2-in. BSPP (G) threads.



5. Lower transmitter with antenna into the nozzle.



A. Gasket (for 1½-in. and 2-in. BSPP (G) threads only)

Postrequisites

Align the transmitter head.

Related information

Assemble the segmented cone antenna
Align transmitter head

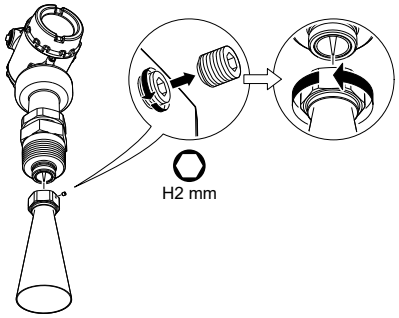
3.5.6 Threaded version, antenna diameter larger than thread diameter

Prerequisites

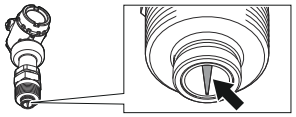
If applicable, assemble the segmented cone antenna.

Procedure

1. Unscrew and remove the antenna.

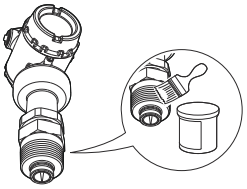


Note
Be careful not to scratch the microwave launcher. The microwave launcher is sensitive to mechanical impacts.

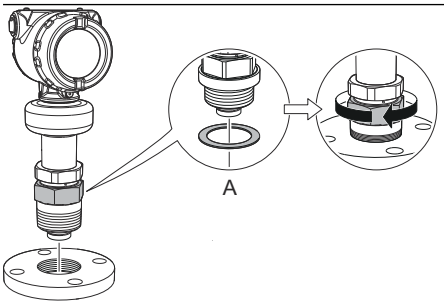


2. Apply anti-seize paste or PTFE tape on threads according to your site procedures.

   ⚠ Gasket may be used as a sealant for adapters with 1½- or 2-in. BSPP (G) threads.



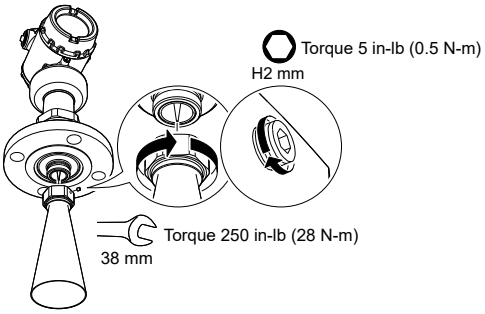
3. Mount the adapter on the customer supplied flange.



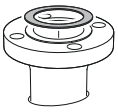
A. Gasket (for 1½-in. and 2-in. BSPP (G) threads only)

4. Mount the antenna.

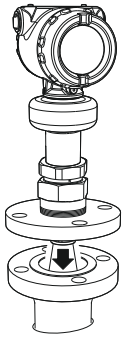
Note
Visually inspect the microwave launcher for damage and dirt.



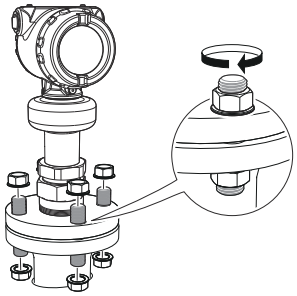
5. Place a suitable gasket on the tank flange.



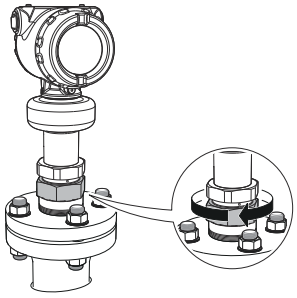
6. Lower transmitter with antenna and flange into the nozzle.



7. Tighten the bolts and nuts with sufficient torque for the flange and gasket choice.



8. Screw the adapter until it is properly tightened.



Postrequisites

Align the transmitter head.

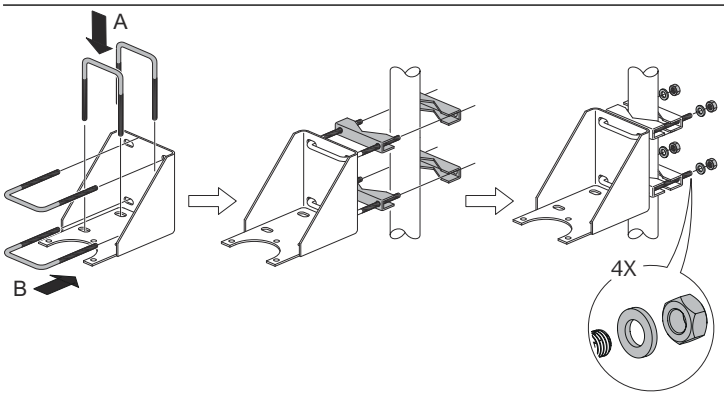
Related information

Assemble the segmented cone antenna
Align transmitter head

3.5.7 Mount the bracket

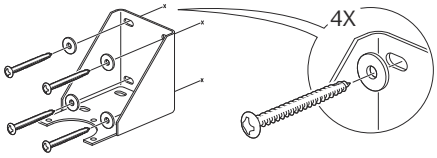
Procedure

1. Mount the bracket to the pipe/wall.
   On pipe:

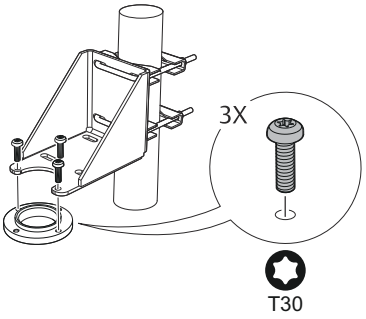


A. Horizontal pipe
B. Vertical pipe

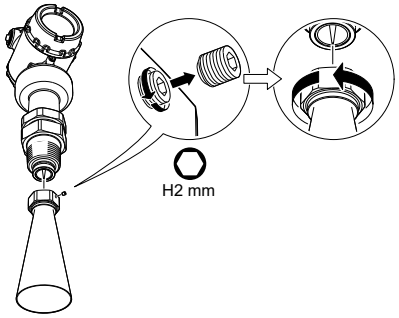
   On wall:



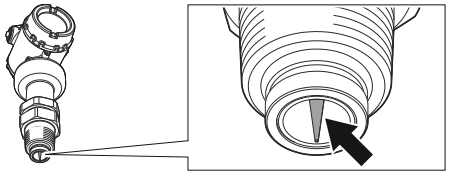
2. Mount the holder to the bracket.



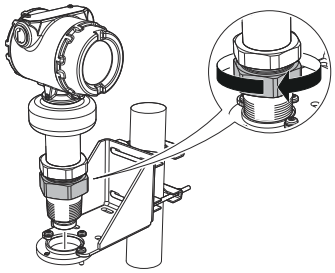
3. Unscrew and remove the antenna.



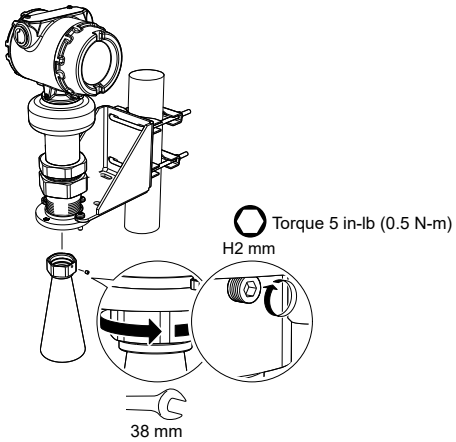
Note
Be careful not to scratch the microwave launcher. The microwave launcher is sensitive to mechanical impacts.



4. Screw the transmitter into the holder.



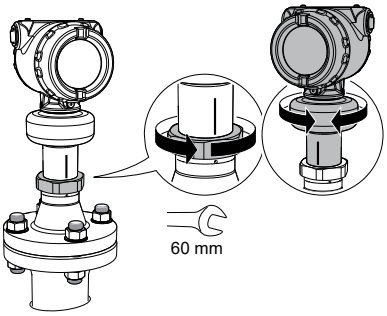
5. Mount the antenna.



3.5.8 Align transmitter head

Procedure

1. Loosen the nut slightly and turn the transmitter.



2. Verify the transmitter head is properly aligned.

Option	Description
Open tank	Align the marking on the sensor module toward the tank wall (see Figure 3-15).
Still pipe	Align the external ground screw toward the holes of the still pipe (see Figure 3-16).
Chamber	Align the external ground screw toward the process connections (see Figure 3-17).

Figure 3-15: Open Tank

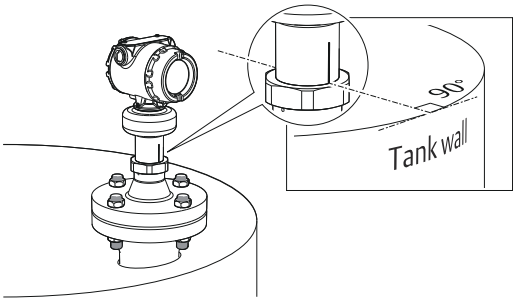


Figure 3-16: Still pipe

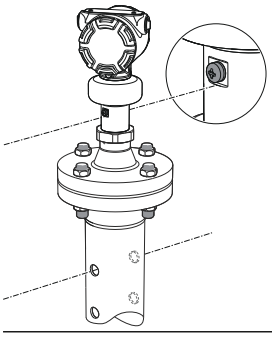
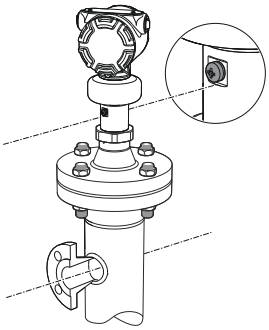
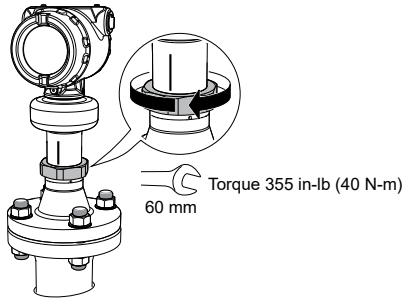


Figure 3-17: Chamber



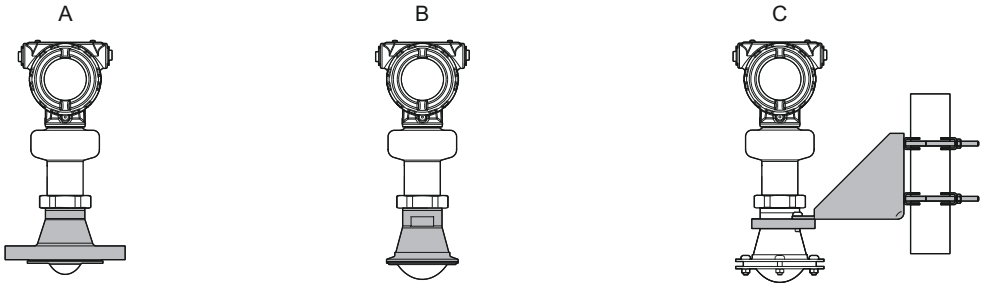
3. Tighten the nut.



3.6 Mount the process seal antenna

3.6.1 Overview

Figure 3-18: Overview

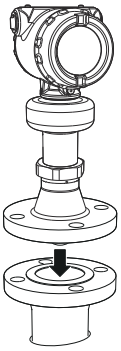


A. Flanged version (see page 44)
B. Tri Clamp version (see page 45)
C. Bracket mounting (see page 46)

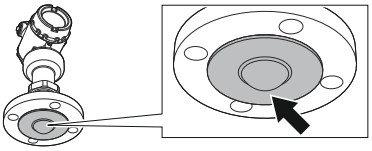
3.6.2 Mount the flanged version

Procedure

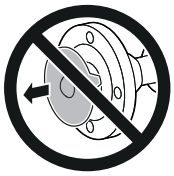
1. Lower the transmitter into the nozzle.



Note
Be careful not to scratch or otherwise damage the PTFE sealing.

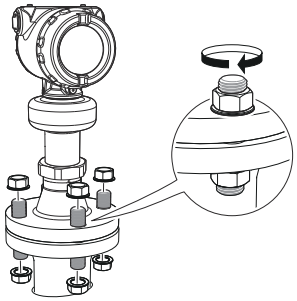


Note
Do not remove the PTFE sealing.



2. Tighten the bolts and nuts (see Table 3-8).

Note
- Re-tighten after 24 hours and again after the first temperature cycle.
- Check at regular intervals and re-tighten if necessary.



Postrequisites

Align the transmitter head.

Related information

Align transmitter head

Torque specifications

The conditions used for the calculation are:

- Standard mating metal flange
- A193 B8M Cl.2 / A4-70 bolt material
- Friction coefficient of μ=0.16

Low strength bolt and non-metallic mating flange may require lower tightening torque.

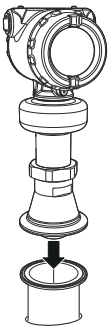
Table 3-8: Torque Values for Process Seal Antenna, lb-ft (N-m)

Process connection size	Process connection rating					
	ASME B16.5		EN1092-1			JIS B2220
	Class 150	Class 300	PN6	PN10/ PN16	PN25/PN40	10K
2-in./DN50/50A	29 (40)	52 (70)	15 (20)	26 (35)	29 (40)	18 (25)
3-in./DN80/80A	33 (45)	48 (65)	37 (50)	37 (50)	41 (55)	22 (30)
4-in./DN100/100A	59 (80)	52 (70)	37 (50)	37 (50)	74 (100)	26 (35)

3.6.3 Mount the Tri Clamp version

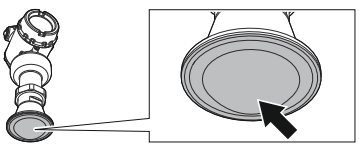
Procedure

1. Lower the transmitter into the nozzle.

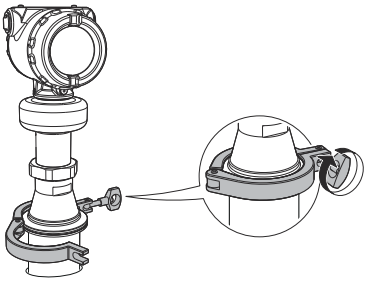


Note

Be careful not to scratch or otherwise damage the PTFE sealing.



2. Tighten the clamp to the recommended torque (see the manufacturer's instruction manual).



Postrequisites

Align the transmitter head.

Related information

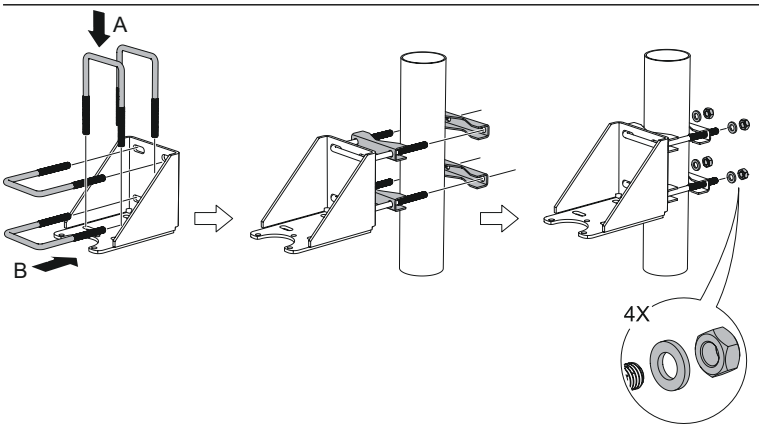
Align transmitter head

3.6.4 Mount the bracket

Procedure

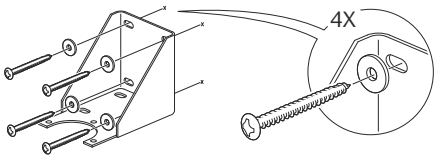
1. Mount the bracket to the pipe/wall.

   On pipe:

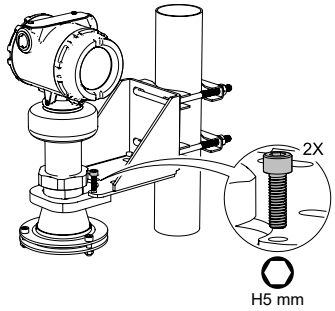


A. Horizontal pipe
B. Vertical pipe

   On wall:



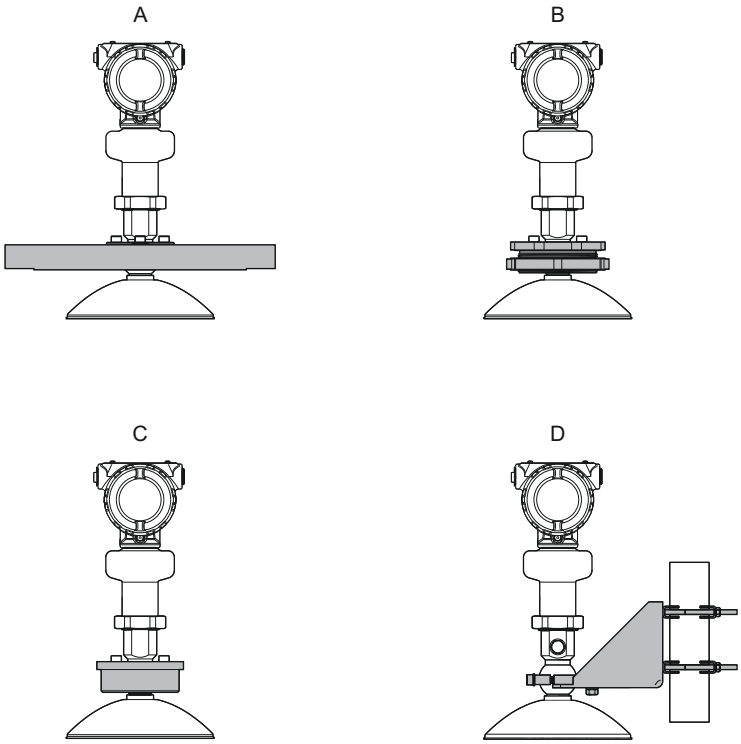
2. Mount the transmitter to the bracket.



3.7 Mount the parabolic antenna

3.7.1 Overview

Figure 3-19: Overview

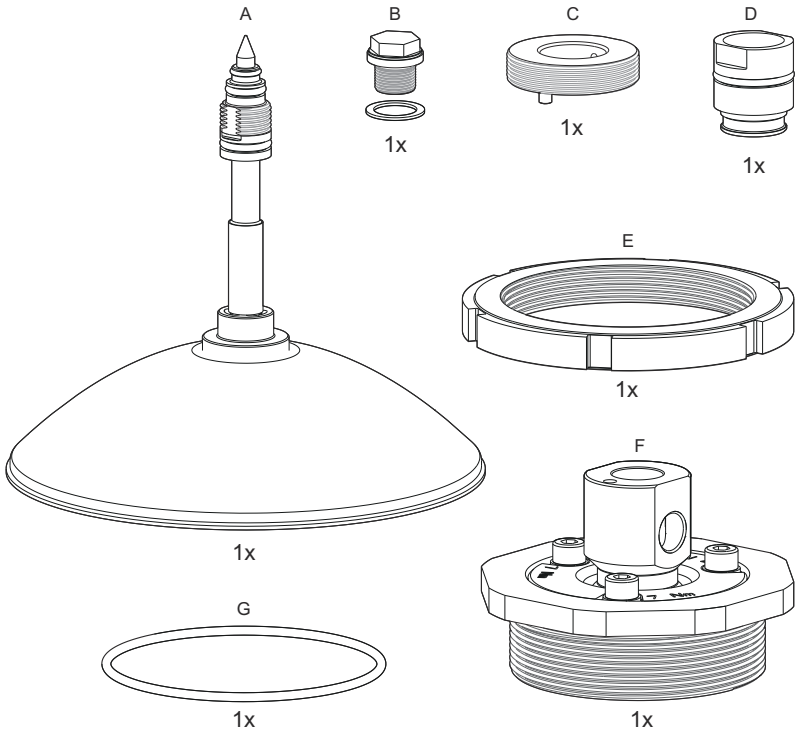


A. Flanged version (see page 49)
B. Threaded version (see page 50)
C. Welded version (see page 54)
D. Bracket mounting (see page 58)

3.7.2 Components of the parabolic antenna

Components of the threaded version

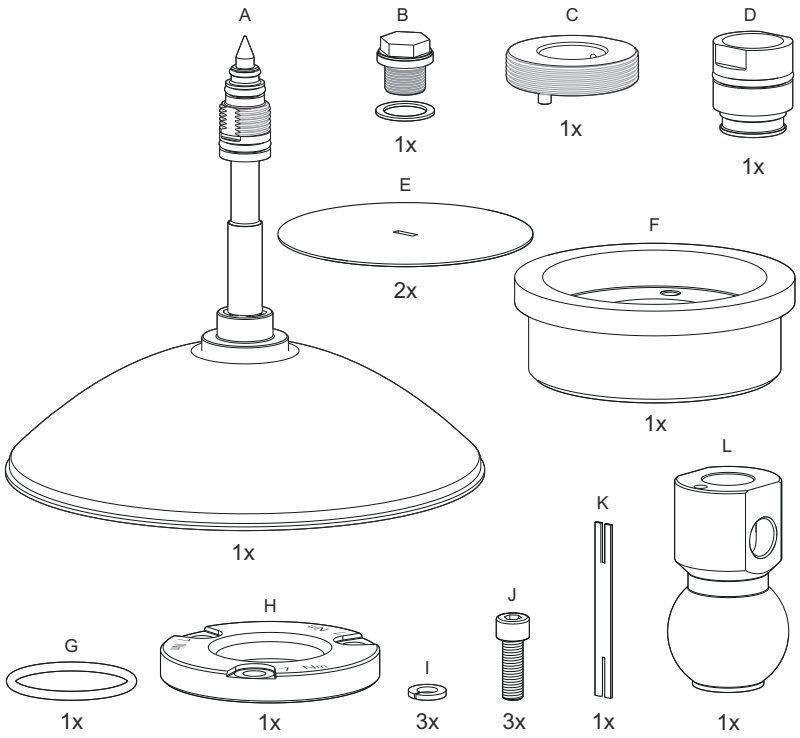
Figure 3-20: Components



A. Antenna
B. Purge plug kit
C. Threaded sleeve
D. M20 adapter
E. Lock nut BSPP (G) 3½-in.
F. Antenna adapter with ball joint
G. O-ring

Components of the welded version

Figure 3-21: Components

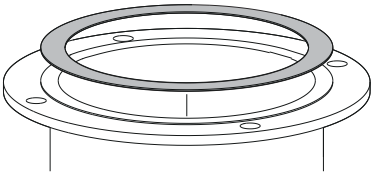


A. Antenna
B. Purge plug kit
C. Threaded sleeve
D. M20 adapter
E. Weld protection plate
F. Flange ball
G. O-ring
H. Clamp flange
I. Washer
J. M8 screw
K. Weld protection bar
L. Ball joint

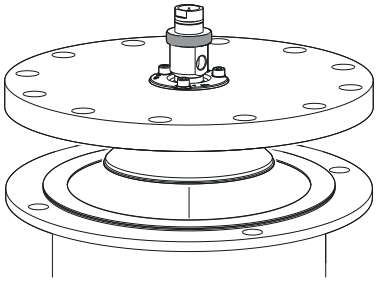
3.7.3 Mount the flanged version

Procedure

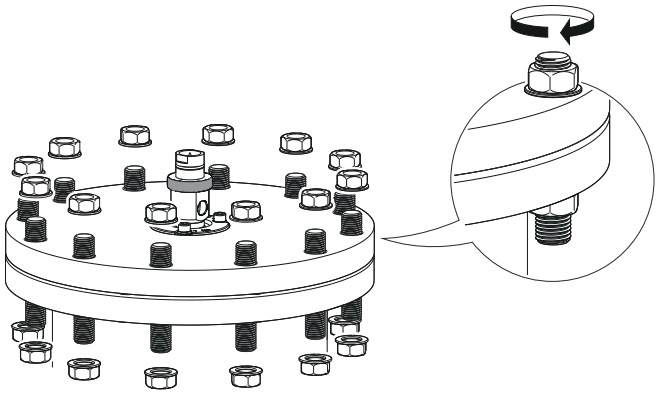
1. Place a suitable gasket on the tank flange.



2. Lower the flange and antenna assembly into the nozzle.



3. Tighten the bolts and nuts with sufficient torque for the flange and gasket choice.



Postrequisites

1. Adjust the inclination of the antenna.
2. Connect the air purging system.

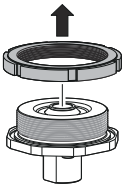
Related information

Adjust the inclination of the antenna
Connect the air purging

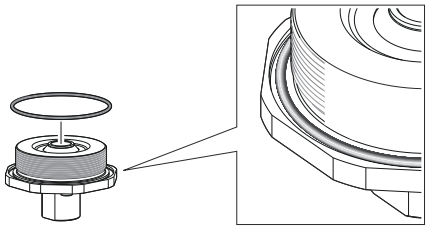
3.7.4 Mount the threaded version

Procedure

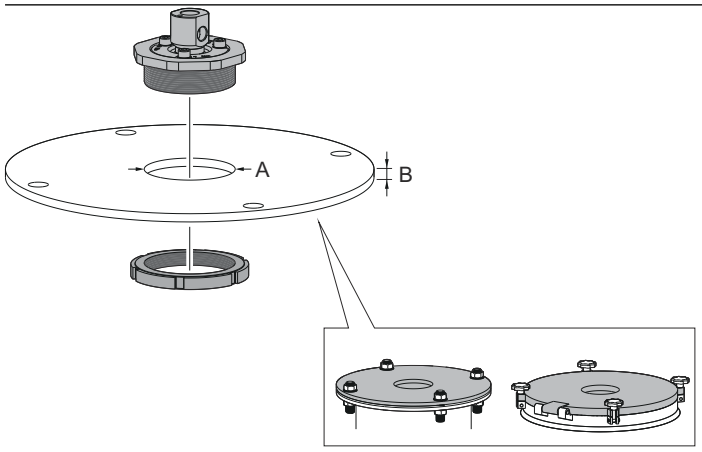
1. Remove the lock nut.



2. Mount the O-ring.

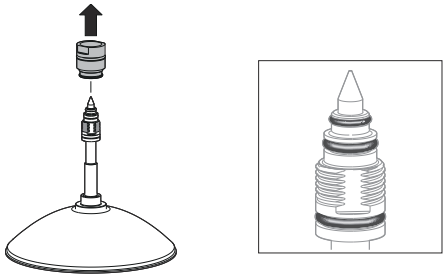


3. Mount the antenna adapter on flange/manhole cover. Ensure the antenna adapter fits tightly to the flange/manhole cover.

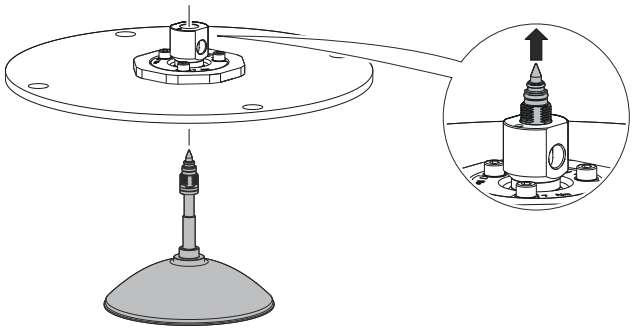


A. Ø 3.98 ± 0.02 in. (Ø 101 ± 0.6 mm) or G 3½-in.
B. Max. 0.59 in. (15 mm)

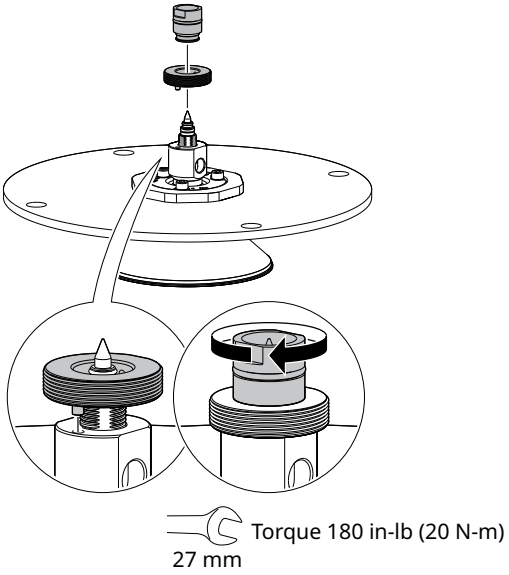
4. Remove the M20 adapter and visually inspect the O-rings for damage and dirt.



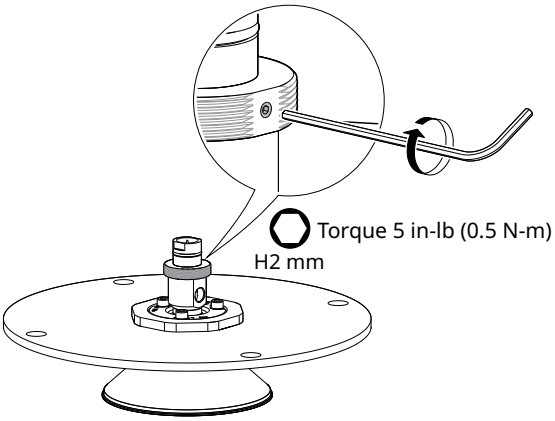
5. Carefully insert the antenna.



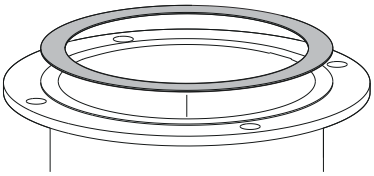
6. Secure the antenna.



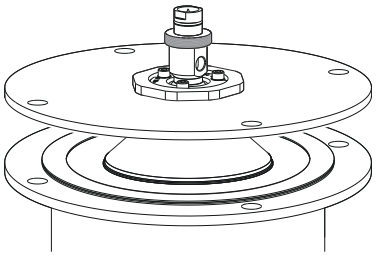
7. Tighten the set screw.



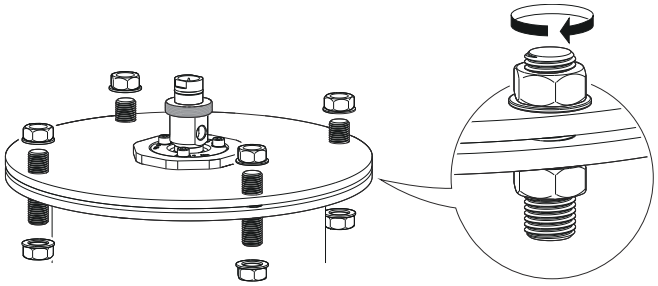
8. Place a suitable gasket on the tank flange.



9. Lower the antenna assembly into the tank.



10. Tighten the bolts and nuts with sufficient torque for the flange and gasket choice.



Postrequisites

1. Adjust the inclination of the antenna.
2. Connect the air purging system.

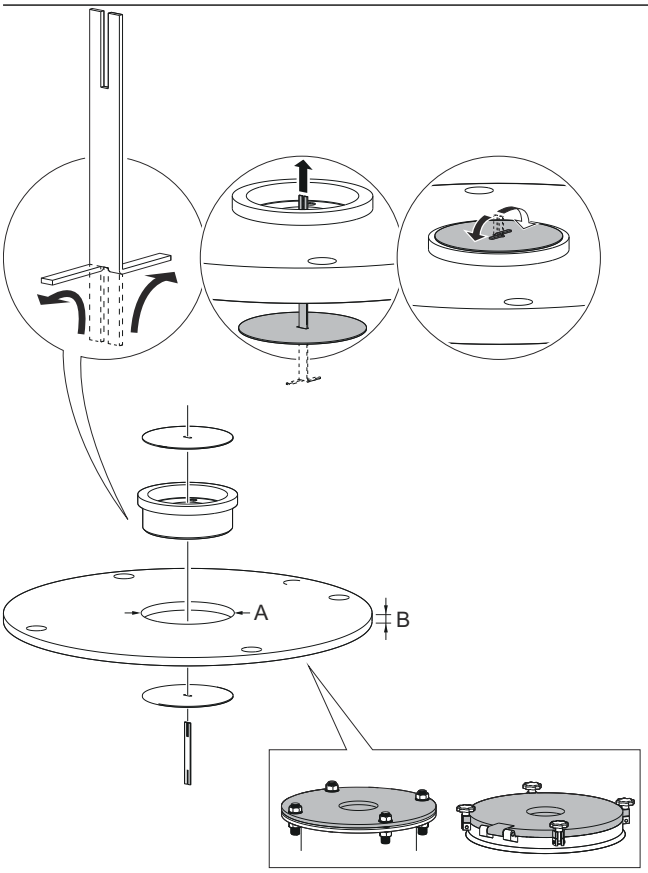
Related information

Adjust the inclination of the antenna
Connect the air purging

3.7.5 Mount the welded version

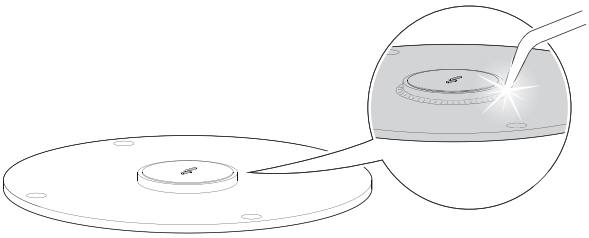
Procedure

1. Mount the protection plates to flange/manhole cover. These plates protect the internal surfaces of the flange ball from dust and sparks during welding.

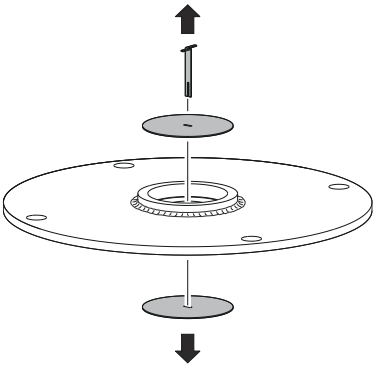


A. Ø 3.94 ± 0.02 in. (Ø 100 ± 0.5 mm)
B. Max. 1.18 in. (30 mm)

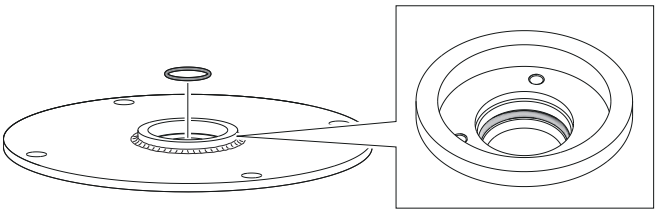
2. Weld the flange ball.



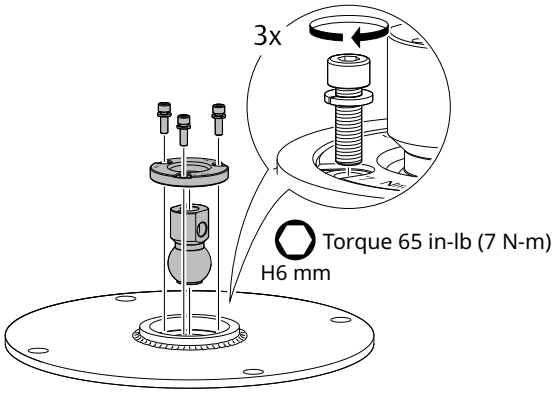
3. Remove the protection plates and visually inspect the internal surfaces of the flange ball for damage and dirt.

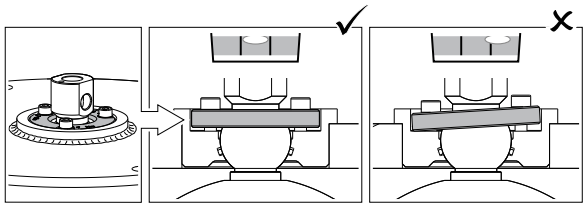


4. Mount the O-ring.

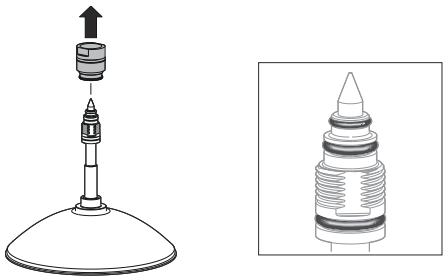


5. Mount the ball joint.
   a) Insert the ball joint and place the clamp flange with the “7 Nm” marking side up.
   b) Gradually tighten the M8 screws.

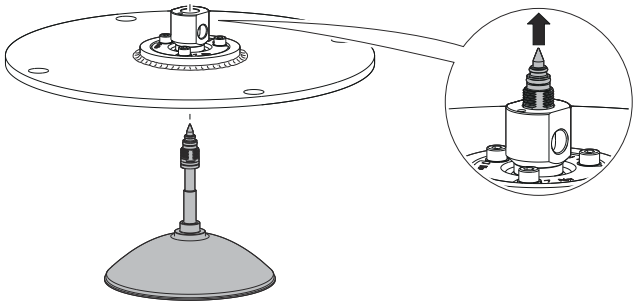




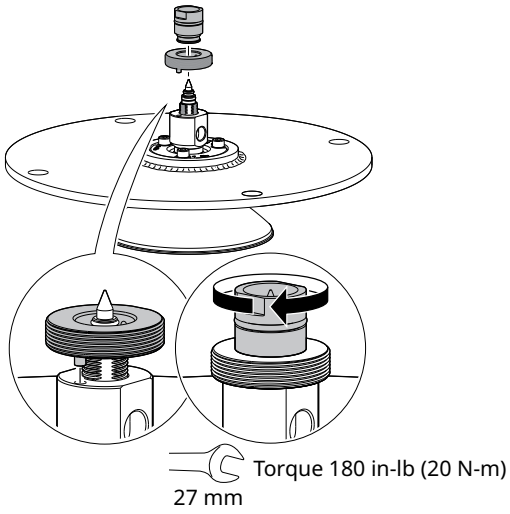
6. Remove the M20 adapter and visually inspect the O-rings for damage and dirt.



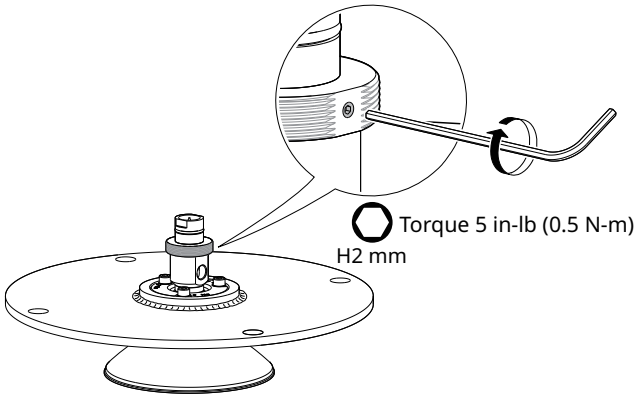
7. Carefully insert the antenna.



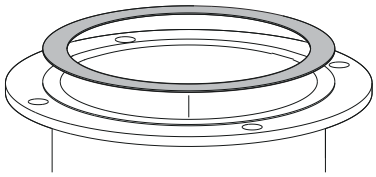
8. Secure the antenna.



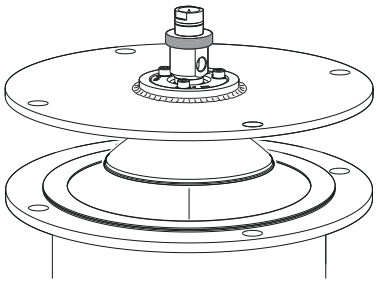
9. Tighten the set screw.



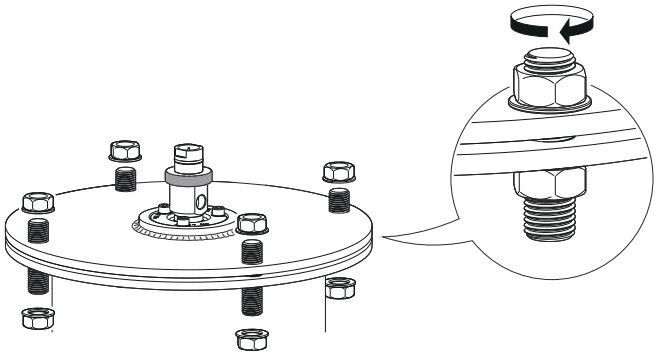
10. Place a suitable gasket on the tank flange.



11. Lower the antenna assembly into the tank.



12. Tighten the bolts and nuts with sufficient torque for the flange and gasket choice.



Postrequisites

1. Adjust the inclination of the antenna.
2. Connect the air purging system.

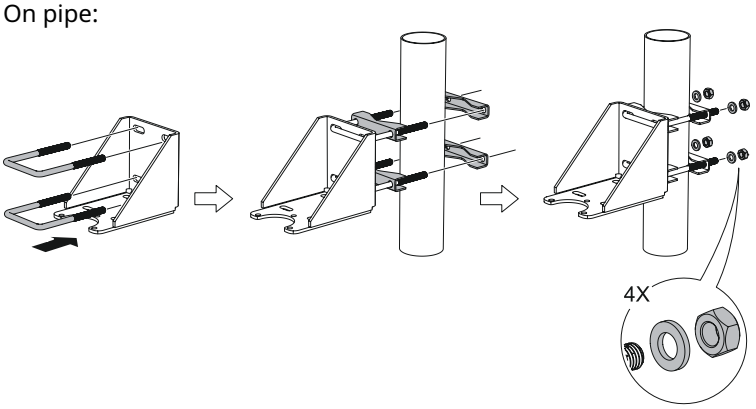
Related information

Adjust the inclination of the antenna
Connect the air purging

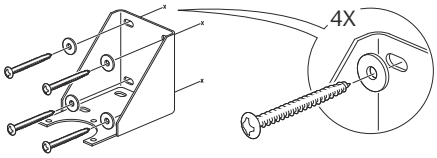
3.7.6 Mount the bracket

Procedure

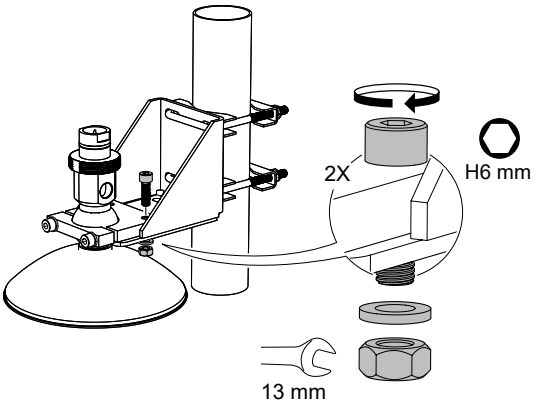
1. Mount the bracket to the pipe/wall.
   On pipe:



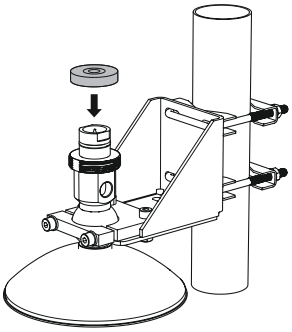
   On wall:



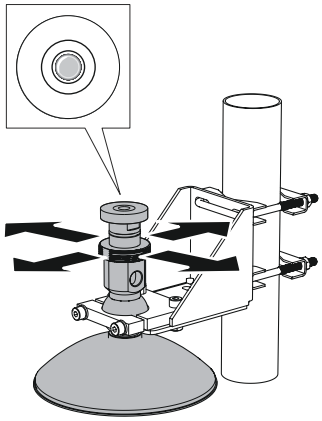
2. Mount the antenna assembly to the bracket.



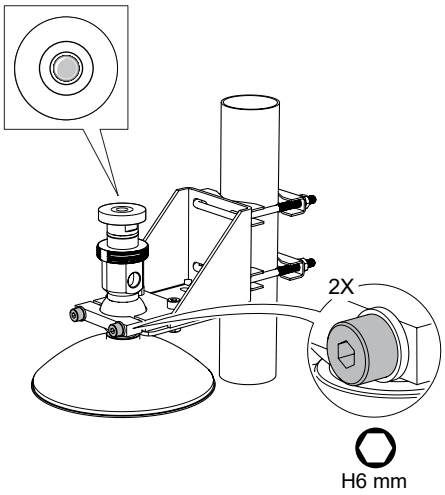
3. Place the supplied circular level on top of the antenna assembly.



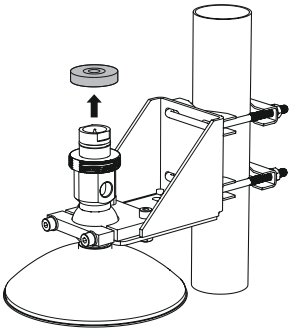
4. Adjust the inclination of the antenna.



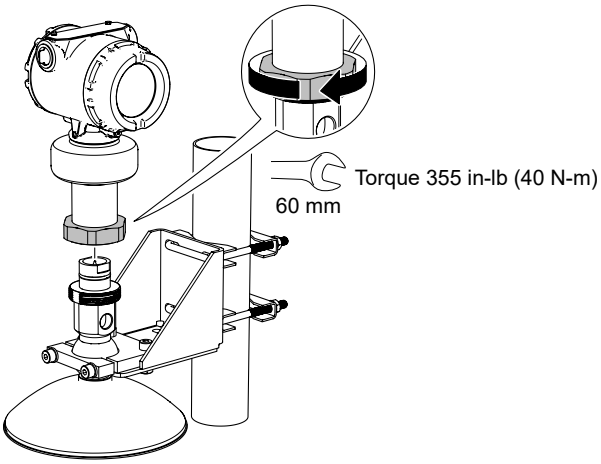
5. Gradually tighten the two M8 screws.



6. Remove the circular level.



7. Mount the transmitter head.



Postrequisites

1. Connect the air purging system.

Related information

Connect the air purging

3.7.7 Adjust the inclination of the antenna

Prerequisites

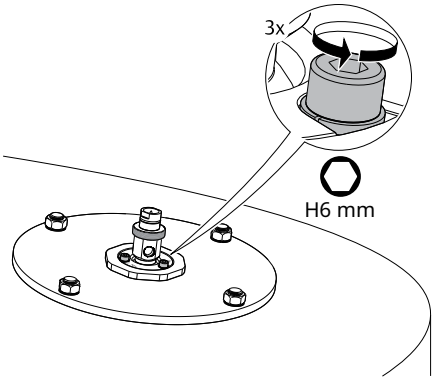
⚠ WARNING

Contents may be under pressure.

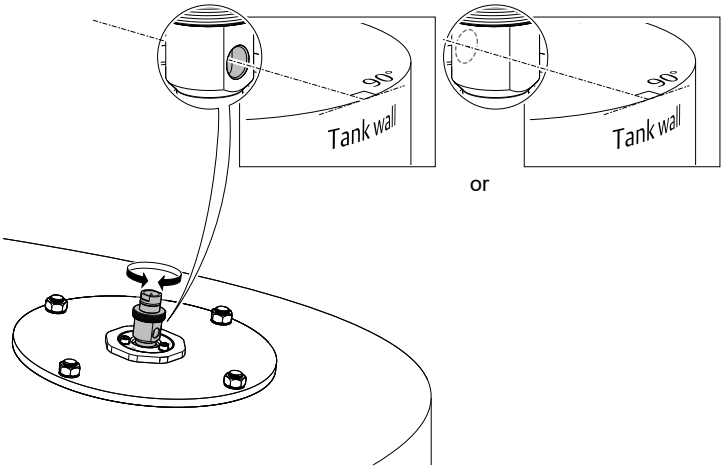
Do not loosen the M8 screws while in operation. Attempting to do so may release pressurized gases, resulting in serious injury or death.

Procedure

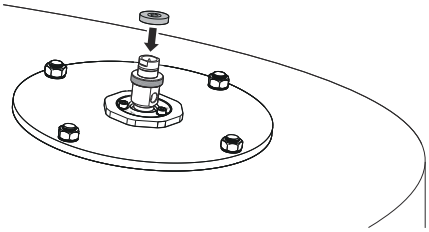
1. Loosen the M8 screws until the antenna can rotate smoothly.



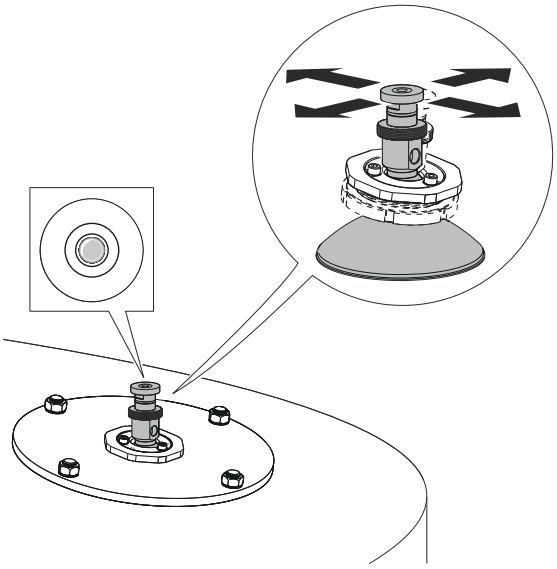
2. Rotate the antenna so the air purge connection is directed toward the tank wall.



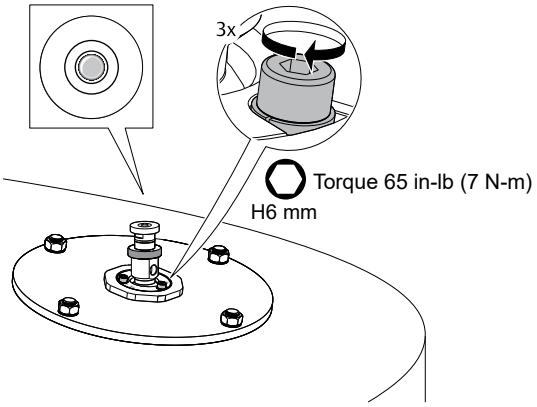
3. Place the supplied circular level on top of the antenna assembly.



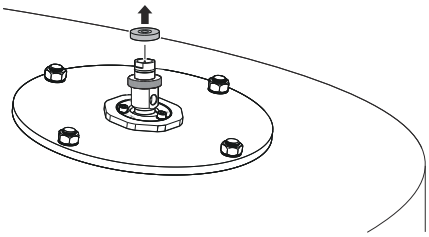
4. Adjust the inclination of the antenna.



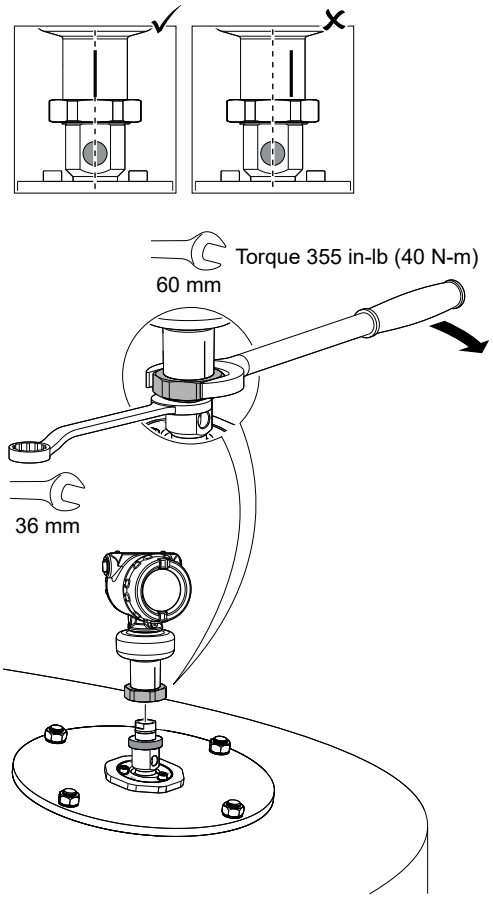
5. Gradually tighten the M8 screws.



6. Remove the circular level.



7. Mount the transmitter head.
   Align the marking on the sensor module with the air purge connection.

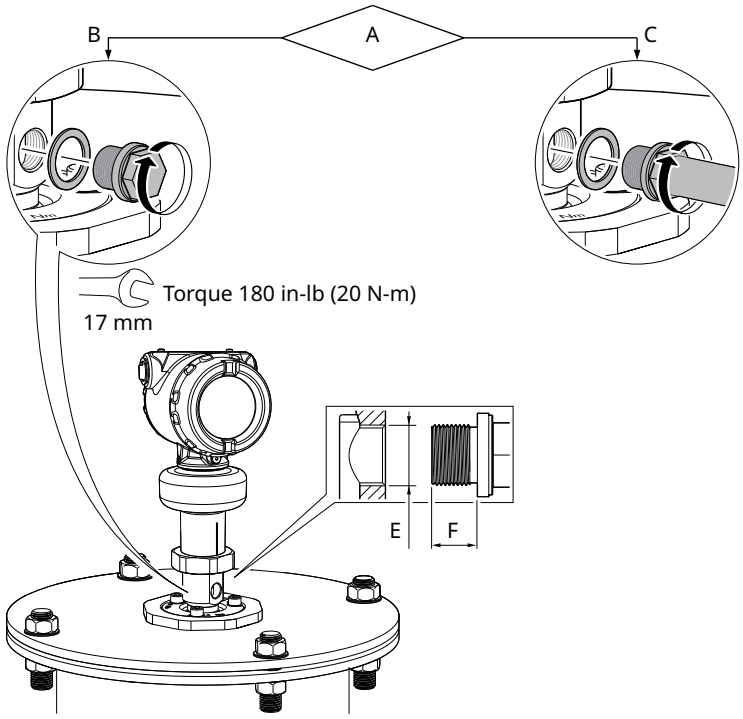


3.7.8 Connect the air purging

Procedure

- If air purging is not used, plug and seal the entry with the purge plug kit.

Figure 3-22: Air Purging



A. Air purging?
B. No
C. Yes
D. Use thread sealant or gasket according to your site procedures.
E. G⅜-in.
F. 0.3-0.4 in. (8-10 mm) (gasket excluded)

Related information

Incoming air supply specification

3.8 Adjust display orientation (optional)

To improve field access to wiring or to better view the optional LCD display:

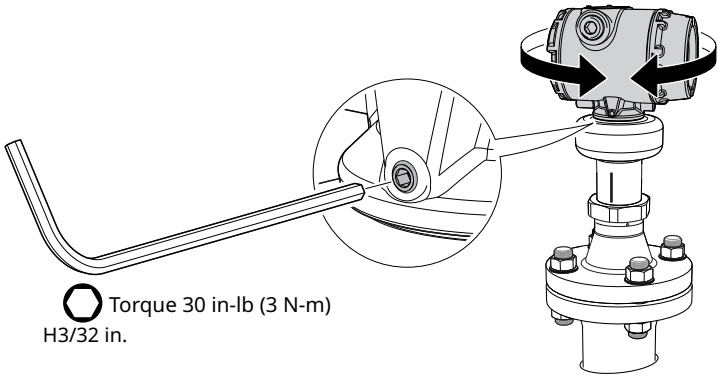
Prerequisites

Note
In high vibration applications, the transmitter housing must be fully engaged into the sensor module to meet the vibration test specifications. This is achieved by rotating the transmitter housing clockwise to thread limit.

Procedure

1. Loosen the set screw until the transmitter housing can rotate smoothly.
2. First, rotate the housing clockwise to the desired location. If the desired location cannot be achieved due to thread limit, rotate the housing counterclockwise to the desired location (up to 360° from thread limit).
3. Re-tighten the set screw.

Figure 3-23: Rotate the Transmitter Housing



4 Electrical installation

4.1 Safety messages

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that potentially raises safety issues is indicated by a warning symbol (⚠). Refer to the following safety messages before performing an operation preceded by this symbol.

⚠ WARNING

Failure to follow safe installation and servicing guidelines could result in death or serious injury.

Ensure the transmitter is installed by qualified personnel and in accordance with applicable code of practice.

Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment.

For installations in hazardous locations, the transmitter must be installed according to the Rosemount 5408 Product Certifications document and System Control Drawing.

⚠ WARNING

Explosions could result in death or serious injury.

Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.

Before connecting a handheld communicator in an explosive atmosphere, ensure that the instruments are installed in accordance with intrinsically safe or non-incendive field wiring practices.

In Explosion-proof/Flameproof and Non-Incendive/Type n installations, do not remove the transmitter covers when power is applied to the unit.

Both transmitter covers must be fully engaged to meet Explosion-proof/Flameproof requirements.

⚠ WARNING

Electrical shock could cause death or serious injury.

In Explosion-proof/Flameproof and Non-Incendive/Type n installations, avoid contact with the leads and terminals. High voltage that may be present on leads can cause electrical shock.

Ensure the mains power to the transmitter is off and the lines to any other external power source are disconnected or not powered while wiring the transmitter.

4.2 Hazardous areas

When the transmitter is installed in hazardous areas, local regulations, and specifications in applicable certificates must be observed.

Related information

Product certifications

4.3 Prepare the electrical connections

4.3.1 Cable selection

Use 24-14 AWG wire. Twisted pairs and shielded wiring are recommended for environments with high EMI (electromagnetic interference).

Use wire rated at least 5 °C above maximum ambient temperature.

Two wires can be safely connected to each terminal screw.

4.3.2 Cable gland/conduit

For explosion-proof/flameproof installations, only use cable glands or conduit entry devices certified explosion-proof or flameproof.

4.3.3 Power consumption

Max. 1 W, current max. 23 mA

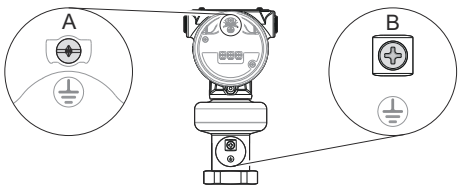
4.3.4 Grounding

Make sure grounding is done according to national and local electrical codes. Failure to do so may impair the protection provided by the equipment.

Transmitter housing

The most effective grounding method is direct connection to earth ground with minimal impedance. There are two grounding screw connections provided (see Figure 4-1).

Figure 4-1: Ground Screws



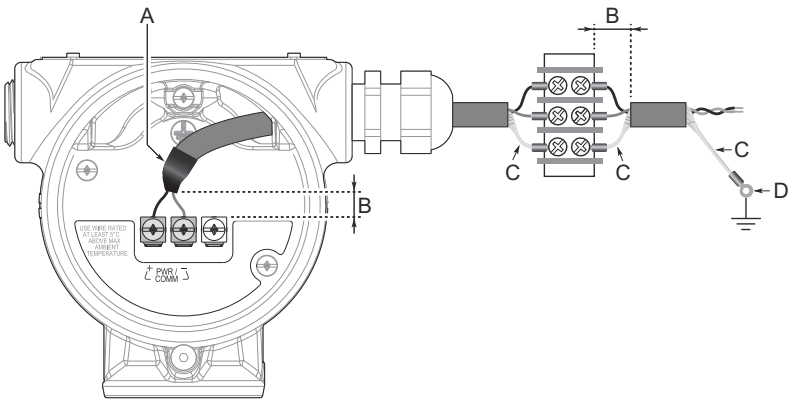
A. Internal ground screw
B. External ground screw

Cable shield grounding

Make sure the instrument cable shield is:

- Trimmed close and insulated from touching the transmitter housing.
- Continuously connected throughout the segment.
- Connected to a good earth ground at the power supply end.

Figure 4-2: Cable Shield



A. Insulate shield and drain wire
B. Minimize distance
C. Trim shield and insulate exposed drain wire
D. Connect drain wire to the power supply ground

Note
Do not ground the shield and its drain wire at the transmitter. If the cable shield touches the transmitter housing, it can create ground loops and interfere with communications.

4.3.5 Power supply

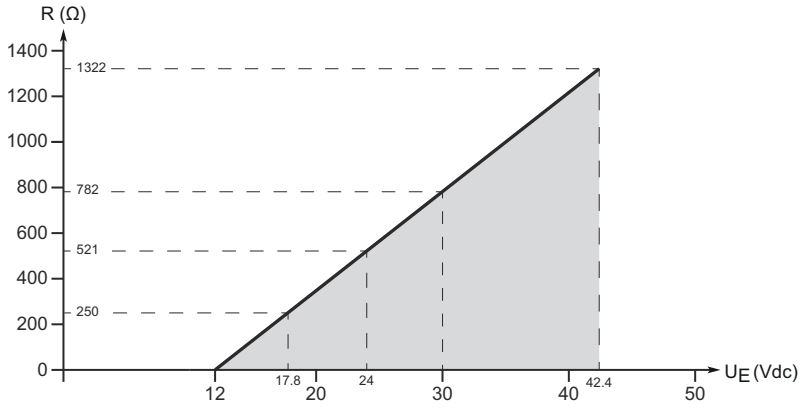
The transmitter operates on 12-42.4 Vdc transmitter terminal voltage (12-30 Vdc in Intrinsically Safe installations).

4.3.6 Load limitations

For HART® communication, a minimum loop resistance of 250 Ω is required. Maximum loop resistance (R) is determined by the voltage level of the external power supply (U_E):

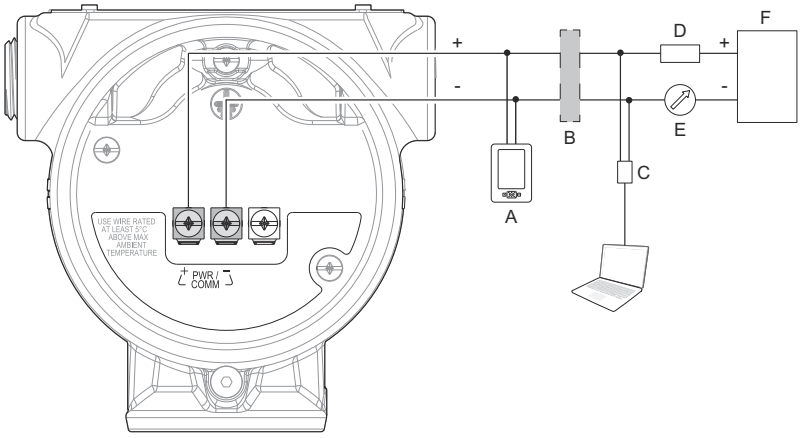
$R = 43.5 \times (U_E - 12)$

Figure 4-3: Load Limits



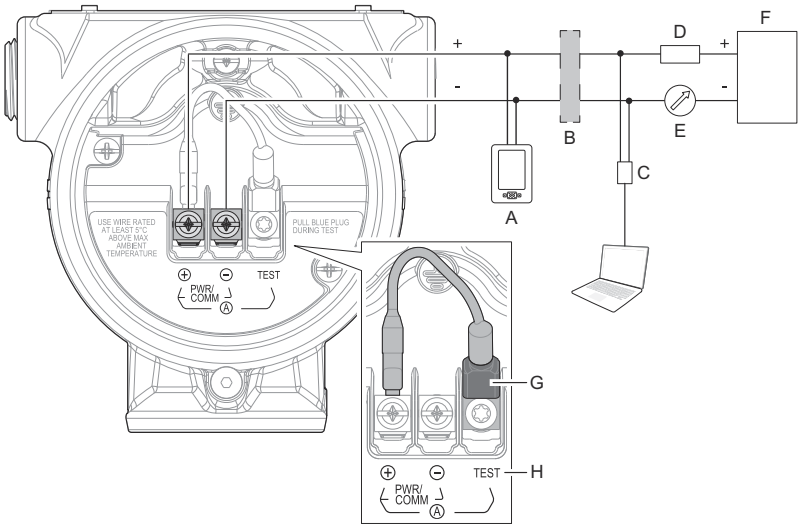
4.3.7 Wiring diagram

Figure 4-4: 4-20 mA/HART® Communication



A. Handheld communicator
B. Approved IS barrier (for Intrinsically Safe installations only)
C. HART modem
D. Load resistance (≥250 Ω)
E. Current meter
F. Power supply

Figure 4-5: 4-20 mA/HART Communication - Terminal Block with TEST Terminal



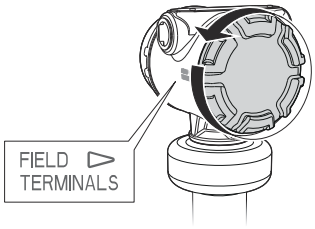
A. Handheld communicator
B. Approved IS barrier (for Intrinsically Safe installations only)
C. HART modem
D. Load resistance (≥250 Ω)
E. Current meter
F. Power supply
G. Blue plug
H. TEST terminal

Note
Disconnect the blue plug only during the loop current measurement procedure.

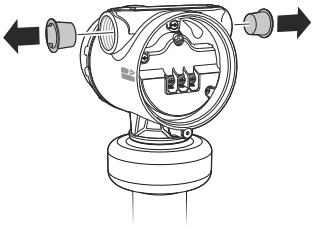
4.4 Connect wiring and power up

Procedure

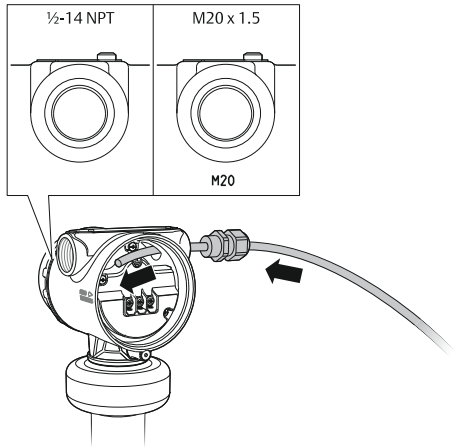
1. ⚠ Verify the power supply is disconnected.
2. Remove the cover.



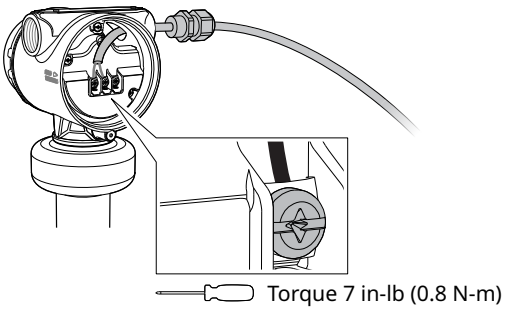
3. Remove the plastic plugs.



4. Pull the cable through the cable gland/conduit.(2)
   Identification of thread size and type:



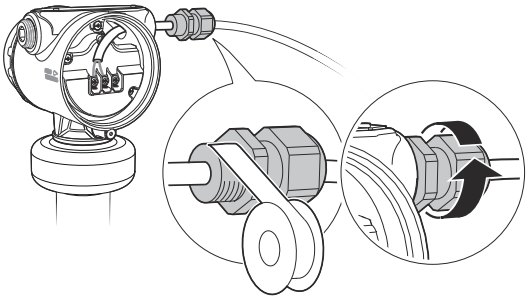
5. Connect the cable wires.



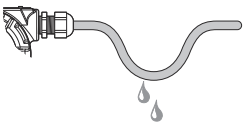
6. Ensure proper grounding.

(2) Unless marked, the conduit/cable entries in the transmitter housing use a ½–14 NPT thread form.

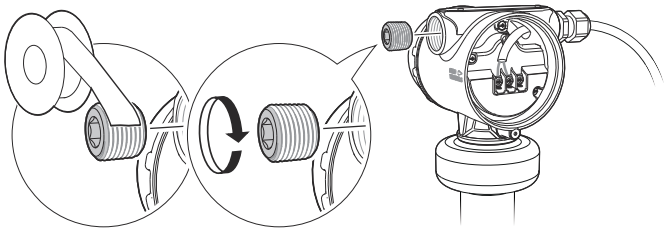
7. Tighten the cable gland.
   Apply PTFE tape or other sealant to the threads.



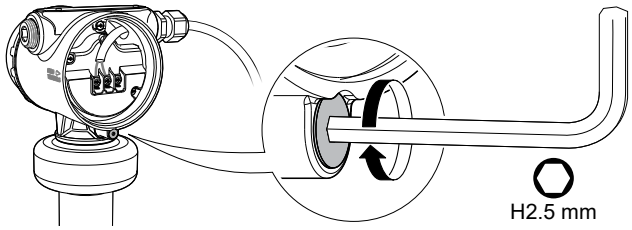
Note
Make sure to arrange the wiring with a drip loop.



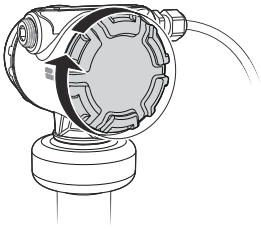
8. Seal any unused port with the enclosed metal plug.
   Apply PTFE tape or other sealant to the threads.



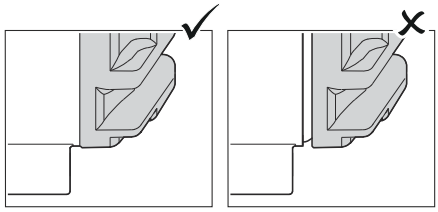
9. Attach and tighten the cover.
   a) Verify the cover jam screw is completely threaded into the housing.



b) Attach and tighten the cover.

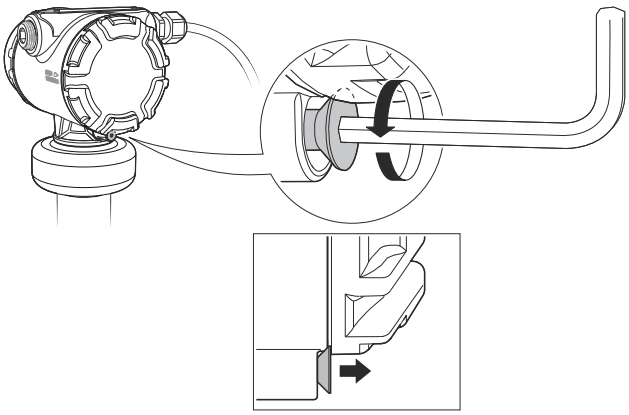


Note
Make sure the cover is fully engaged. There should be no gap between the cover and the housing.



c) Turn the jam screw counterclockwise until it contacts the cover.

Note
Required for explosion-proof/flameproof installations only.



d) Turn the jam screw an additional ½ turn counterclockwise to secure the cover.

10. Connect the power supply.

Note
It may take up to 15 seconds before the LCD display lights up.

4.5 Optional devices

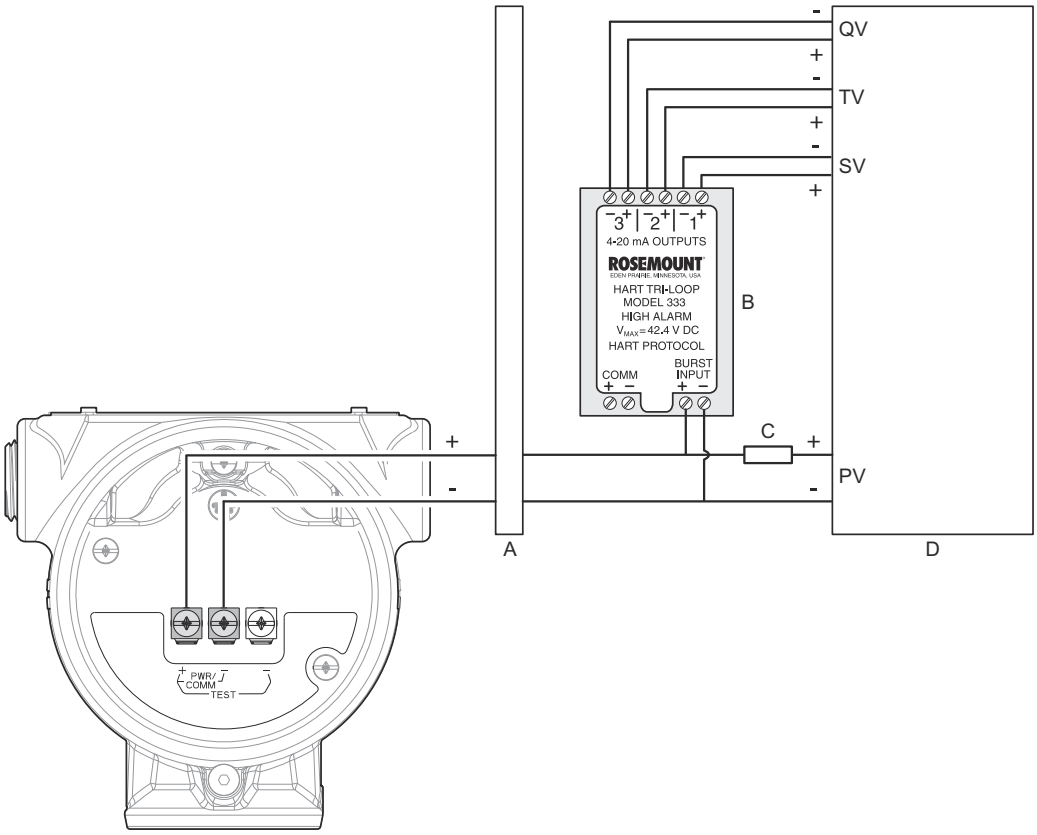
4.5.1 Rosemount™ 333 HART® Tri-Loop™

The Rosemount 5408 outputs a HART signal with four process variables. By using the Rosemount 333 HART Tri-Loop, up to three additional analog 4-20 mA outputs are provided.

Each Tri-Loop channel receives power from control room. Channel 1 must be powered for the Tri-Loop to operate.

The transmitter receives power from control room.

Figure 4-6: Example Installation of Rosemount 333 with Rosemount 5408



A. Approved IS barrier
B. DIN rail mounted Rosemount 333
C. Load resistance (≥250 Ω)
D. Control room

Related information

Rosemount 333 Reference Manual

5 Configuration

5.1 Safety messages

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that potentially raises safety issues is indicated by a warning symbol (⚠). Refer to the following safety messages before performing an operation preceded by this symbol.

⚠ WARNING

Explosions could result in death or serious injury.

Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.

Before connecting a handheld communicator in an explosive atmosphere, ensure that the instruments are installed in accordance with intrinsically safe or non-incendive field wiring practices.

In Explosion-proof/Flameproof and Non-Incendive/Type n installations, do not remove the transmitter covers when power is applied to the unit.

Both transmitter covers must be fully engaged to meet Explosion-proof/Flameproof requirements.

⚠ WARNING

Electrical shock could cause death or serious injury.

In Explosion-proof/Flameproof and Non-Incendive/Type n installations, avoid contact with the leads and terminals. High voltage that may be present on leads can cause electrical shock.

5.2 Overview

This chapter provides information about configuration and configuration tools. Appendix Configuration parameters provides extended information about the configuration parameters.

5.3 Configuration tools

- Field Device Integration (FDI) compliant systems
- Device Descriptor (DD) compliant systems
- Device Type Manager (DTM™) compliant systems

5.4 Confirm correct device driver

Procedure

1. Verify that the correct FDI/DD/DTM Package is loaded on your systems to ensure proper communication.
2. Download the latest FDI/DD/DTM Package at Emerson.com/DeviceInstallKits or FieldCommGroup.org.

Related information

NAMUR NE 53 revision history

5.5 Rosemount Radar Master Plus

Rosemount Radar Master Plus is the recommended tool for configuration. It is a User Interface Plug-in (UIP) that includes basic configuration options, as well as advanced configuration and service functions. An FDI or DTM compliant host is needed to run Rosemount Radar Master Plus.

Related information

Emerson.com/RosemountRadarMasterPlus

5.5.1 Download AMS Device Configurator

AMS Device Configurator is a software for configuration of Emerson field devices using FDI technology.

Procedure

Download the software at Emerson.com/AMSDeviceConfigurator.

5.5.2 Add the FDI Package to AMS Device Configurator

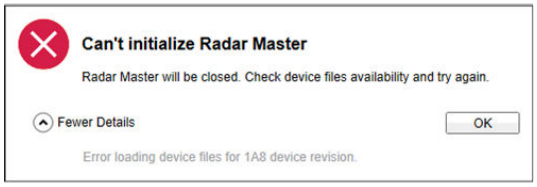
Procedure

1. Start **AMS Device Configurator**.
2. At the top left, click the menu icon and select **Add Device Package**.

3. Browse to the downloaded FDI Package and select **Open**.
4. Select **Add**.
5. Select **Back**.

5.5.3 Radar Master error message

If the `Can't initialize Radar Master` error message occurs, then the software revision on your device requires an update of the Rosemount Radar Master Plus FDI Package.



5.6 Confirm HART® revision capability

If using HART based control or asset management systems, confirm the HART capability of those systems prior to transmitter installation. Not all systems are capable of communicating with HART Revision 7 protocol. This transmitter can be configured for either HART Revision 6 or Revision 7.

5.6.1 Switch HART® revision mode

If the HART configuration tool is not capable of communicating with HART Revision 7, the device will load a generic menu with limited capability. To switch the HART revision mode from the generic menu:

Procedure

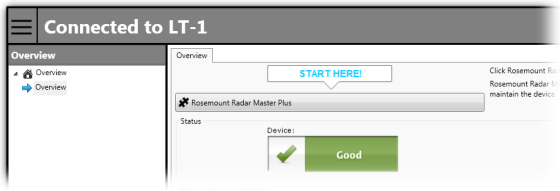
1. Locate the "Message" field.
2. In the Message field, enter **HART6** or **HART7** and then 27 trailing spaces.

5.7 Configure transmitter using guided setup

The options available in the Guided Setup wizard include all items required for basic operation.

Procedure

1. If using an FDI compliant software, then select **Overview** → **Rosemount Radar Master Plus**.



2. Select **Configure** → **Guided Setup** and follow the on-screen instructions.

Related information

Save a backup file of the device configuration

5.8 Run verify level

The Verify Level tool matches the product level reported by the device to a reference measurement (for example hand-dipping with a measurement tape).

If any difference, the Calibration Offset parameter will be adjusted. A minor adjustment using Calibration Offset is normal. There may, for example be a deviation between the actual tank height and the configured value.

Verify Level may also be run in an empty tank. Besides the offset calibration, it includes some setup of the signal processing such as registration of disturbance echoes.

Prerequisites

Ensure that:

- The product surface is calm.
- The tank is not being filled or emptied.
- The actual level is well above the tank bottom.

Procedure

1. Select **Configure** → **(Guided Setup)** → **Verify Level**.
2. Follow the on-screen instructions.

Related information

Calibration offset

5.9 Multidrop communication

Multidropping transmitters refers to the connection of several transmitters to a single communications transmission line. Communication between the host and the transmitters takes place digitally with the analog output of the transmitters deactivated.

5.9.1 Establish multidrop communication

In multidrop communication, each transmitter in the loop must have a unique HART address.

Procedure

1. Select **Configure** → **(Manual Setup)** → **Device Setup** → **HART**.
2. Select **Change Address** (not applicable to Rosemount Radar Master Plus).
3. Enter the desired HART address.
4. Ensure that **HART Multidrop** is selected.

5.10 Use with the Rosemount 333 HART® Tri-Loop™

To prepare the transmitter for use with a Rosemount 333 HART Tri-Loop, the transmitter must be configured to Burst Mode and the process variable output order must be set.

Prerequisites

The operational mode on the Rosemount 5408:SIS must be set to Control/Monitoring when used with the Rosemount 333 HART Tri-Loop.

Burst Mode configuration is possible via host systems supporting Device Descriptors (DD).

Procedure

1. Make sure the transmitter is properly configured.
2. If desired, change the measurement units.
   a) Select **Configure** → **Manual Setup** → **Device Setup** → **Units**.
3. Set the desired device variable to use for Primary Variable (PV), Secondary Variable (SV), Third Variable (TV), and Fourth Variable (QV).
   a) Select **Configure** → **Manual Setup** → **Device Setup** → **HART**.
   b) Under ***Variable Mapping***, select variables for PV, SV, TV, and QV.
4. Set the Rosemount 5408 to Burst Mode.
   - HART Revision 6:
     a. Select **Configure Burst Mode**.
     b. Under ***Burst Mode***, select **On**.
     c. Under ***Burst Command***, select **PV, SV, TV, QV**.
     d. Select **Send**.
   - HART Revision 7:
     a. Select **Configure Burst Mode**.
     b. Select **View/Configure Message 1**.
     c. Under ***Message 1 Broadcast***, select **Wired HART Enabled**.
     d. Under ***Burst Command***, select **PV, SV, TV, QV**, and then select **Next**.
     e. Under ***Burst Msg Trigger Mode***, select **Continuous**, and then select **Next**.
     f. Set the Update Period, and then select **Finish**.
5. Prior to exiting the configuration, note the selected variables for SV, TV, and QV, and the units set for each of the variables. The same configuration must be used for the Rosemount 333.

Related information

Rosemount 333 Reference Manual

5.11 Write protect a transmitter

The transmitter can be write protected (with or without a password) to prevent unauthorized changes.

Prerequisites

If the transmitter is configured for use in Safety (SIS) operational mode, then the Safety Mode must be enabled for the transmitter to become operational. When Safety Mode is enabled, the transmitter is write protected to prevent unauthorized changes.

Procedure

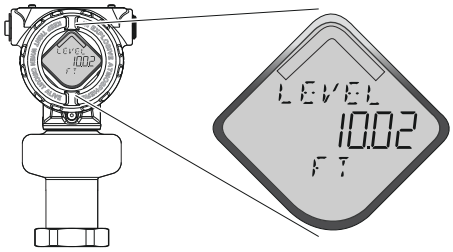
1. Select **Overview** → **Device Information** → **Alarm and Security**.
2. Under ***Security***, select **Change Write Protection** and follow the on-screen instructions.

6 Operation

6.1 LCD display screen messages

The optional LCD display shows output variables and abbreviated diagnostic messages.

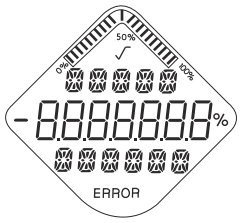
Figure 6-1: LCD Display



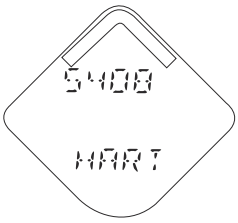
Startup screen sequence

The following screens are shown on the LCD display when the transmitter is switched on:

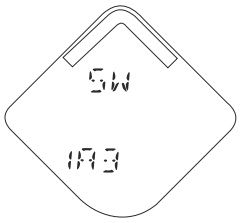
Figure 6-2: Startup Screen Sequence



1. All segments on

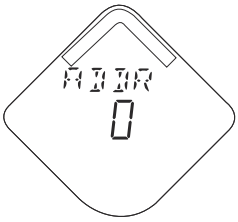


2. Device type and communication protocol



3. Software revision

4. Serial number



5. Device HART address

6.1.1 Variable screens

The transmitter can display the following variables:

Table 6-1: LCD Display Variables

Parameter	Presentation on display	Description
Level	LEVEL	The current level measurement value.
Distance	DIST	Distance from the upper reference point to the product surface.
Level rate	LR	The current velocity at which the level is moving. A positive value indicates the surface is moving up.
Signal strength	AMP	The signal amplitude of the surface echo.
Volume	VOLUM	Volume of the product at the current level.
Electronics temperature	ITEMP	The current temperature at the electronics.
Signal quality (1)	SIG QUALITY	The quality of product surface echo signal compared to surface threshold and noise.
Scaled variable(1)	SCALE(2)	A variable calculated from a scaling table (as defined by pairs of input/ scaled values).
Percent of range primary variable	PV %RANGE	A variable value expressed in percent within a range defined by a Lower Range Value (LRV) and an Upper Range Value (URV).
Auxiliary percent of range	AUX %RANGE	A variable value expressed in percent within a range defined by the lower and upper range values (0% Auxiliary and 100% Auxiliary).
User defined variable(1)	USER(2)	A variable associated with a selected register in the device.
Loop current	AOUT	Loop current as perceived by the device.

(1) Only for transmitters ordered with Smart Diagnostics Suite.
(2) Default, user selectable display text (up to five characters).

Related information

User defined variable setup

6.2 Select the display variables

It is possible to specify the variables to be presented on the optional LCD display.

Procedure

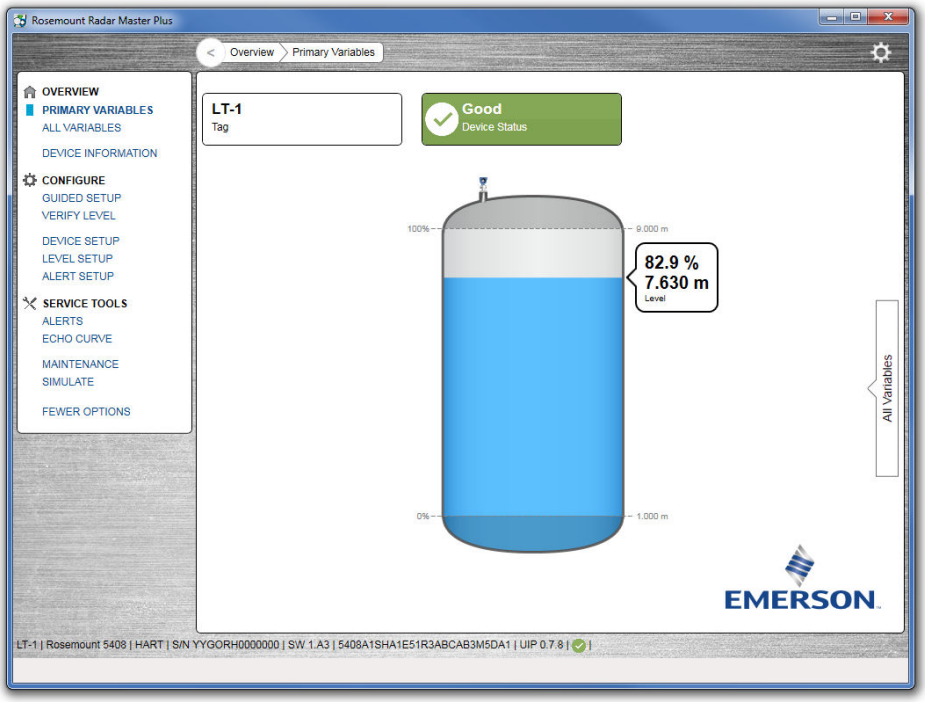
1. Select **Configure** → **(Manual Setup)** → **Device Setup** → **Display**.
2. Select the desired variables to be displayed on the LCD display.

6.3 View measurement data

Procedure

1. Select **Overview** → **Primary Variables**.

Figure 6-3: Overview Screen in Rosemount Radar Master Plus



2. Optional: Select **Overview** → **All Variables** (**Service Tools** → **Variables** in DD).

6.3.1 Interpret measurement status

A “Good” or “Bad” status next to a value is an indication of the reliability or integrity of the data being received, not an indication of whether or not the value is within the configured upper or lower ranges. A value that triggers an alert, such as a high or low temperature indication, will change the overall status of the device, but the measurement might still be indicated as “Good” if the reliability of the data is good.

Figure 6-4: Measurement Status Bars

6.4 Check device status

The device reports diagnostic alerts when there is a device malfunction.

Procedure

1. Go to the **Overview** screen to view the overall device status.

2. If status is anything other than Good, select the button in the device status image to open a window with Active Alerts.

   Active Alerts can also be obtained via **Service Tools** → **Alerts**.

Related information

Diagnostic messages per NAMUR NE 107

6.4.1 Device status images

Table 6-2: Device Status Images in DD

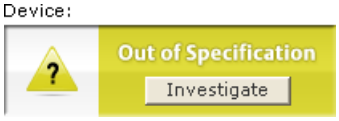
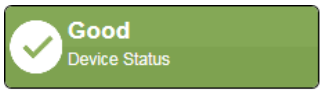
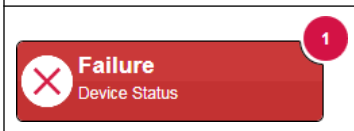
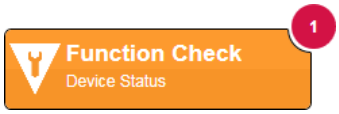
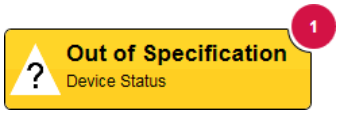
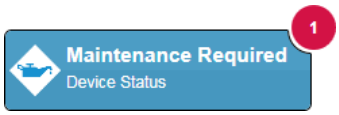
Device status image	Category	Description	Action
	Good	No active alert.	N/A
	Failure	At least one Failure alert is active.	Click the **Troubleshoot** button to open a window with active alerts together with recommended actions.
	Function Check	At least one Function Check alert is active (and no Failure alerts).	Click the **Investigate** button to open a window with active alerts together with recommended actions.
	Out of Specification	At least one Out of Specification alert is active (and no Failure or Function Check alerts).	
	Maintenance Required	At least one Maintenance Required alert is active (and no Failure, Function Check, or Out of Specification alerts).	

Table 6-3: Device Status Images in UIP (Rosemount Radar Master Plus)

Device status image	Category	Description	Action
	Good	No active alert.	N/A
	Failure	At least one Failure alert is active.	Click the device status image to open a window with active alerts together with recommended actions.
	Function Check	At least one Function Check alert is active (and no Failure alerts).	
	Out of Specification	At least one Out of Specification alert is active (and no Failure or Function Check alerts).	
	Maintenance Required	At least one Maintenance Required alert is active (and no Failure, Function Check, or Out of Specification alerts).	

6.5 Smart echo level test

The function allows you to test the behavior of the transmitter in a real tank environment without raising the level. During the test, a virtual surface echo is superimposed onto the radar signal, and the transmitter will output a level corresponding to the echo position.

The test verifies the integrity of the signal processing, and can be used to test the alarm limits in the host system, output of the transmitter, and transmitter configuration (for example the upper/lower range values).

Related information

Rosemount 5408:SIS Safety Manual

6.5.1 Configure the smart echo level

Prerequisites

This test is available for transmitters with:

- Device software revision 1.C0 or later
- Option code ET
- Rosemount Radar Master Plus

Procedure

1. Select **Service Tools** → **Proof Test**.
2. Select **Configure Smart Echo**.
3. In the **Smart Echo Level** box, enter the desired value.
4. Select **Save**.

6.5.2 Perform a smart echo level test

During the test, a virtual surface echo is superimposed onto the radar signal, and the transmitter will output a level corresponding to the echo position.

Prerequisites

This test is available for transmitters with:

- Device software revision 1.C0 or later
- Option code ET
- Rosemount Radar Master Plus

Prior to and during the test, ensure that:

- The product surface is calm.
- The smart echo level is not closer than 1 ft. (0.3 m) to the liquid surface (3.3 ft. [1 m] for the extended range option and 5 ft. [1.5 m] when measuring solids).
- The tank is not being filled or emptied.

⚠ WARNING

During the test, the transmitter will not output measurement values corresponding to the product surface level. Ensure systems and people relying on measurement values from the transmitter are made aware of the changed conditions. Failure to do so could result in death, serious injury and/or property damage.

Procedure

1. Select **Service Tools** → **Proof Test**.
2. Select **Smart Echo Level Test**.
3. Select **Start** and follow the on-screen instructions.

Postrequisites

When you have finished testing, select **Stop** to return to normal operation.

Related information

Simulation/test active

7 Service and troubleshooting

7.1 Safety messages

Instructions and procedures in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that potentially raises safety issues is indicated by a warning symbol (⚠). Refer to the following safety messages before performing an operation preceded by this symbol.

⚠ WARNING

Failure to follow safe installation and servicing guidelines could result in death or serious injury.

Ensure the transmitter is installed by qualified personnel and in accordance with applicable code of practice.

Use the equipment only as specified in this manual. Failure to do so may impair the protection provided by the equipment.

⚠ WARNING

Explosions could result in death or serious injury.

Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.

Before connecting a handheld communicator in an explosive atmosphere, ensure that the instruments are installed in accordance with intrinsically safe or non-incendive field wiring practices.

In Explosion-proof/Flameproof and Non-Incendive/Type n installations, do not remove the transmitter covers when power is applied to the unit.

Both transmitter covers must be fully engaged to meet Explosion-proof/Flameproof requirements.

⚠ WARNING

Process leaks could result in death or serious injury.

Ensure that the transmitter is handled carefully. If the process seal is damaged, gas might escape from the tank.

⚠ WARNING

Electrical shock could cause death or serious injury.

In Explosion-proof/Flameproof and Non-Incendive/Type n installations, avoid contact with the leads and terminals. High voltage that may be present on leads can cause electrical shock.

Ensure the mains power to the transmitter is off and the lines to any other external power source are disconnected or not powered while wiring the transmitter.

7.2 Diagnostic messages per NAMUR NE 107

7.2.1 Electronics failure, transmitter

Category	Failure
LCD display message	ELEC FAILUR

Cause

An electronics error has occurred.

The device measurement reading is invalid.

Recommended actions

1. Restart the device.
2. If the condition persists, replace the device.

Related information

Restart the device

7.2.2 Electronics failure, sensor module

Category	Failure
LCD display message	ELEC FAILUR

Cause

An electronics error has occurred.

The device measurement reading is invalid.

Recommended actions

1. Restart the device.
2. If the condition persists, replace the device.

Related information

Restart the device

7.2.3 Device memory failure

Category	Failure
LCD display message	MEMRY FAILUR

Cause

A device memory error has occurred.

The device measurement reading is invalid.

Recommended actions

1. Restore default settings, restart device, and reconfigure the device.
2. If the condition persists, replace the device.

Related information

Restore to default settings
Restart the device
Configure transmitter using guided setup

7.2.4 Radar signal failure

Category	Failure
LCD display message	SIGNL FAILUR

Cause

The received radar signal is invalid resulting in an invalid device measurement reading.

Recommended actions

1. Clean the antenna.
2. If the condition persists, replace the device.

7.2.5 Startup failure

Category	Failure
LCD display message	START FAILUR

Cause

Device repeatedly failed to start up with user configuration settings.

The device measurement reading is invalid.

Recommended actions

1. Check supply voltage is within range and restart device.
2. Restore default settings, restart device, and reconfigure the device.
3. If the condition persists, replace the device.

Related information

Power supply
Restore to default settings
Restart the device
Configure transmitter using guided setup

7.2.6 Software error

Category	Failure

LCD display message	SW FAILUR

Cause

The software in the device encountered a problem and stopped running which may cause an invalid measurement reading.

In some cases, problems may be caused by temporary environmental conditions (e.g. electromagnetic interferences) and not observed again.

Recommended actions

1. Restart the device.
2. Restore default settings and reconfigure the device.
3. If the condition persists, replace the device.

Related information

Restart the device
Restore to default settings
Configure transmitter using guided setup

7.2.7 Level measurement lost

Category	Failure
LCD display message	MEAS FAILUR

Cause

No valid level reading. Reasons may be multiple:

- No valid surface echo peak in the measuring range.
- Incorrect device configuration.

Recommended actions

1. Analyze the Echo Curve at time of loss for reason and check device configuration, especially thresholds.
2. Check device physical installation (for instance antenna contamination).
3. Consider increasing Measurement Recovery Time parameter for intermittent conditions.
4. Restart the device.
5. Restore default settings and reconfigure the device.
6. If the condition persists, replace the device.

Related information

Read the echo curve
Amplitude threshold
Measurement recovery time
Restart the device
Restore to default settings
Configure transmitter using guided setup

7.2.8 Configuration error

Category	Failure
LCD display message	CONFG ERROR

Cause

The device has detected a configuration error. Reasons may be multiple.

Recommended actions

1. Click the **Details** button for more information.
2. Correct the parameter causing the error.

Volume configuration error

Cause

The volume cannot be calculated correctly with the current configuration.

Recommended actions

1. If strapping table is used, check that level-volume values are entered in increasing order.
2. If strapping table is used, check that number of strapping points to use is correct.
3. If tank dimensions are used for volume, check that geometry shape and size measures are correct.
4. If condition persists, restore default settings and reconfigure the device.

Related information

Volume
Geometry
Restore to default settings
Configure transmitter using guided setup

Scaled variable configuration error

Cause

The Scaled Variable configuration is incorrect.

Recommended actions

1. Check that the value pairs in the scaled variable table are entered in increasing order.
2. Check the number of table points to use is correct.
3. If condition persists, restore default settings, and reconfigure the device.

Related information

Scaled variable
Restore to default settings
Configure transmitter using guided setup

Geometry configuration error

Cause

The configured tank geometry results in a too large level measuring range for this device.

Recommended actions

1. Check tank geometry configuration and reduce Reference Height.
2. If condition persists, restore default settings and reconfigure the device.

Related information

Reference height
Restore to default settings
Configure transmitter using guided setup

Primary variable configuration error

Cause

The Primary Variable selection is not supported.

Note
Rosemount 5408:SIS only supports level or distance as Primary Variable.

Recommended actions

1. Change Primary Variable to variable supported by device.
2. Consider purchasing an upgrade of the device to access additional variables.

Related information

Primary variable

Measurement correction configuration error

Cause

The factory measurement correction data is invalid.

Recommended actions

1. Restore default settings and reconfigure the device.
2. If the condition persists, replace the device.

Related information

Restore to default settings
Configure transmitter using guided setup

Threshold configuration error

Cause

The surface threshold configuration is incorrect.

Recommended actions in UIP

1. Adjust the threshold as necessary.
2. If condition persists, restore default settings and reconfigure device.

Recommended actions in DD

1. In the threshold table, check that distance-threshold values are entered in increasing order.
2. Check that the number of threshold points to use is correct.
3. If condition persists, restore default settings and reconfigure the device.

Related information

Amplitude threshold
Restore to default settings
Configure transmitter using guided setup

Factory approval error

Cause

- The Sensor Module factory approval is missing.
- The Transmitter factory approval is missing.

Note
This error may also be set as a result of the startup failure. If both errors are present, then see the startup failure message.

Recommended actions

1. Restart the device.
2. Restore default settings and reconfigure device.
3. If the condition persists, replace the device.

Related information

Restart the device
Restore to default settings
Configure transmitter using guided setup

SIS configuration error

Cause

It is currently not possible to enable Safety Mode due to other active alerts.

Note
Rosemount 5408:SIS only supports liquids level measurement when operating in Safety (SIS) mode.

Recommended actions

1. Clear other active alerts by priority order until this alert is cleared.
2. Change Operational Mode to Control/Monitoring if device is not intended to be used as safety device.
3. If the condition persists, restore default settings and reconfigure device.

Related information

Rosemount 5408:SIS Safety Manual
Operational mode
Restore to default settings
Configure transmitter using guided setup

Function not supported

Cause

Functionality in the device is enabled, but not supported by this device.

Additional features may be enabled by purchasing an upgrade of the device.

Recommended actions

1. Check that selections for variables (e.g. Primary Variable) are supported by this device.
2. Turn off functionality not supported by this device.
3. Consider purchasing an upgrade of the device to access additional variables and functionality.
4. If condition persists, restore default settings and reconfigure device.

Related information

Primary variable
Restore to default settings
Configure transmitter using guided setup

Antenna type configuration error

Cause

The configured Antenna Type is not supported by the device.

Recommended actions

1. Check configuration of Antenna Type.
2. Make sure the configured antenna type matches the physical antenna for the device.

Related information

Antenna type

Factory calibration error

Cause

The factory calibration in the device is missing.

Note
This error may also be set as a result of the startup failure. If both errors are present, then see the startup failure message.

Recommended actions

Replace the device.

Analog out span configuration error

Cause

The span for the configured analog out range is too small.

Recommended actions

Increase analog out span by adjusting Upper or Lower Range Value.

Related information

Upper/lower range value

Analog out calibration error

Cause

Analog output calibration failed.

Recommended actions

1. Try calibrating the analog output again.
2. If the condition persists, replace the device.

Related information

Calibrate analog out

SIS multidrop error

Cause

HART multidrop mode is not supported for safety (SIS) devices. Only 4-20 mA output is supported for safety devices.

Recommended actions

1. Disable multidrop mode.
2. Change Operational Mode to Control/Monitoring if device is not intended to be used as safety device.
3. If the condition persists, restore default settings and reconfigure device.

Related information

Rosemount 5408:SIS Safety Manual
Operational mode
Restore to default settings
Configure transmitter using guided setup

Engineering unit configuration error

Cause

One of the configured engineering units is not supported by the device.

Recommended actions

1. Check unit configuration.
2. If condition persists, restore default settings and reconfigure device.

Related information

Units
Restore to default settings
Configure transmitter using guided setup

Burst mode configuration error

Cause

The burst mode configuration is incorrect.

Recommended actions

1. Check configuration of burst mode.
2. If condition persists, restore default settings and reconfigure device.

Related information

Burst mode
Restore to default settings
Configure transmitter using guided setup

Start code configuration error

Cause

The start code to enable options in the device is invalid.

Note
Start codes are unique for individual devices and cannot be copied from one device to another.

Recommended actions

1. Enter a valid start code for this device using the Upgrade function.
2. If condition persists, contact your local Emerson representative to get a valid start code.

7.2.9 Safety mode not activated

Category	Function Check
LCD display message	SAFE DISBLD

Cause

Safety Mode is disabled and device is in alarm mode.

This device is configured for use in Safety Instrumented Systems (SIS) which requires Safety Mode to be enabled.

Recommended actions

1. Change Safety Mode to Enabled for use in SIS application.
2. Change Operational Mode to Control/Monitoring if device is not intended to be used as safety device.

Related information

Rosemount 5408:SIS Safety Manual

7.2.10 Simulation/test active

Category	Function Check
LCD display message	SIMUL ACTIVE

Cause

The device is in simulation or test mode and is not reporting actual information.

Recommended actions

1. If this behavior is not desired, stop simulation or test mode.
2. If the condition persists, restart the device.

Related information

Use the simulation mode
Restart the device

7.2.11 Electronics temperature out of limits

Category	Out of Specification
LCD display message	TEMP LIMITS

Cause

The temperature of the electronics board has exceeded the transmitter's operating range.

Recommended actions

1. Verify ambient temperature is within the operating range.
2. Remote mount the transmitter away from the process and environmental conditions.

Related information

Ambient temperature limits

7.2.12 Supply voltage low

Category	Maintenance Required
LCD display message	SUPLY LOW

Cause

The supply voltage is low and may affect device operation.

Recommended actions

1. Check supply voltage is within range.
2. If not needed, disable this alert.

Related information

Power supply

7.2.13 Low signal quality

Category	Maintenance Required
LCD display message	LOW

SIG Q

Cause

The Signal Quality is below the defined alert limit.

Recommended actions

1. Take action based on your intended use of this alert.
2. Clean the antenna.
3. If no actions were necessary, consider to change the limit.

Related information

Signal quality alert

7.2.14 High user defined alert

Category	Maintenance Required
LCD display message	HIGH ALERT

Cause

The user defined variable is above the defined limit.

Recommended actions

1. Bring the system to a safe state.
2. Verify that the process variable is within specified limits.
3. Reconfirm the user defined alarm limit.
4. If not needed, disable this alert.

Related information

High/low user defined alert

7.2.15 Low user defined alert

Category	Maintenance Required
LCD display message	LOW ALERT

Cause

The user defined variable is below the defined limit.

Recommended actions

1. Bring the system to a safe state.
2. Verify that the process variable is within specified limits.
3. Reconfirm the user defined alarm limit.
4. If not needed, disable this alert.

Related information

High/low user defined alert

7.2.16 Linearized variable out of range

Category	Maintenance Required
LCD display message	VAR OUTRNG

Cause

The level measurement is outside the configured range for volume or scaled variable, or both.

Accuracy of volume/scaled variable measurement may be degraded.

Recommended actions

1. If volume strapping table is used, make sure level values within operating range are included.
2. If scaled variable table is used, make sure input variable values within operating range are included.

Related information

Volume
Scaled variable

7.2.17 Dielectric constant estimation degraded

Category	Maintenance Required
LCD display message	DC DEGRAD

Cause

The dielectric constant estimation is degraded.

Accuracy of level measurement may be degraded.

Recommended actions

1. Check configuration of Bottom Product Dielectric Constant.
2. Check configuration of Reference Height and Bottom Offset.
3. If not needed, disable Tank Bottom Projection.

Related information

Tank bottom projection
Reference height
Bottom offset

7.3 Troubleshooting guides

If there is a malfunction despite the absence of alerts, follow the procedures described in the appropriate troubleshooting guide. Under each of the symptoms, specific suggestions for solving problems are offered.

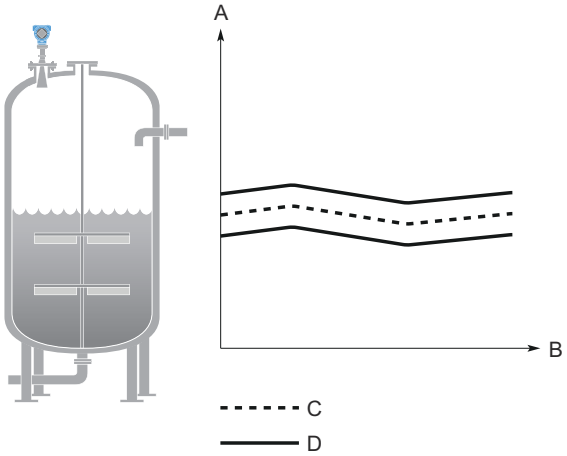
Related information

Troubleshooting incorrect level readings
Troubleshooting the 4-20 mA/HART output

7.3.1 Troubleshooting incorrect level readings

Reported level is too high or low

Figure 7-1: Symptom



A. Level
B. Time
C. Actual level
D. Reported level

Possible cause

Incorrect tank geometry configuration.

Recommended actions

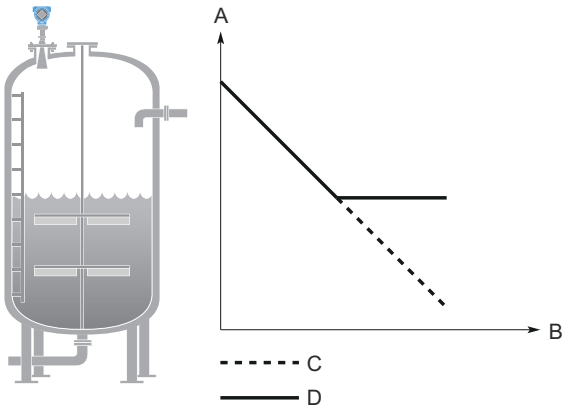
- Verify the tank geometry parameters are configured correctly (especially the Reference Height).
- Run Verify Level to adjust level measurement.
- Analyze the echo curve and check amplitude thresholds.
- Restore default settings and reconfigure the device.

Related information

Reference height
Run verify level
Read the echo curve
Amplitude threshold
Restore to default settings

Level is stuck in measuring range

Figure 7-2: Symptom



A. Level
B. Time
C. Actual level
D. Reported level

Possible cause

Incorrect alignment of the transmitter.

Recommended actions

- Verify the transmitter head is correctly aligned.

Possible cause

Disturbing object in the tank.

Recommended actions

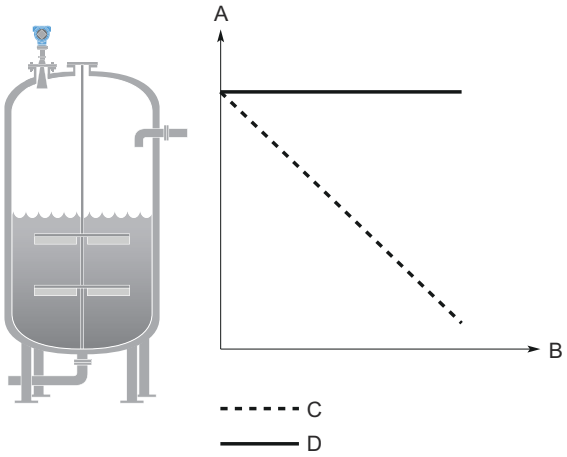
- Use the suppress false echoes function to manage strong disturbance echoes.
- Analyze the echo curve and check amplitude thresholds.
- Remove the disturbing object.
- Change alignment of transmitter head in steps of about 15 degrees. After each step, check if impact of disturbing echoes is decreased using the echo curve.
- Put an inclined metal plate on top of the disturbing object.
- Move the transmitter to another position.

Related information

Align transmitter head
Suppressing false echoes
Read the echo curve
Amplitude threshold
Installation considerations

Level is stuck in full tank

Figure 7-3: Symptom



A. Level
B. Time
C. Actual level
D. Reported level

Possible cause

Disturbing object near the antenna.

Recommended actions

- Use the suppress false echoes function to manage strong disturbance echoes.
- Analyze the echo curve and check amplitude thresholds.
- For process seal antenna installed in a nozzle taller than 10-in. (25 cm), adjust the pre-configured amplitude threshold.
- Increase the Upper Null Zone.
- Remove the disturbing object.
- Move the transmitter to another position.

Possible cause

Product build-up on the antenna.

Recommended actions

- Clean the antenna.
- Use transmitter with air purging connection.

Possible cause

Cone antenna does not extend below the nozzle.

Recommended actions

- Use the extended cone antenna.

Related information

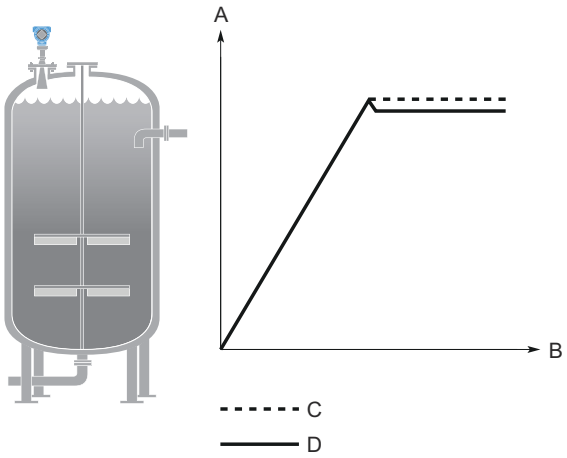
Suppressing false echoes
Read the echo curve
Amplitude threshold
Handling disturbances at top of tank
Installation considerations

Level value drops when close to antenna

Symptom

Level value drops to a lower value when product surface is close to antenna.

Figure 7-4: Symptom



A. Level
B. Time
C. Actual level
D. Reported level

Possible cause

Product surface is within the Upper Null Zone and a disturbance echo is interpreted as the product surface.

Recommended actions

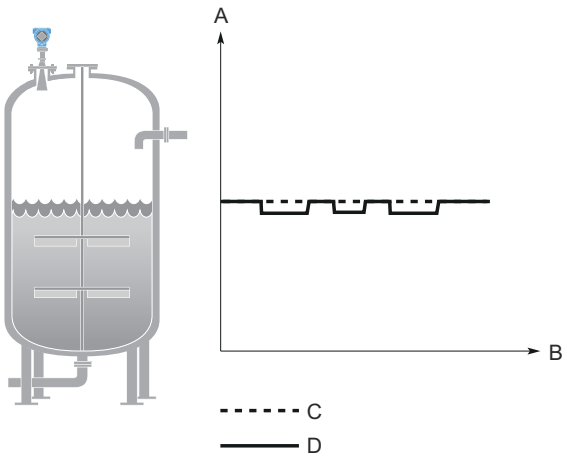
- Check the setting of the Upper Null Zone.

Related information

Upper null zone

Measured value jumps to a lower value

Figure 7-5: Symptom



A. Level
B. Time
C. Actual level
D. Reported level

Possible cause

Multiple products in the tank, e.g. thin oil layer on top of water that is sometimes detected, sometimes not.

Recommended actions

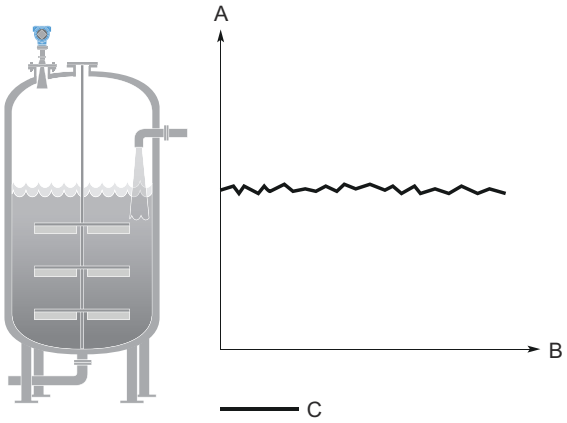
- Set Double Surface Handling to Track Upper Surface or Track Lower Surface.

Related information

Double surface handling

Measured level fluctuates

Figure 7-6: Symptom



A. Level
B. Time
C. Reported level

Possible cause

Excessive foaming or turbulence.

Recommended actions

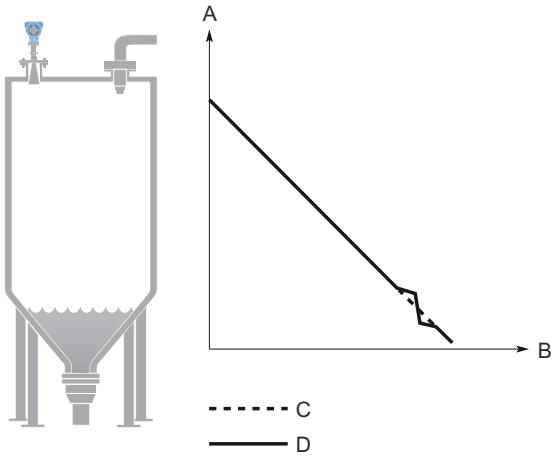
- Under turbulent conditions with low level rates, consider increasing the Damping value.
- Enable the Foam parameter or Turbulent Surface parameter, or both.

Related information

Damping value
Process conditions

Measured level is occasionally unstable

Figure 7-7: Symptom



A. Level
B. Time
C. Actual level
D. Reported level

Possible cause

The product surface is close to a suppressed false echo.

Recommended actions

- If possible, remove the disturbing object.

Related information

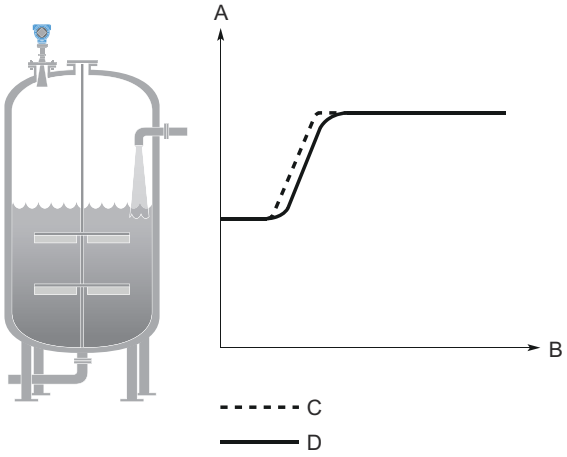
Read the echo curve

Lagging of measured level

Symptom

Measured level lags during rapid level changes.

Figure 7-8: Symptom



A. Level
B. Time
C. Actual level
D. Reported level

Possible cause

Damping value is set too high.

Recommended actions

- If there is a problem with lag during rapid level changes, consider decreasing the Damping value.

Possible cause

Maximum Level Rate value too low.

Recommended actions

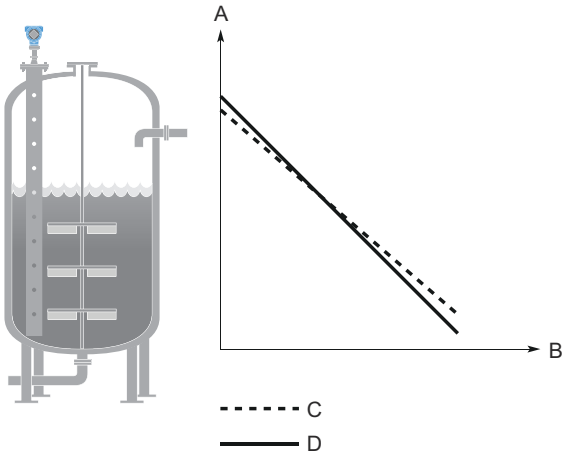
- Verify Maximum Level Rate configuration.

Related information

Damping value
Maximum level rate

Incorrect level when using still pipe

Figure 7-9: Symptom



A. Level
B. Time
C. Actual level
D. Reported level

Possible cause

Device is not configured for still pipe measurement.

Recommended actions

- Enable pipe measurement.

Possible cause

Incorrect Pipe Inner Diameter configuration.

Recommended actions

- Verify the configured Pipe Inner Diameter matches the physical inner diameter.

Possible cause

Ghost echo problems below the product surface.

Recommended actions

- Enable the Track First Echo function.

Related information

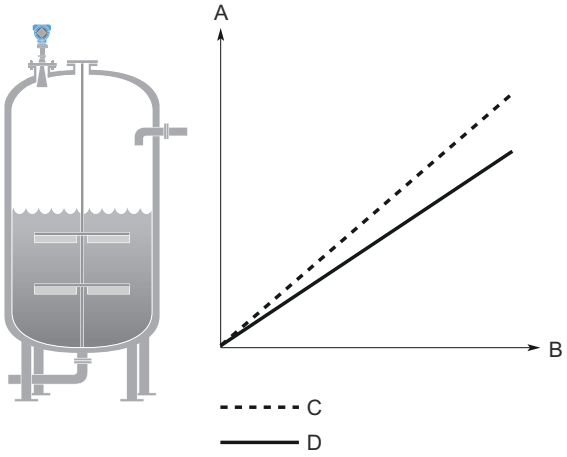
Mounting type
Inner diameter, pipe/chamber
Handling ghost echoes in still pipes

Incorrect level at 100% (20 mA)

Symptom

Measured level is correct at 0% (4 mA) but incorrect at 100% (20 mA).

Figure 7-10: Symptom



A. Level
B. Time
C. Actual level
D. Reported level

Possible cause

Upper Range Value is not set correctly.

Recommended actions

- Check that the Upper Range Value matches the 100% (20 mA) level in the tank.

Related information

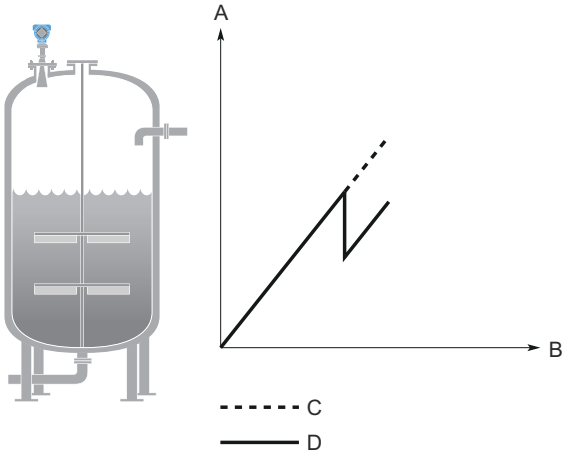
Upper/lower range value

Incorrect level when product surface is above 50%

Symptom

The reported level is incorrect when the product surface is above the 50% level.

Figure 7-11: Symptom



A. Level
B. Time
C. Actual level
D. Reported level

Possible cause

A strong double bounce echo is interpreted as the product surface.

Recommended actions

- Enable the Double Bounce Handling function.

Related information

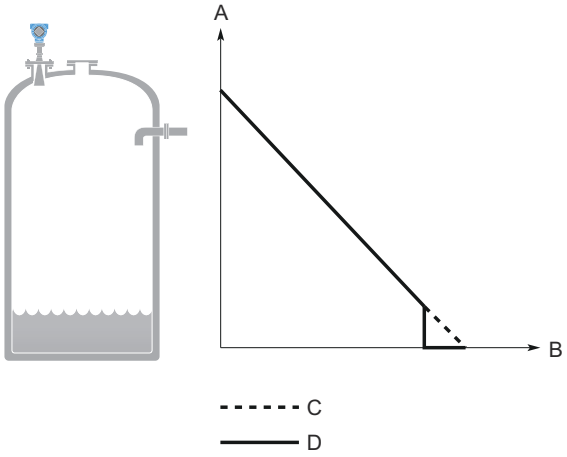
Handling strong double bounce echoes

Dropping of level close to tank bottom

Symptom

Measured value drops to zero level in the tank bottom region.

Figure 7-12: Symptom



A. Level
B. Time
C. Actual level
D. Reported level

Possible cause

Transmitter has locked on a strong tank bottom echo.

Recommended actions

- Verify the Reference Height is configured correctly.
- Enable the Tank Bottom Projection function
- Enable the Bottom echo visible when tank is empty parameter.

Related information

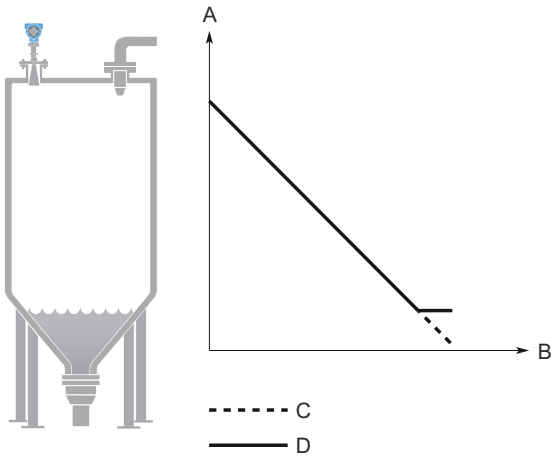
Reference height
Use tank bottom projection
Enable bottom echo visible when tank is empty

Alarm mode close to tank bottom

Symptom

When the product surface is near the sloped tank bottom, the transmitter enters alarm mode.

Figure 7-13: Symptom



A. Level
B. Time
C. Actual level
D. Reported level

Possible cause

Reduction of projected surface area close to sloping tank bottom.

Recommended actions

- Verify the tank geometry parameters are configured correctly (especially the Reference Height and Bottom Offset).
- If measurement in this region is not crucial, increase the Empty Tank Detection Area.
- Verify the Bottom echo visible when tank is empty parameter is disabled.

Related information

Reference height
Bottom offset
Empty tank handling
Enable bottom echo visible when tank is empty

7.3.2 Troubleshooting the 4-20 mA/HART output

Device milliamp reading is zero

Recommended actions

1. Verify power is applied to signal terminals.

2. Verify power supply voltage is adequate at signal terminals.
3. Verify device and power supply are properly grounded.

Related information

Power supply
Grounding

Device milliamp reading is too low or high

Recommended actions

1. Verify level.
2. Check the settings of the 4-20 mA range values.
3. Verify output is not in alarm condition.
4. Check that power wires are connected to the correct signal terminals.
5. Perform Calibrate Analog Out.

Related information

Upper/lower range value
Alarm mode
Calibrate analog out

Milliamp reading is erratic

Recommended actions

1. Verify power supply voltage is adequate at signal terminals.
2. Check for external electrical interference.
3. Verify device is properly grounded.
4. Verify shield for twisted pair is only grounded at the power supply end.
5. Under turbulent conditions with low level rates, consider increasing the Damping value.

Related information

Power supply
Grounding
Damping value

Device will not respond to changes in level

Recommended actions

- Verify level is between the 4 and 20 mA set points.
- Verify output is not in alarm condition.
- Verify device is not in loop test or simulation mode.

Related information

Upper/lower range value
Alarm mode
Check device status

There is no HART communication (lost device communication)

Recommended actions

1. Verify power supply voltage is adequate at signal terminals.
2. Check load resistance (250 ohms minimum).
3. Check if device is at an alternate HART address.
4. Check current analog output value to verify that device hardware works.
5. Verify the blue plug is attached to the TEST terminal (if applicable). When unplugged, HART communication to configuration tool may be compromised.

Related information

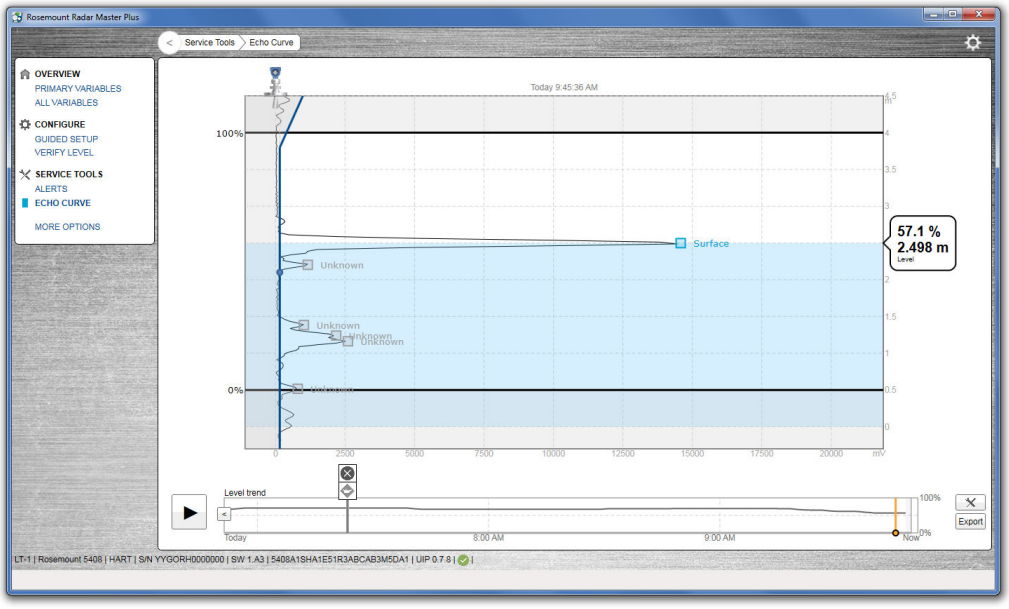
Power supply
HART/polling address
Use the TEST terminal

7.4 Service and troubleshooting tools

7.4.1 Using the echo curve

The Rosemount Radar Master Plus software includes functions for viewing and recording single instances or movies of the echo curve. The echo curve represents the tank, as seen by the radar transmitter. Each peak corresponds to a strong reflection of the radar signal.

Figure 7-14: Echo Curve



When connected to Rosemount Radar Master Plus, past measurement records and echo curves including the 10 highest peaks, as well as the 50 last alert events are automatically transferred from the transmitter's internal memory to the hard drive on your local computer. Past measurement records are then available the next time you connect to the transmitter using the level trend timeline.

Measurement problems can be understood by studying the position and amplitude of the different peaks. Additionally, the recorded echo curves give insight into unexpected and intermittent measurement behaviors, for instance, at the time of the triggered alert.

Read the echo curve

To read the echo curve in Rosemount Radar Master Plus:

Procedure

1. Select **Service Tools** → **Echo Curve**.
   Rosemount Radar Master Plus reads one echo curve and then stops.
2. To continuously update the echo curve, select the **Play** icon.

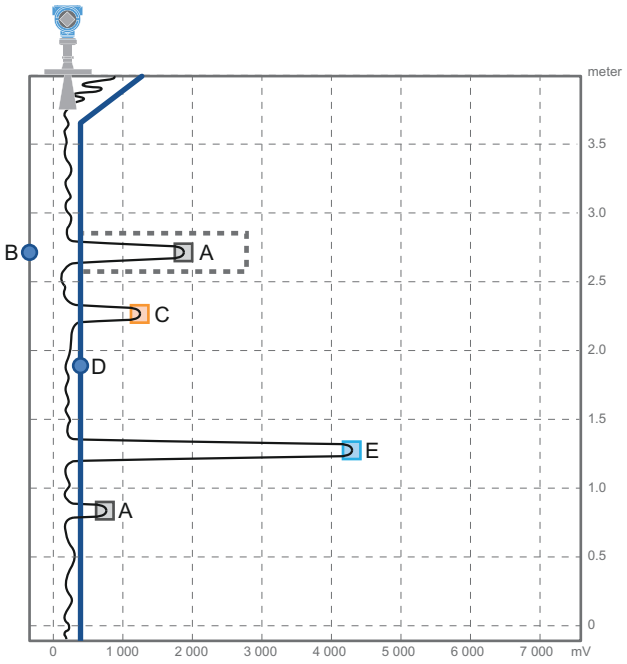
Analyzing the echo curve

The following echo peaks may appear in the echo curve:

Table 7-1: Echo Peak Types

Type	Description
Surface	Echo tracked as the current surface echo
Unknown	Echo not recognized by the device, which might interfere with measurement
Suppressed	Echoes that are identified but suppressed by the device
Suppressed (double bounce)	Echo managed as a double bounce echo by the Double Bounce function
Secondary surface	Echo tracked as the current secondary surface (if Double Surface Handling function is enabled)
Tank bottom echo	Echo considered as an echo from the tank bottom

Figure 7-15: Echo Curve with Typical Echo Peaks



A. Suppressed (dashed line indicates use of false echo suppression)
B. False echo suppression
C. Unknown
D. Amplitude threshold
E. Surface

Zoom in and out the echo curve

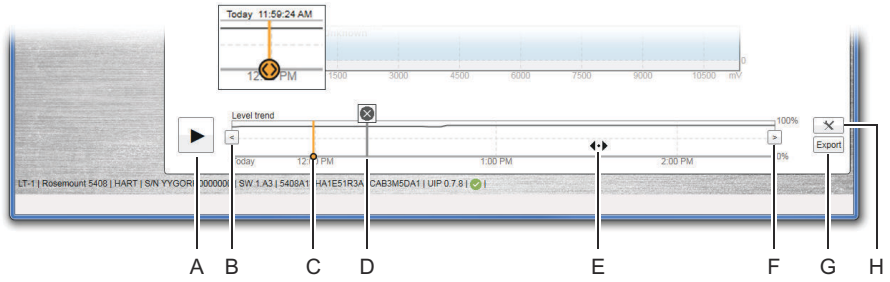
You can zoom in to a specific area of the echo curve.

Procedure

- To zoom in, drag a rectangle around the area you want to magnify.
- To zoom out, in the upper right corner of the echo curve, select **Reset Zoom**.

Level trend timeline

Figure 7-16: Timeline



A. Play or pause
B. Left arrow
C. Timeline slider
D. History alert icon
E. Drag anywhere in the timeline to move the timeline forward or backward.
F. Right arrow
G. Export echo curves
H. Options

View level trends and historical echo curves

Procedure

- To go to a desired point in the displayed part of the timeline, drag the slider, or click anywhere in the timeline.
- To move the timeline forward or backward, click the left or right arrow, or drag anywhere in the timeline.

Tip
To speed up the upload time of historical data in a specific area, click or drag the slider to the desired start point on the timeline. Rosemount Radar Master Plus continues to load data from that point forward.

View active/historical alerts

Procedure

In the timeline, click the left or right arrow to scroll to the alert, and then select the alert icon for details.

Play echo curve movies

Procedure

1. Set the start point.
   a) Click the left or right arrow, or drag anywhere in the timeline.
   b) Click the start point in the timeline.
2. Select **Play**, or drag the timeline slider to move one frame at a time.

Export echo curve movies

Procedure

1. Select **Service Tools** → **Echo Curve**.
2. Select **Export**.

3. Type your desired file name.
4. Browse to the desired directory, and then select **Save**.
5. Under ***Time range***, select **Last 1 hour**, **Last 3 hours**, **Last 24 hours**, or **User defined range**.
6. If **User defined range** is selected, specify the start and end times.
7. Select **Export**.
8. Select **Back**.

Set echo curve range

Procedure

1. Select **Service Tools** → **Echo Curve**.
2. Select **Options**.

3. Under ***Echo Curve Range***, select **User Defined**.
4. Enter the desired values.
5. Select **Save**.
6. Select **Back**.

Set timeline resolution

To set the resolution of the level trend timeline:

Procedure

1. Select **Service Tools** → **Echo Curve**.
2. Select **Options**.

3. In the **Timeline Resolution** list, select the desired length (in hours) of the timeline.
4. Select **Save**.
5. Select **Back**.

7.4.2 Perform an analog loop test

During a loop test, the transmitter outputs a fixed value (4 mA, 20 mA, or user-selected value).

The loop test command verifies the output of the transmitter, the integrity of the loop, and the operations of any recorders or similar devices installed in the loop. A loop test can also be used to determine the need for an analog output calibration.

Prerequisites

If the transmitter is equipped with a TEST terminal, current can be measured directly at the terminal block without disconnecting any signal wires.

Procedure

1. Select **Service Tools** → **Simulate**.
2. Under ***Analog Out***, select **Loop test**, and then follow the on-screen instructions.
3. Measure the loop current.

Postrequisites

Select **End** or **Cancel** to exit loop test (**Stop** in Rosemount Radar Master Plus).

Related information

Calibrate analog out
Use the TEST terminal
Simulation/test active

7.4.3 Use the TEST terminal

Prerequisites

⚠ WARNING

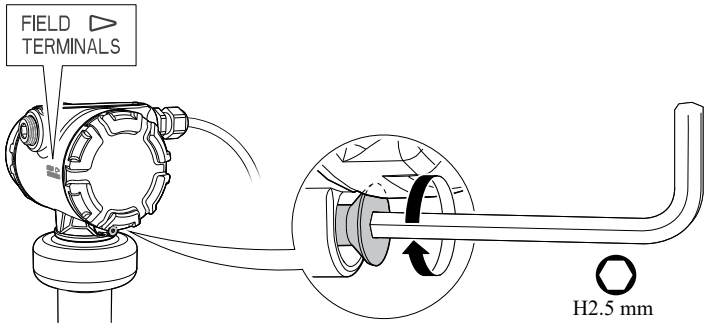
Verify that the installation is consistent with the appropriate hazardous locations certifications when the instrument used for loop current measurement is connected.

For Explosion-proof/Flameproof and Non-Incendive/Type n installations, the cover must not be opened in an explosive atmosphere.

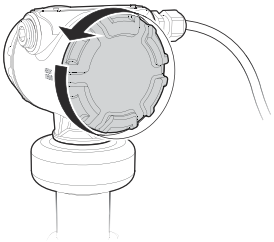
Note
Disconnect the blue plug only during the loop current measurement procedure. To meet the stated EMC specification during normal operation, the blue plug must be plugged in.

Procedure

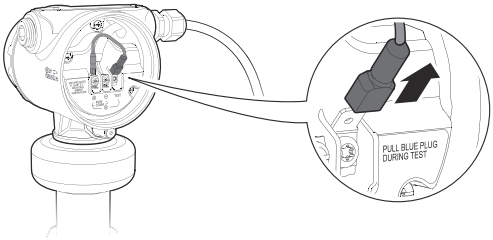
1. Turn the jam screw clockwise until it is completely threaded into the housing.



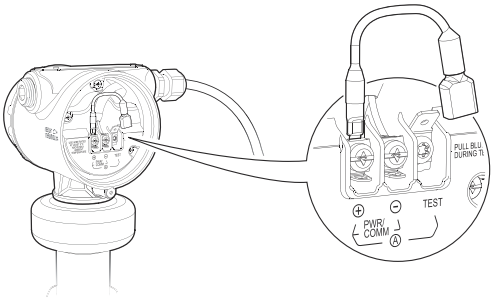
2. Remove the cover.



3. Remove the blue plug from the TEST terminal.

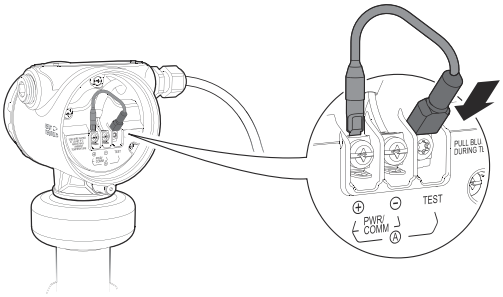


4. Connect the ampere meter leads to the terminals labeled “+” and “TEST”.

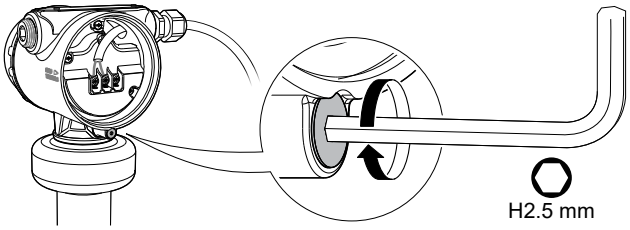


5. Measure the loop current.

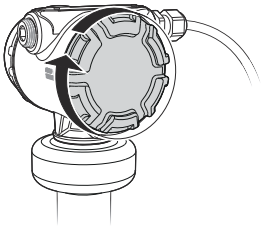
6. Attach the blue plug to the TEST terminal.



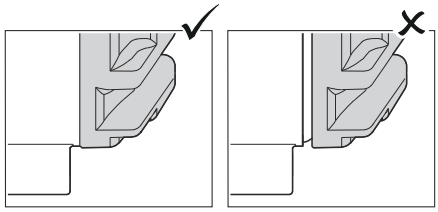
7. Attach and tighten the cover.
   a) Verify the cover jam screw is completely threaded into the housing.



   b) Attach and tighten the cover.

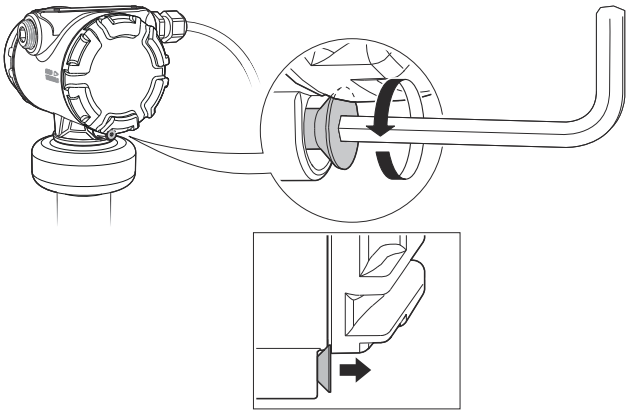


Note
Make sure the cover is fully engaged. There should be no gap between the cover and the housing.



c) Turn the jam screw counterclockwise until it contacts the cover.

Note
Required for explosion-proof/flameproof installations only.



d) Turn the jam screw an additional ½ turn counterclockwise to secure the cover.

7.4.4 Calibrate analog out

Use this function to calibrate the analog output by comparing the actual output current with the nominal 4 mA and 20 mA currents. Calibration is done at factory and the analog output does not normally need to be recalibrated.

Procedure

1. Select **Service Tools** → **Maintenance** → **Routine Maintenance**.
2. Select **D/A trim** (**Calibrate Analog Out** in Rosemount Radar Master Plus) and follow the on-screen instructions.

7.4.5 Save a backup file of the device configuration

When configuration is finished, it is recommended to store the device configuration in a backup file for future reference. A backup of the device configuration will be saved to file as well as a configuration report (optional).

The backup file may be useful to:

- Restore the configuration of the transmitter.
- Install another transmitter in a similar tank.
- Troubleshoot the transmitter.

Prerequisites

This function is only available in Rosemount Radar Master Plus.

Procedure

1. Select **Service Tools** → **Maintenance** → **Backup**.
2. Select **Save Configuration**.
3. Type your desired file name.
4. Browse to the desired directory, and then select **Save**.

5. Optional: Select the **Create and save report (.pdf)** check box.
6. Select **Save**.

7.4.6 Download configuration from file to device

Prerequisites

This function is only available in Rosemount Radar Master Plus.

Procedure

1. Select **Service Tools** → **Maintenance** → **Backup**.
2. Select **Restore Configuration**.
3. Browse to the backup file and select **Open**.

7.4.7 Restart the device

To restart the device electronics:

Procedure

1. Select **Service Tools** → **Maintenance** → **Reset/Restore**.
2. Select **Restart Device** and follow the on-screen instructions.

7.4.8 Restore to default settings

This function restores the transmitter to default settings (user configuration is overwritten).

Prerequisites

Before restoring the transmitter to default settings, it is recommended to backup the device configuration. The backup file can be used to restore configuration at a later stage.

Procedure

1. Select **Service Tools** → **Maintenance** → **Reset/Restore**.
2. Select **Restore Default Settings** and follow the on-screen instructions.

7.4.9 Use the simulation mode

This function can be used to simulate measurements.

Procedure

1. Select **Service Tools** → **Simulate**.
2. Under ***Simulate Measurement Values***, select desired transmitter variable and follow the on-screen instructions.

Related information

Simulation/test active

7.4.10 View input registers

Measured data is continuously stored in the input registers. By viewing the contents of the input registers, expert users can check that the transmitter works properly.

Procedure

1. Select **Configure** → **(Manual Setup)** → **Level Setup** → **Advanced** → **Expert Options** → **Input Registers**.
2. Type the desired register number to start reading from.

   In Rosemount Radar Master Plus, registers can also be viewed by selecting a group from the **Block** list.
3. Select **Read Input Registers** (**Refresh** in Rosemount Radar Master Plus).
4. (Handheld communicator) Select **Input Registers**.

7.4.11 View holding registers

The holding registers store various transmitter parameters, such as configuration data, used to control the measurement performance.

Procedure

1. Select **Configure** → **(Manual Setup)** → **Level Setup** → **Advanced** → **Expert Options** → **Holding Registers**.
2. Type the desired register number to start reading from.

   In Rosemount Radar Master Plus, registers can also be viewed by selecting a group from the **Block** list.
3. Select **Read Holding Registers** (**Refresh** in Rosemount Radar Master Plus).
4. (Handheld communicator) Select **Holding Registers**.

7.4.12 Edit holding registers

Edit holding registers using Rosemount Radar Master Plus

Prerequisites

Note
Do not use holding registers to configure the transmitter unless you are qualified. This dialog is mainly used for service purposes and for advanced configuration.

Procedure

1. To change a holding register value, type a new value in the corresponding value field, or select a new value from the corresponding list.
2. Select **Save** to store the new value.

Edit holding registers in DD compliant host

Prerequisites

Note
Do not use holding registers to configure the transmitter unless you are qualified. This dialog is mainly used for service purposes and for advanced configuration.

Procedure

In the **Holding Registers** tab, select **Write Holding Register** and follow the on-screen instructions.

7.5 Application challenges

7.5.1 Managing disturbance echoes

There are two general methods for managing disturbance echoes:

- Set amplitude threshold to filter out weak disturbance echoes and noise.
- Use the suppress false echoes function to manage strong disturbance echoes.

Amplitude threshold

The amplitude threshold is used to filter out noise and disturbing echoes from the product surface echo. The transmitter uses certain criteria to decide which type of echo peak that is detected. Only echoes above the amplitude threshold might be considered the product surface. The amplitude threshold can either be set to a constant value, or split into sections as defined by up to 10 anchor points.

If necessary, a customized amplitude threshold section can for instance be used to remove the influence from the tank nozzle, or disturbances close to the tank bottom. Additionally, it might be needed in areas where there are occasionally strong echoes present, for instance due to wide mixer blades. Suppressing false echoes may not be sufficient in those areas.

Note
Do not create a customized amplitude threshold section around echoes which are already registered as false echoes.

General recommendations

Use the following best practices to apply custom threshold adjustments:

- Generally, set amplitude threshold to about 10 percent of surface echo amplitude.
- Do not set the amplitude threshold to less than 150 mV (50 mV for solids measurements)[(3)].

Adjust the amplitude threshold

If necessary, the amplitude threshold can be increased if a disturbance echo is interpreted as the product surface. Alternatively, a lower threshold may be required to handle weak surface echoes (e.g. due to excessive foaming or turbulence).

Prerequisites

The amplitude threshold is set at factory for optimum performance and should not normally need an adjustment. Before changing the factory default, study the position and amplitude of the different echo peaks.

It is recommended to adjust thresholds using Rosemount Radar Master Plus.

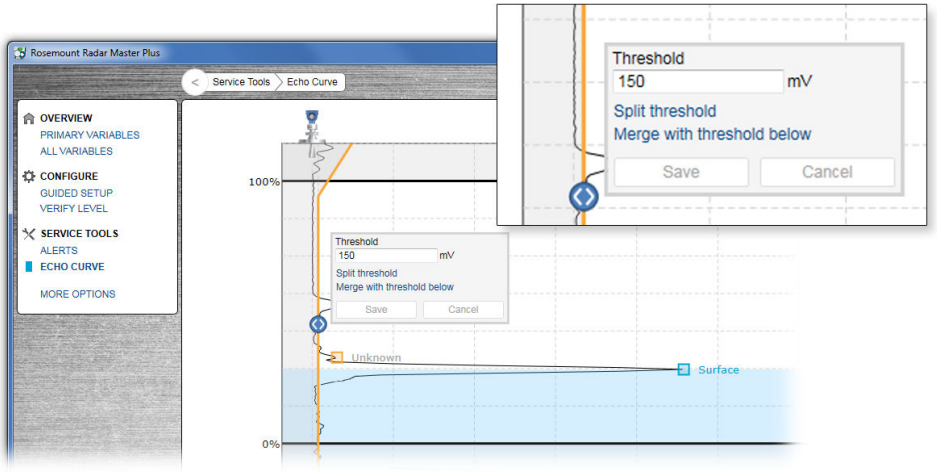
Procedure

1. Select **Service Tools** → **Echo Curve**.

(3) If required in solids applications with weak surface echoes, the amplitude threshold can be set down to 50 mV, as long as it is greater than the disturbance echoes.

2. In the echo curve, drag the amplitude threshold point left or right, or type the desired value.

Figure 7-17: Amplitude Threshold Point



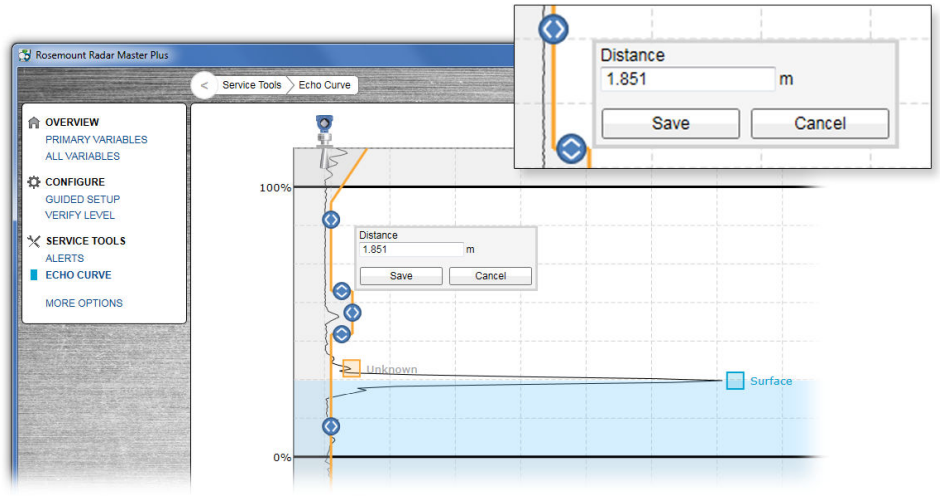
3. Select **Save**.

Set the endpoint of a threshold segment

Procedure

1. In the echo curve, drag the endpoint up or down, or type the desired value.

Figure 7-18: Endpoint



2. Select **Save**.

Add or delete an amplitude threshold point

Procedure

1. In the echo curve, select the desired amplitude threshold point, and select **Split threshold** or **Merge with threshold below**.

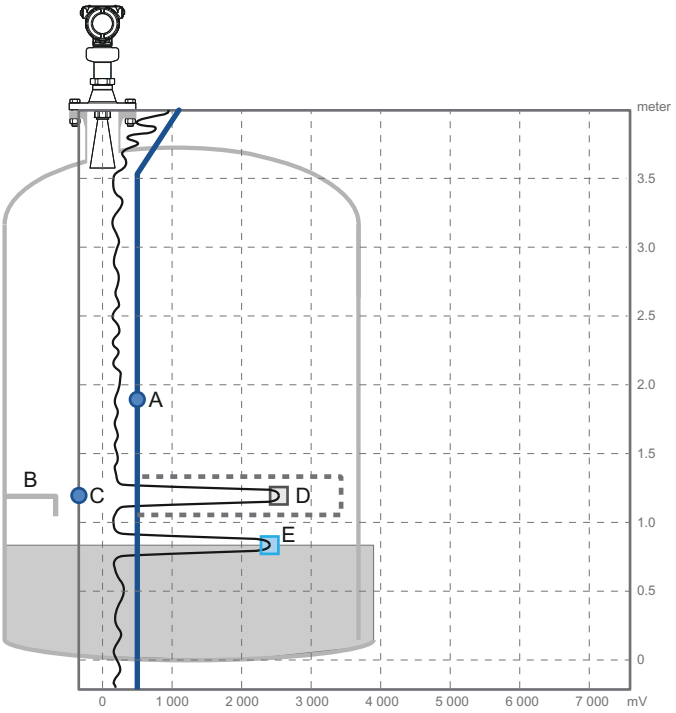
2. Click again on one of the amplitude threshold points and select **Save**.

Suppressing false echoes

Stationary objects with horizontal surfaces may generate strong false echoes. When the surface is close to an obstruction in the tank (e.g. beams and agitators), the surface and false echoes might interfere and cause a decrease in performance.

However, false echoes can be suppressed to reduce the influence of such objects, in case they cannot be totally avoided. When the surface is passing by a disturbing object, the transmitter will then measure with higher reliability, even if the surface echo is weaker than the false echo, see Figure 7-19.

Figure 7-19: Suppression of False Echoes



A. Amplitude threshold
B. Disturbing object
C. False echo suppression
D. Suppressed echo
E. Surface

Add a new false echo suppression

Prerequisites

Follow these recommendations before suppressing new false echoes:

- Make sure a correct amplitude threshold is set.
- Make sure the level is stable. A fluctuating level may indicate a temporary disturbance which is not due to an interfering object.
- Only suppress echoes which can be clearly identified as objects in the tank. Compare the list of interfering echoes with the tank drawing or visual inspection of the tank.

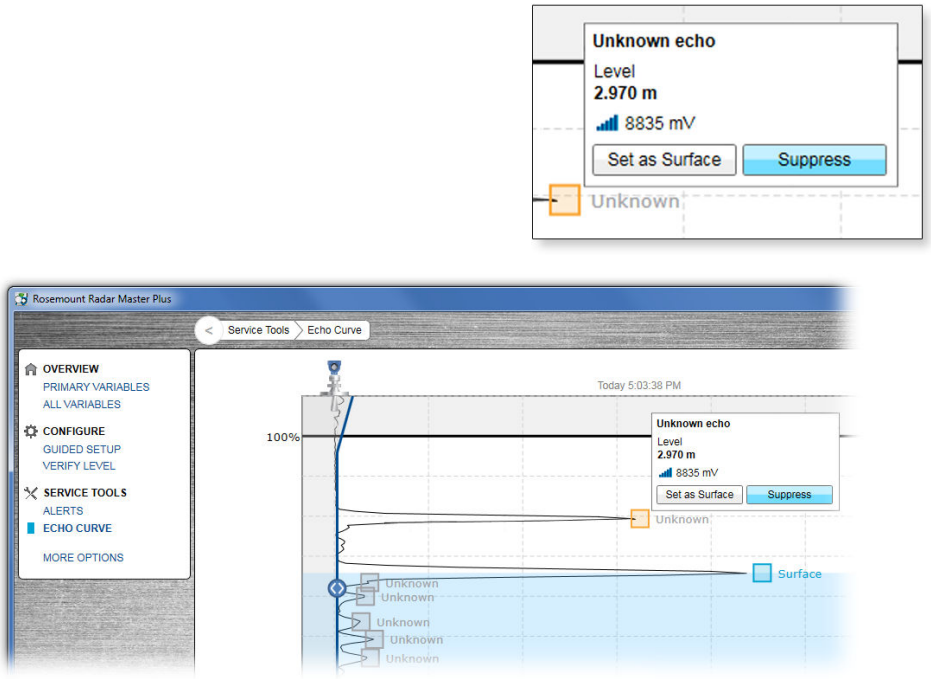
- Do not suppress false echoes located below the product surface.
- Keep the number of suppressed false echoes to a minimum.

It is recommended to suppress false echoes using Rosemount Radar Master Plus.

Procedure

1. Select **Service Tools** → **Echo Curve**.
2. In the echo curve, click at the unknown echo peak, and then select **Suppress**.

Figure 7-20: Add False Echo Suppression



Postrequisites

It may be necessary to suppress new false echoes at a later stage when objects have become visible due to surface movement.

Related information

Amplitude threshold

Delete a false echo suppression

Prerequisites

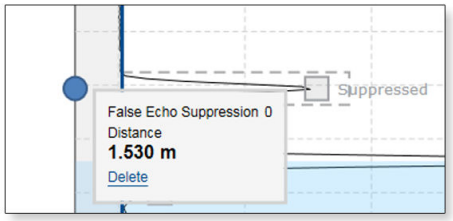
It is recommended to suppress false echoes using Rosemount Radar Master Plus.

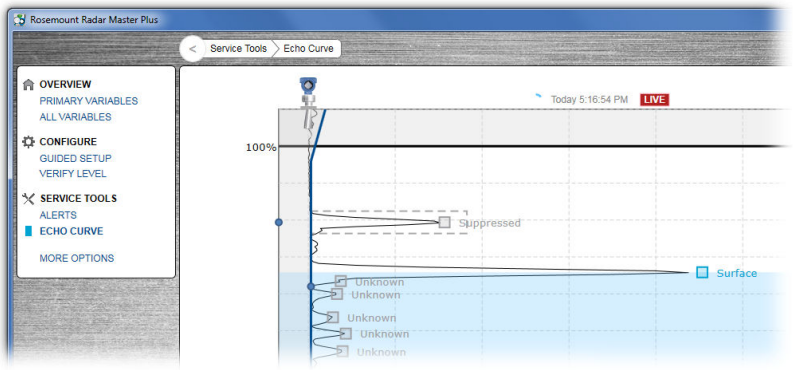
Procedure

1. Select **Service Tools** → **Echo Curve**.

2. In the echo curve, click at the left end of the false echo suppression, and then select **Delete**.

Figure 7-21: Delete False Echo Suppression





Suppress a false echo manually

The false echo may also be suppressed manually if the position of the false echo is known.

Prerequisites

It is recommended to suppress false echoes using Rosemount Radar Master Plus.

Procedure

1. Select **Service Tools** → **Echo Curve**.
2. Select **Options**.

3. Select **Suppress False Echo Manually**. Suppressed echoes are shown in the table.
   - To add a new suppression, select **Add**, and then type the distance to the false echo and the width of the false echo area.
   - To change a suppression, select the cell you want change and type the new value.
   - To delete a suppression, select the row you want to delete, and then select **Delete**.
4. Select **Save**.
5. Select **Back**.

7.5.2 Handling disturbances at top of tank

There are two general methods for managing disturbance echoes at the top of the tank:

- Set amplitude threshold section
- Extend the Upper Null Zone

Set amplitude threshold section

If necessary, a customized amplitude threshold section can be used to block out disturbing echoes (e.g. from the tank nozzle or bypass well inlet).

Prerequisites

Amplitude threshold sections are pre-configured at the factory for transmitters with process seal antenna. For nozzles taller than 10 in. (25 cm), it may be necessary to manually increase the distance value for the first endpoint (Figure 7-22).

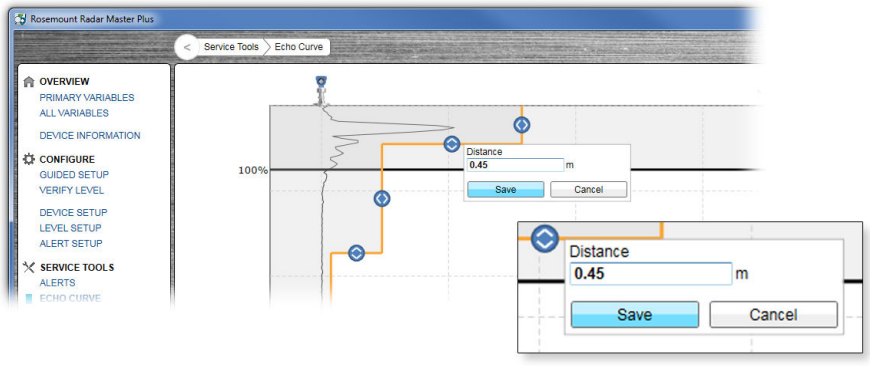
Procedure

1. In Rosemount Radar Master Plus, start the echo curve reading.
2. View the echo curve plot to find out if there are disturbing echoes close to the transmitter.
3. Calculate the required distance to the first endpoint.

Distance = Nozzle height + 2 in. (50 mm) =

4. In the echo curve, click the first endpoint and type the calculated value (Figure 7-22).
5. Select **Save**.

Figure 7-22: First Endpoint



A. First endpoint

Related information

Amplitude threshold
Read the echo curve

Change the upper null zone

The Upper Null Zone defines a zone close to the transmitter where echoes are ignored. This zone can be extended to block out disturbing echoes at the top of the tank.

Prerequisites

Note
Make sure the Upper Range Value (100%/20 mA) value is below the Upper Null Zone. Measurements are not performed within the Upper Null Zone.

Procedure

1. Identify desired Upper Null Zone using the echo curve plot.
   a) In Rosemount Radar Master Plus, start the echo curve reading.
   b) View the echo curve plot to find out if there are disturbing echoes close to the transmitter.
2. Set the desired Upper Null Zone value.
   a) Select **Configure** → **Level Setup** → **Antenna**.
   b) Under ***Advanced***, type desired Upper Null Zone, and then select **Save**.

Related information

Read the echo curve
Upper null zone

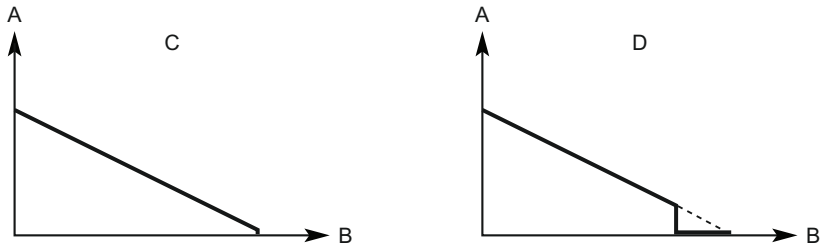
7.5.3 Tracking of weak surface echoes close to tank bottom

Use tank bottom projection

The Tank Bottom Projection function can be used to enhance measurement performance in the tank bottom region.

If the product surface echo is weak in the tank bottom region and the bottom echo is strong (typical for flat tank bottoms), the transmitter may lock on the bottom echo and report a false level measurement (empty tank). If the application requires, the Tank Bottom Projection settings can be user-defined. Figure 7-23 illustrates an example of the Tank Bottom Projection when the tank is being emptied.

Figure 7-23: Tank Bottom Projection



A. Level
B. Time
C. Enabled
D. Disabled

Prerequisites

The Tank Bottom Projection function is only available in Rosemount Radar Master Plus.

Procedure

1. Select **Configure** → **Level Setup** → **Advanced**.
2. Under ***More Advanced Options***, select **Empty Tank Handling**.
3. In the **Tank Bottom Projection** list, select **Enabled** or **Disabled**.
4. If you enabled Tank Bottom Projection, then:
   a) Set the Bottom Product Dielectric Constant.
   b) Enter Maximum Projection Distance.
   c) Enter Minimum Tank Bottom Echo Amplitude.
5. Select **Save**.

Bottom product dielectric constant

Enter the product dielectric constant for the product in the bottom of the tank.

Maximum projection distance

This defines the range in which the function operates. Enter the maximum distance from the zero level (tank bottom). It is recommended to use the default setting.

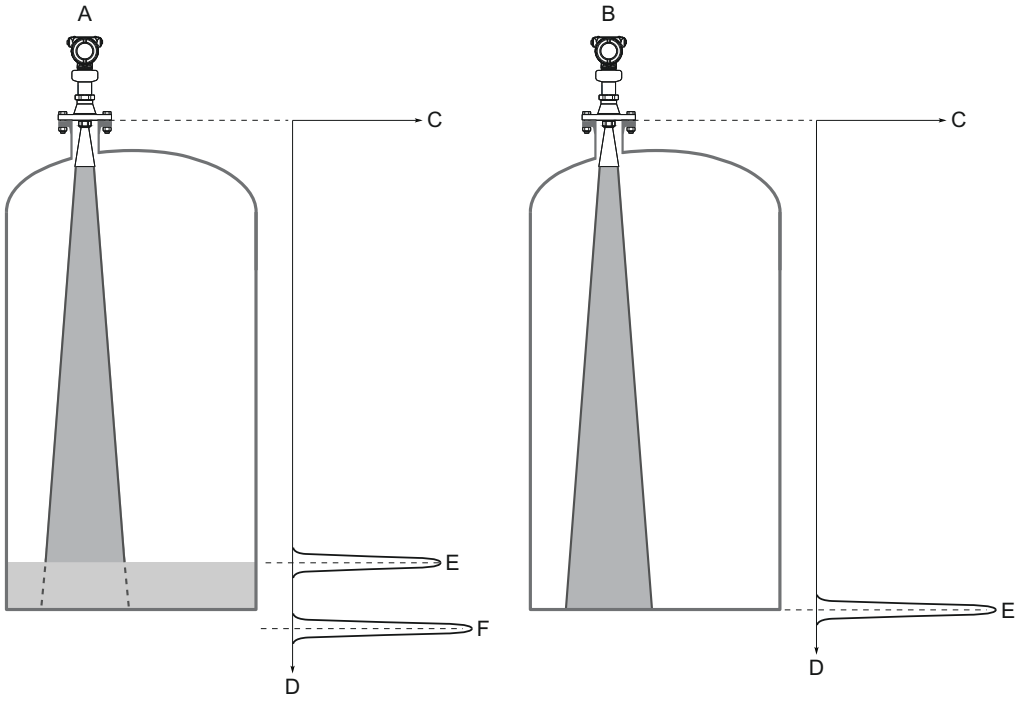
Minimum tank bottom echo amplitude

Enter the minimum allowed amplitude for the echo from the tank bottom before this function is activated. It is recommended to use the default setting.

Enable bottom echo visible when tank is empty

Enable the Bottom echo visible when tank is empty parameter if a bottom echo is visible when tank is empty (i.e. for flat tank bottoms). The bottom echo will then be treated as a disturbance echo to facilitate tracking of weak surface echoes close to the tank bottom. This function may be useful for products which are relatively transparent for microwaves, such as oil.

Figure 7-24: Bottom Echo Visible



A. Product surface near bottom of tank
B. Empty tank
C. Signal amplitude
D. Distance
E. Surface echo
F. Echo peak from tank bottom (at the electrical distance when product in the tank)

Prerequisites

Before enabling the Bottom echo visible when tank is empty parameter:

- Analyze the echo curve and check that a bottom echo is visible when tank is empty.
- Verify that the Bottom Offset value is correct.

The Bottom echo visible when tank is empty parameter is only available in Rosemount Radar Master Plus.

Procedure

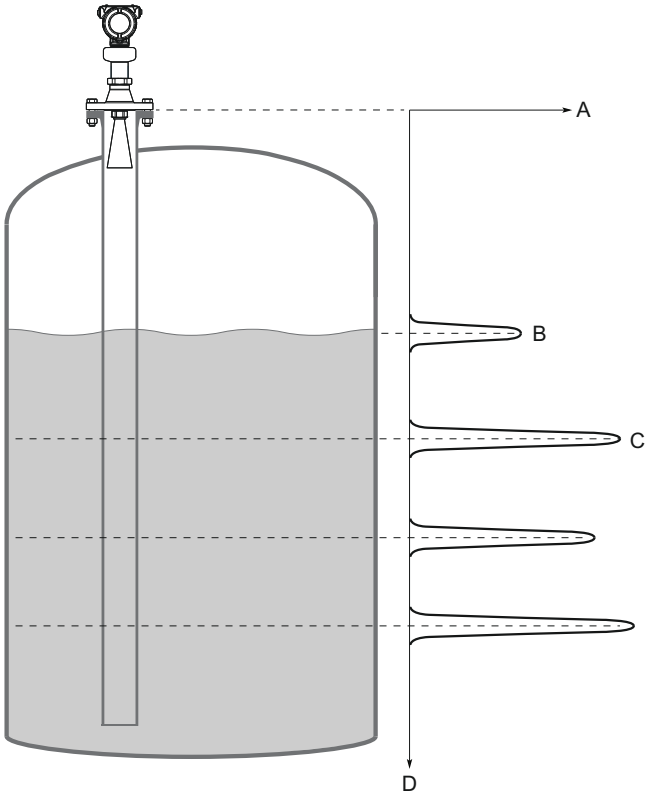
1. Select **Configure** → **Level Setup** → **Advanced**.
2. Under ***More Advanced Options***, select **Empty Tank Handling**.
3. In the **Empty Tank Handling list**, select **User Defined**.
4. Select the **Bottom echo visible when tank is empty** check box.
5. Select **Save**.

7.5.4 Handling ghost echoes in still pipes

The Track First Echo function can eliminate ghost echo problems below the product surface. When enabled, the first echo above threshold will always be considered as the surface echo.

Ghost echoes may occur in still pipes because of multiple reflections between the pipe wall, flange, and antenna. In the echo curve, these echoes appear as amplitude peaks at various distances below the product surface, see Figure 7-25.

Figure 7-25: Ghost Echoes in Still Pipes



A. Signal amplitude
B. Actual level
C. Virtual level
D. Distance

Procedure

1. In Rosemount Radar Master Plus, read the echo curve. Make sure there are no disturbing echoes above the product surface.
2. Select **Configure** → **Level Setup** → **Advanced**.
3. Under ***More Advanced Options***, select **Echo Tracking**.
4. In the **Surface Echo Tracking** list, select **User defined**, and then select the **Track First Echo** check box.
5. Select **Save**.

Related information

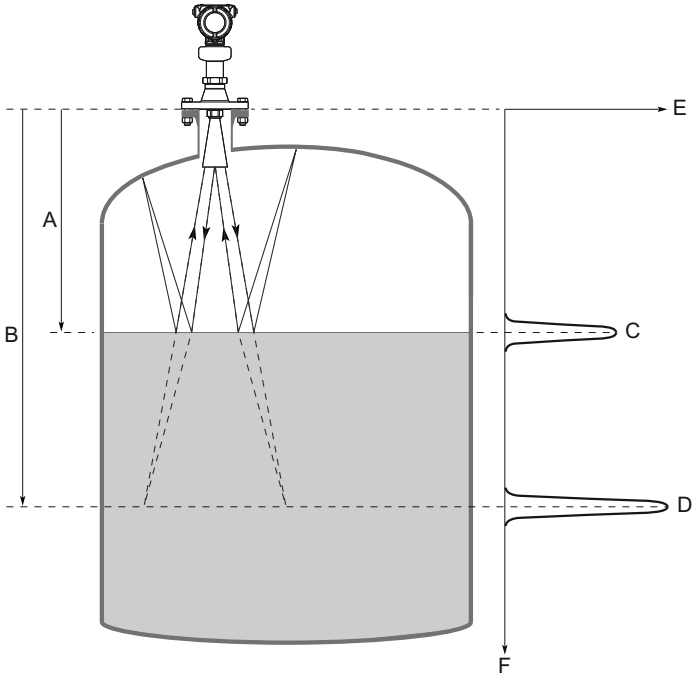
Read the echo curve

7.5.5 Handling strong double bounce echoes

Double bounces are most commonly present in spherical or horizontal cylinder tanks, and usually appear when the tank is about 60-70 percent filled. In these cases, the amplitude may be strong enough for the transmitter to interpret the double bounce as the surface echo. The Double Bounce Handling function is used for managing such problems.

A double bounce echo occurs when a radar signal bounces back and forth between the product surface and tank roof (or other object within the tank) before it is detected by the transmitter. Normally, these signals have a low amplitude and are ignored by the transmitter.

Figure 7-26: Double Bounce Echoes



A. Distance to surface
B. Distance to first double bounce
C. Actual level
D. Virtual level (first double bounce)
E. Signal amplitude
F. Distance

Prerequisites

Note
The Double Bounce Handling function should only be used if the problem of double bounces cannot be solved by changing the mounting position.

Note
The surface echo is required to suppress the double bounce. If the surface echo enters the Upper Null Zone, there is no product surface reference and the double bounce might be interpreted as the surface echo.

The Double Bounce Handling function is only available in Rosemount Radar Master Plus.

Procedure

1. Read the echo curve plot to determine if double bounce echoes are present.
2. Select **Configure** → **Level Setup** → **Advanced**.
3. Under ***More Advanced Options***, select **Echo Tracking**.
4. In the **Double Bounce Handling** list, select **Enabled** or **Disabled**.
5. If you enabled Double Bounce Handling, then enter desired Double Bounce Offset.
6. Select **Save**.

Related information

Read the echo curve

Double bounce offset

The distance between each double bounce echo is constant. The Double Bounce Offset is used to define the distance between detected double bounces, as given by the following formula (see Figure 7-26):

Double Bounce Offset = B - 2A

The Double Bounce Offset is negative if the reflection point (normally the tank roof) is below the Tank Reference Point.

7.6 Replace the transmitter head

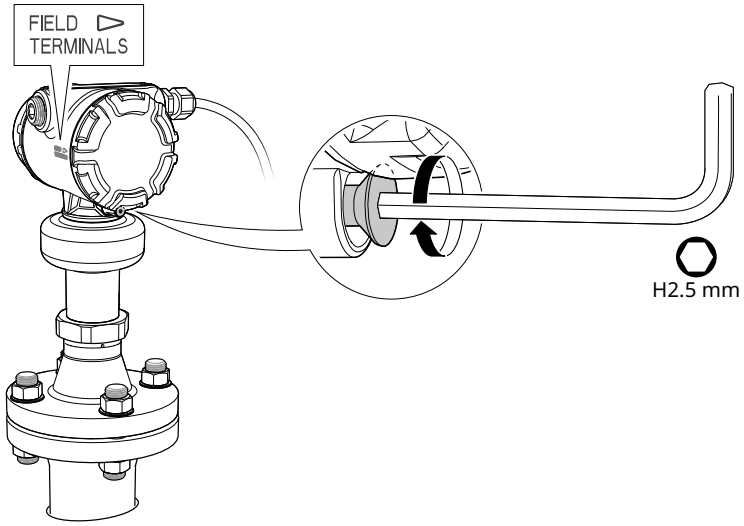
Prerequisites

⚠ In Explosion Proof/Flameproof and Non-Incendive/Type n installations, do not remove the transmitter covers when power is applied to the unit.

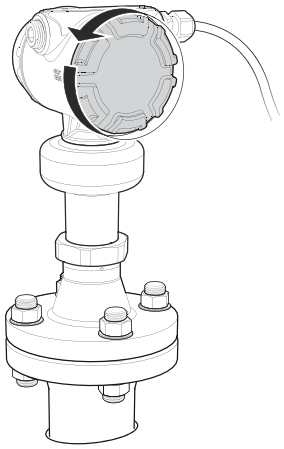
Procedure

1. Disconnect the power supply.
2. If applicable, remove the external ground cable from the transmitter head.

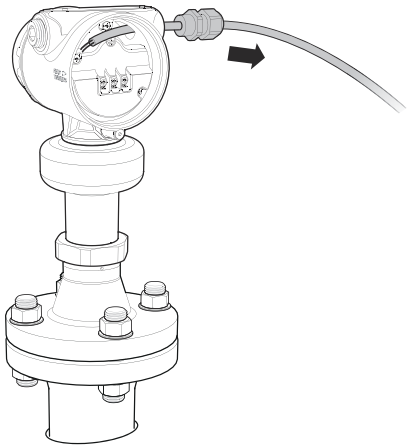
3. Turn the jam screw clockwise until it is completely threaded into the housing.



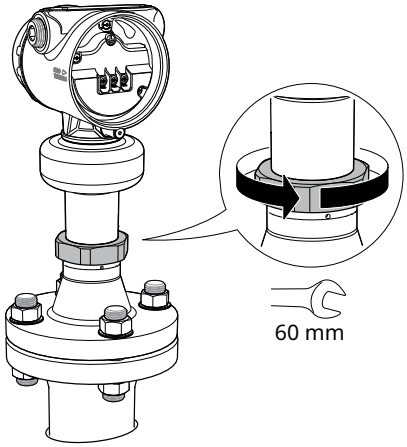
4. Remove the cover.



5. Remove all electrical leads and disconnect conduit.

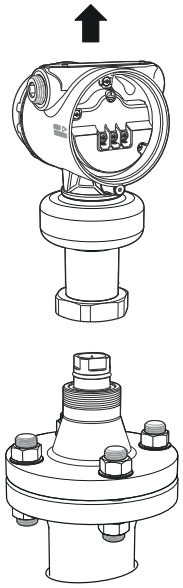


6. Loosen the nut that connects the transmitter head to the process seal.

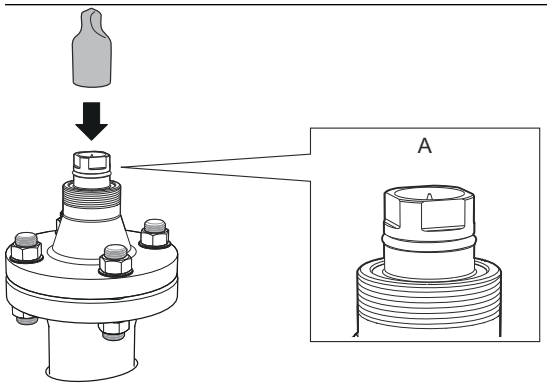


7. Carefully lift the transmitter head.

   ⚠ Do not attempt to loosen it by rotating the transmitter head. If it is stuck, then it may need to be replaced with a new process connection and transmitter head, by following all plant safety rules and procedures.



8. Attach a protection plug to the process seal to protect it from dust and water.



A. Process seal

7.7 Cleaning or replacing the PTFE sealing

This section applies only to transmitters with a process seal antenna.

Replace the PTFE sealing if it shows any signs of damage. If it is not damaged, clean and reuse it.

Remove from service

⚠ Be aware of the following:

- Follow all plant safety rules and procedures.
- In Explosion Proof/Flameproof and Non-Incendive/Type n installations, do not remove the transmitter covers when power is applied to the unit.
- Do not remove the process connection while in operation. Removing while in operation may cause process gas leaks.

Cleaning

To avoid electrostatic charges, use only a damp cloth to clean the PTFE surfaces. Clean the PTFE sealing with care.

The transmitter is suitable for:

- Cleaning-Out-of-Place (COP)
- Cleaning-In-Place (CIP)
- Steaming-In-Place (SIP)

Related information

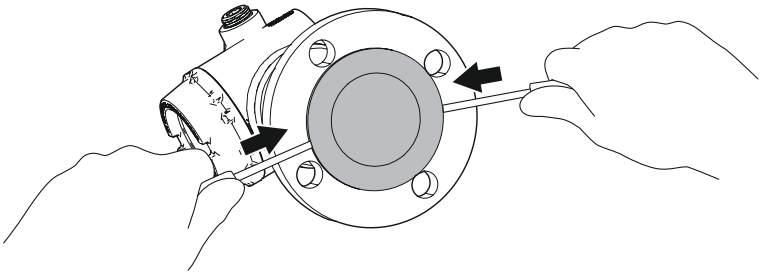
Product certifications

7.7.1 Flanged version

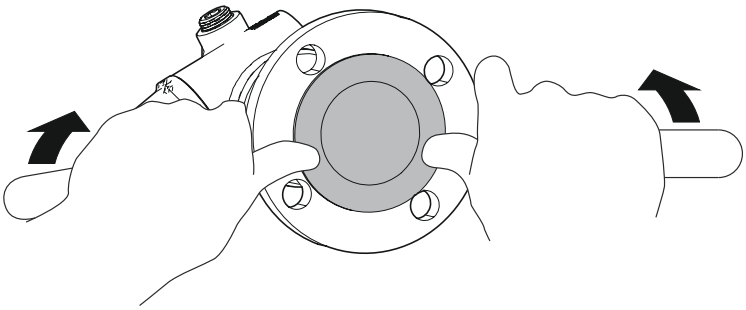
Disassembly procedures

Procedure

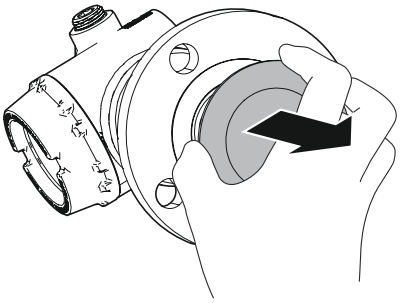
1. Insert two flathead screwdrivers between the PFTE sealing and flange.



2. Gently push the screwdriver handles forward until the PTFE sealing pops out.



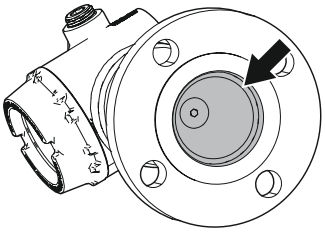
3. Carefully pull the PTFE sealing straight out.



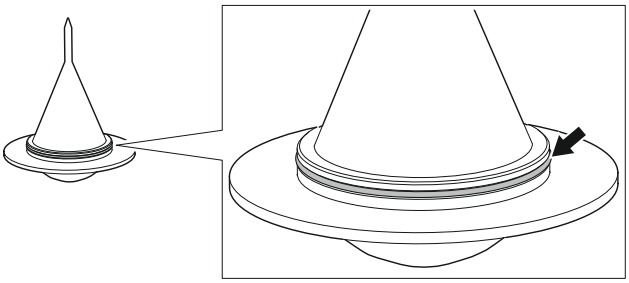
Reassembly procedures

Procedure

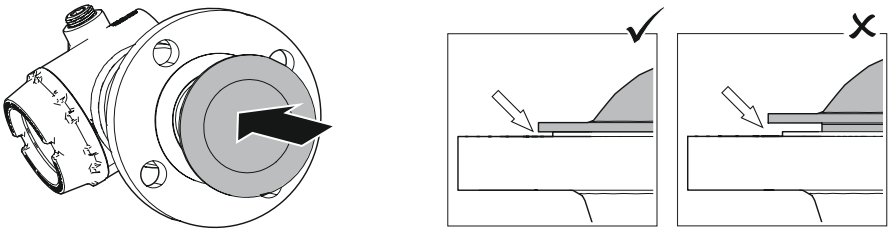
1. Clean the cavity with a lint-free cloth.



2. Verify the O-ring on the PTFE sealing is in place.



3. Gently insert the PTFE sealing until it stops, and then firmly push it all the way in.



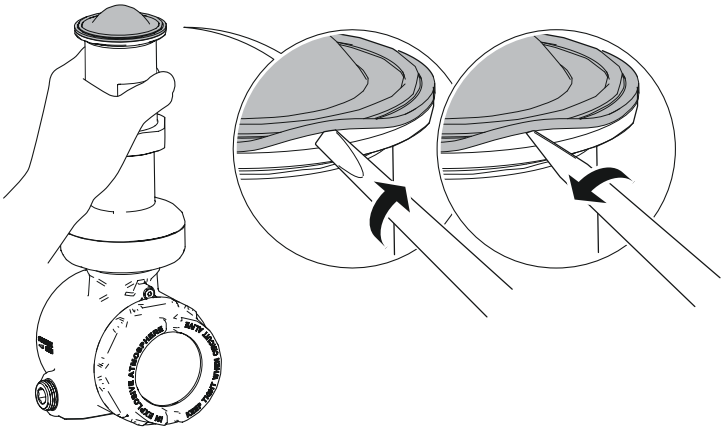
7.7.2 Tri Clamp version

Disassembly procedures

Procedure

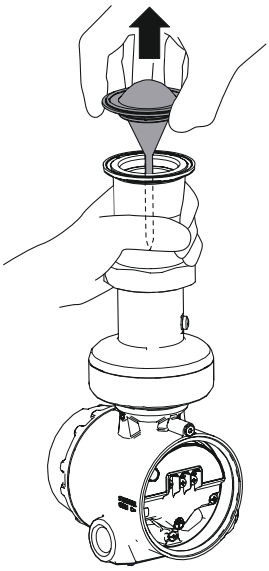
1. Insert a wide flathead screwdriver into the groove at the base of the PTFE sealing.
2. Gently wiggle the screwdriver back and forth.

Note
Be careful not to scratch or depress the PTFE surfaces (facing the process).



3. Repeat Step 1-Step 2 at different positions until the PTFE sealing is loose.

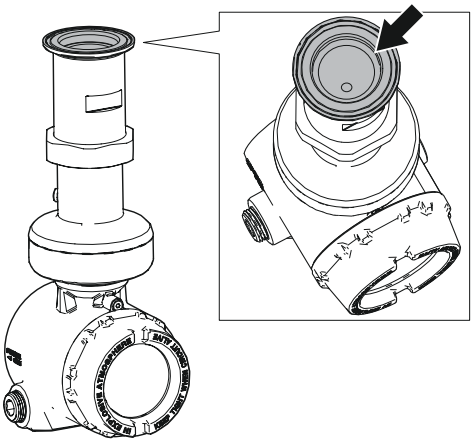
4. Carefully lift the PTFE sealing.



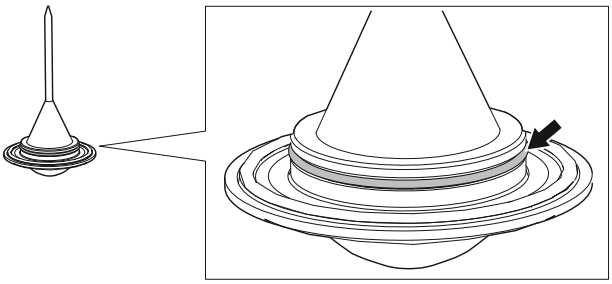
Reassembly procedures

Procedure

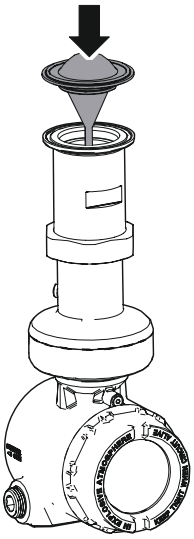
1. Clean the cavity with a lint-free cloth.

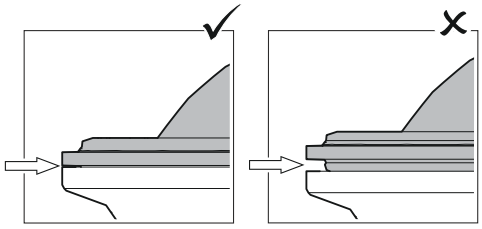


2. Verify the O-ring on the PTFE sealing is in place.



3. Gently insert the PTFE sealing until it stops, and then firmly push it all the way in.





7.8 Service support

To expedite the return process, refer to Emerson.com and contact the nearest Emerson representative.

⚠ CAUTION

Individuals who handle products exposed to a hazardous substance can avoid injury if they are informed of and understand the hazard. Returned products must include a copy of the required Safety Data Sheet (SDS) for each substance.

Emerson representatives will explain the additional information and procedures necessary to return goods exposed to hazardous substances.

A Specifications and reference data

A.1 Performance specifications

A.1.1 General

Reference conditions

- Measurement target: Stationary metal plate, no disturbing objects
- Temperature: 59 to 77 °F (15 to 25 °C)
- Ambient pressure: 14 to 15 psi (960 to1060 mbar)
- Relative humidity: 25-75%
- Damping: Default value, 2 s

Instrument accuracy (under reference conditions)

- Ultra accuracy: ±0.04 in. (±1 mm)[4]
- Standard: ±0.08 in. (±2 mm)[4]

Repeatability

±0.04 in. (±1 mm)

Ambient temperature effect

±0.04 in. (±1 mm)/10 K[5]

Sensor update rate

Minimum 1 update per second

Maximum level rate

40 mm/s as default, adjustable up to 200 mm/s

(4) Refers to inaccuracy according to IEC 60770-1 when excluding installation dependent offset. See the IEC 60770-1 standard for a definition of radar specific performance parameters and if applicable corresponding test procedures.

(5) Ambient temperature effect specification valid over temperature range -40 °F to 176 °F (-40 °C to 80 °C).

A.1.2 Measuring range

Table A-1: Maximum Measuring Range, ft. (m)

Model	Performance class	
	Standard	Ultra accuracy
Rosemount 5408	492 (150)[1]	50 (15)
Rosemount 5408:SIS[2]	130 (40) in Control/Monitoring mode 82 (25) in Safety (SIS) mode	50 (15)

(1) Up to 492 ft. (150 m) with the extended range option code ER selected, otherwise up to 130 ft. (40 m).
(2) The Rosemount 5408:SIS has two operational modes: Safety (SIS) and Control/Monitoring. Safety (SIS) mode must be set when used in Safety Instrumented Systems. Control/Monitoring mode is intended for use in a Basic Process Control System (BPCS).

Note that a combination of adverse process conditions, such as heavy turbulence, foam, and condensation, together with products with poor reflection may affect the measuring range.

Measuring range for solids

The figures given in Table A-2 should be considered as guidelines; the total measuring range may differ depending on other contributing application conditions such as product filling, how the product piles up, silo diameter vs. angle of repose, internal obstacles within the silo, dust, condensation, antenna build up, etc.

Table A-2: Recommended Measuring Range for Solids, ft. (m)

Antenna	Light powder[1]	Light granulates and pellets[2]	Heavy powder[3]	Grains [4]	Larger particles[5]
1½-in. (DN40) cone[6]	16 (5)	33 (10)	66 (20)	66 (20)	82 (25)
2-in. (DN50) cone/process seal[6]	16 (5)	33 (10)	82 (25)	82 (25)	98 (30)
3-in. (DN80) cone/process seal[6]	49 (15)	66 (20)	98 (30)	98 (30)	130 (40)
4-in. (DN100) process seal[6]					
4-in. (DN100) cone[6]	66 (20)	98 (30)	130 (40)	130 (40)	130 (40)
8-in. (DN200) parabolic[7]	115 (35)	180 (55)	230 (70)	230 (70)	295 (90)

(1) Plastic powder, etc. (Dielectric constant: 1.2)
(2) Plastic pellets, etc. (Dielectric constant: 1.35)
(3) Lime powder, cement, sand, etc. (Dielectric constant: 1.5)
(4) Kernels, brans, etc. (Dielectric constant: 1.5)
(5) Wood chips/pellets, etc. (Dielectric constant: 1.7)
(6) Cone and process seal antennas are the preferred choice for most solid applications.
(7) Recommended for longer measuring ranges, typically > 66 ft (20 m).

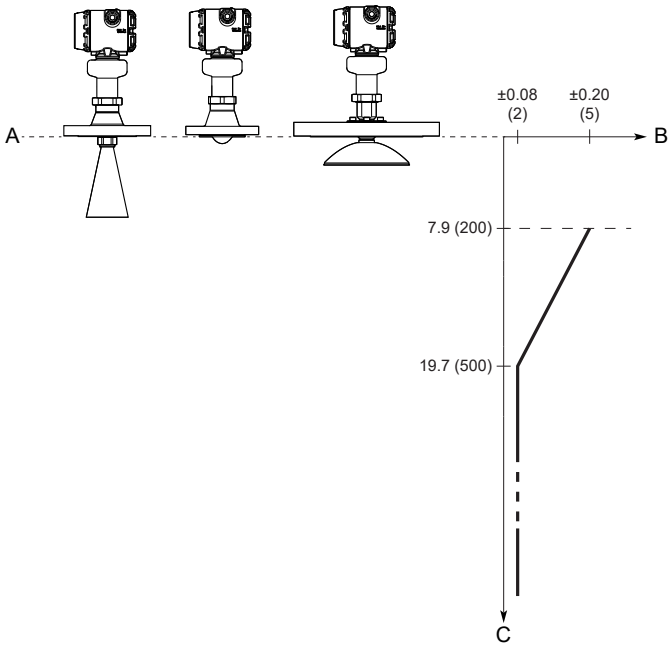
Related information

Measuring the Level of Solid Materials Technical Note

Accuracy over measuring range

Figure A-1 illustrates the accuracy over measuring range at reference conditions.

Figure A-1: Accuracy Over Measuring Range



A. Device Reference Point
B. Accuracy in inches (millimeters)
C. Distance in inches (millimeters)

For the extended cone antennas, the reduced accuracy zone ends 11.8 in. (30 cm) below the antenna end.

The accuracy in still pipe/chamber installations depends on how well the antenna size matches the pipe size.

A.1.3 Environment

Vibration resistance

- 2 g at 10-180 Hz according to IEC 61298-3, level “field with general application”
- IACS UR E10 test 7

For compliance with these standards, the transmitter housing must be fully engaged into the sensor module. This is achieved by rotating the transmitter housing clockwise to thread limit.

Related information

Adjust display orientation (optional)

Electromagnetic compatibility (EMC)

- EMC Directive (2014/30/EU): EN 61326-1
- EN 61326-2-3
- NAMUR recommendations NE21[(6)]

For Rosemount 5408:SIS, the blue plug on the terminal block must be connected.

Pressure Equipment Directive (PED)

Complies with 2014/68/EU article 4.3

Built-in lightning protection

EN 61326, IEC 61000-4-5, level 6kV

Radio approvals

- Radio Equipment Directive (2014/53/EU): ETSI EN 302 372, ETSI EN 302 729 and EN 62479
- Part 15 of the FCC Rules
- Industry Canada RSS 211

A.2 Functional specifications

A.2.1 General

Field of application

Continuous level measurements for tank monitoring, process control, and overfill prevention on a broad range of liquids, slurries, and solids.

Ideal for applications with varying and harsh process conditions, such as heavy turbulence, foaming, product build-up, condensing vapors, sticky, viscous, corrosive, and crystallizing products.

Measurement principle

Frequency Modulated Continuous Wave (FMCW)

Frequency range

24.05 to 27.0 (26.5[7]) GHz

Maximum output power

-5 dBm (0.32 mW)

Internal power consumption

< 1 W in normal operation

Humidity

0 - 100% relative humidity, non-condensing

Turn-on time

< 40 s[8]

(6) In challenging applications where the dynamic of the transmitter sensitivity is utilized by multiple factors such as small aperture antenna, very low product dielectric constant and/or turbulent surface, the margin for additional influence due to extreme EMC may be limited.

(7) 26.5 GHz in Australia, New Zealand, and Russia, and for LPR (Level Probing Radar), option code OA.

A.2.2 Functional safety

The Rosemount 5408:SIS Level Transmitter is IEC 61508 certified to:

- Low and high demand: Type B element
- SIL 2 for random integrity @ HFT=0
- SIL 3 for random integrity @ HFT=1
- SIL 3 for systematic capability

Related information

Functional Safety Certificate
Rosemount 5408:SIS Safety Manual

A.2.3 4-20 mA HART®

Output

Two-wire, 4-20 mA. Digital process variable is superimposed on 4-20 mA signal, and available to any host that conforms to the HART protocol. The digital HART® signal can be used in multidrop mode.

HART Revision

- Revision 6
- Revision 7

The HART revision can be switched in field.

Analog signal on alarm

The transmitter automatically and continuously performs self-diagnostic routines. If a failure or a measurement error is detected, the analog signal will be driven offscale to alert the user. High or low failure mode is user-configurable.

Table A-3: Signal on Alarm

Standard	High	Low
Rosemount standard	≥ 21.75 mA	≤ 3.75 mA
NAMUR NE43	≥ 22.5 mA	≤ 3.6 mA

Analog saturation levels

The transmitter will continue to set a current that corresponds to the measurement until reaching the associated saturation limit (and then freeze).

Table A-4: Saturation Levels

Standard	High	Low
Rosemount standard	20.8 mA	3.9 mA
NAMUR NE43	20.5 mA	3.8 mA

(8) Time from when power is applied to the transmitter until performance is within specifications.

A.2.4 Display and configuration

Damping

User selectable (default is 2 s, minimum is 0 s)

Output units

- Level and distance: ft., in., m, cm, mm
- Level rate: ft/s, in./min, in./s, m/h, m/s
- Volume: ft^3, $in.^3$, yd^3, US gal, imperial gal, barrel (bbl), m^3, l
- Temperature: °F, °C
- Signal strength: mV

Output variables

Variable	4-20 mA	Digital output	LCD display
Level	✓	✓	✓
Distance (ullage)	✓	✓	✓
Volume	✓	✓	✓
Scaled variable(1)	✓	✓	✓
Electronics temperature	N/A	✓	✓
Signal quality(1)	N/A	✓	✓
Level rate	N/A	✓	✓
Signal strength	N/A	✓	✓
Percent of range	N/A	✓	✓
Percent of range auxiliary	N/A	✓	✓
User-defined(1)	✓	✓	✓
Loop current	N/A	N/A	✓

(1) Only for transmitters ordered with Smart Diagnostics Suite.

A.2.5 Process temperature and pressure rating

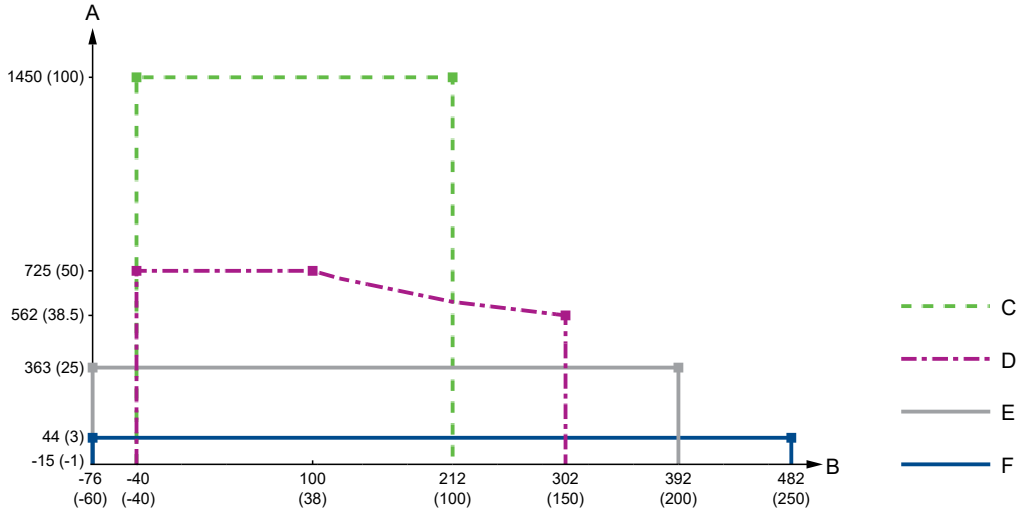
The following figures give the process temperature limits (measured at the lower part of the flange, Tri Clamp, or threaded connection) and pressure rating for different antenna types.

Final rating may be lower depending on flange selection.

For antenna type code CAB, at 100 °F (38 °C), the rating decreases with increasing temperature per ASME B16.5 Table 2-2.2, Class 300.

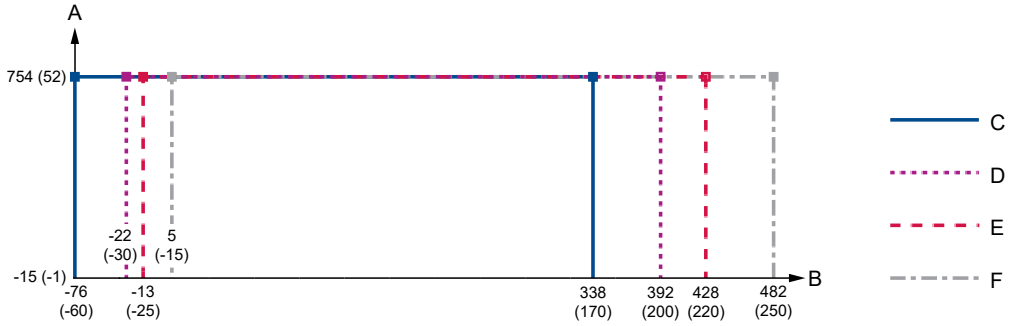
Note
For applications where saturated steam may occur, consult factory.

Figure A-2: Cone Antenna (PTFE Seal)



A. Pressure psig (bar)
B. Temperature °F (°C)
C. Code CAC
D. Code CAB
E. Code CAA
F. Code CAD

Figure A-3: Cone Antenna (PEEK Seal)



A. Pressure psig (bar)
B. Temperature °F (°C)
C. Code CBF (FVMQ)
D. Code CBV (Viton®)
E. Code CBM (FKM)
F. Code CBK (Kalrez® 6375)

Figure A-4: Process Seal Antenna with Tri Clamp

A. Pressure psig (bar)
B. Temperature °F (°C)

Figure A-5: 2-in. Process Seal Antenna with Flange

A. Pressure psig (bar)
B. Temperature °F (°C)

Figure A-6: 3-in. Process Seal Antenna with Flange

A. Pressure psig (bar)
B. Temperature °F (°C)

Figure A-7: 4-in. Process Seal Antenna with Flange

A. Pressure psig (bar)
B. Temperature °F (°C)

Figure A-8: Parabolic Antenna

A. Pressure psig (bar)
B. Temperature °F (°C)

A.2.6 Cryogenic applications

Operating temperature at flange

See Figure A-2 to Figure A-8 for antenna type specific operating limits.

Operating temperature in tank

-320.8 to 482 °F (-196 to 250 °C)

A.2.7 Ambient temperature limits

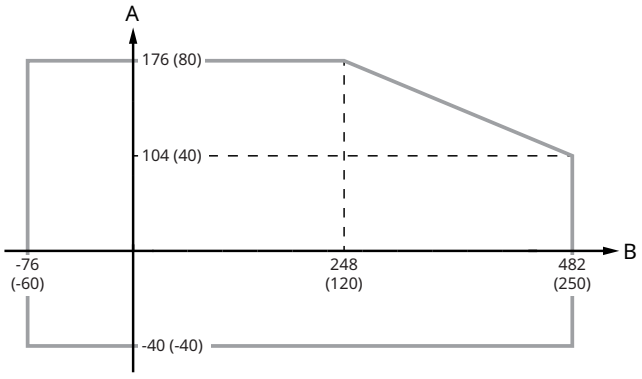
Table A-5: Ambient Temperature Limits

Description	Operating limit	Storage limit(1)
Without LCD display	-40 °F to 176 °F (-40 °C to 80 °C)	-58 °F to 176 °F (-50 °C to 80 °C)
With LCD display(2)		-40 °F to 176 °F (-40 °C to 80 °C)

(1) The minimum storage temperature is -22 °F (-30 °C) for the cone antenna with Kalrez® 6375 O-ring (antenna type code CBK).
(2) LCD display may not be readable and LCD display updates will be slower at temperatures below -4 °F (-20 °C).

The ambient temperature limits may be further restricted by the process temperature as described by Figure A-9.

Figure A-9: Ambient Temperature vs. Process Temperature



A. Ambient temperature °F (°C)
B. Process temperature °F (°C)

Aside from ambient temperature variations, heat from the process may be transferred to the transmitter housing. Being exposed to a high process temperature without extra cooling for an extended period of time may cause the electronics temperature to exceed the allowed limit and thereby affect the transmitter's performance and reliability. The latter are potential risks whenever a transmitter has shut down due to high electronics temperature. The transmitter will warn about the electronics temperature being out of limits.

Verify that the operating atmosphere of the transmitter is consistent with the appropriate hazardous locations certifications.

Related information

Electronics temperature out of limits
Product certifications

A.2.8 Flange rating

ASME

- 316 SST according to ASME B16.5 Table 2-2.2
- 316L SST according to ASME B16.5 Table 2-2.3 (for protective plate design)(9)
- Alloy C-276 (UNS N10276) according to ASME B16.5 Table 2-3.8
- Alloy 400 (UNS N04400) according to ASME B16.5 Table 2-3.4

EN

- 1.4404 according to EN 1092-1 material group 13E0

JIS

- 316 SST according to JIS B2220 material group No. 2.2
- 316L SST according to JIS B2220 material group No. 2.3 (for protective plate design)(9)

A.2.9 Conditions used for flange strength calculations

Table A-6: Stainless Steel Flanges

Item	ASME	EN, JIS
Bolting material	SA193 B8M CL.2, SA193 B7(1), or SA320 L7(1)	ISO 3506 A4-70 or Bumax® 88(1)
Gasket(2)	Soft (1a) with min. thickness 1.6 mm or Spiral wound gasket with nonmetallic filler (1b)	Soft (EN 1514-1) with min. thickness 1.6 mm or Spiral wound gasket with nonmetallic filler (EN 1514-2)
Flange material	Stainless steel A182 Gr. F316 and EN 10222-5-1.4404	
Hub material(3)	Stainless steel SA479 316 and EN 10272-1.4404	

(1) Only applicable to forged one-piece flanges.
(2) Not applicable to process seal antenna (features an integrated gasket). Use of extra gasket may result in faulty installation.
(3) Only applicable to flanges with welded construction.

(9) Flange rating according to backing flange.

Table A-7: Flanges with Protective Plate Design

Item	ASME	EN, JIS
Bolting material	SA193 B8M Cl.2	ISO 3506 A4-70
Gasket(1)	Soft (1a) with min. thickness 1.6 mm or Spiral wound gasket with nonmetallic filler (1b)	Soft (EN 1514-1) with min. thickness 1.6 mm or Spiral wound gasket with nonmetallic filler (EN 1514-2)
Flange material	Stainless steel A182 Gr. F316L/F316 and EN 10222-5-1.4404	
Hub material	SB574 Gr. N10276 (solution annealed condition) or SB164 Gr. N04400 (solution annealed condition)	

(1) Note that a minimum gasket thickness of 0.125 in. (3.2 mm) is required when using an air purge ring (option code PC1).

Table A-8: Alloy C-276 (UNS N10276) Flanges

Item	ASME	EN, JIS
Bolting material	UNS N10276	UNS N10276
Gasket	Soft (1a) with min. thickness 1.6 mm or Spiral wound gasket with nonmetallic filler (1b)	Soft (EN 1514-1) with min. thickness 1.6 mm or Spiral wound gasket with nonmetallic filler (EN 1514-2)
Flange material	SB462 Gr. N10276 (solution annealed condition) or SB575 Gr. N10276 (solution annealed condition)	
Hub material	SB574 Gr. N10276 (solution annealed condition)	

Table A-9: Alloy 400 (UNS N04400) Flanges

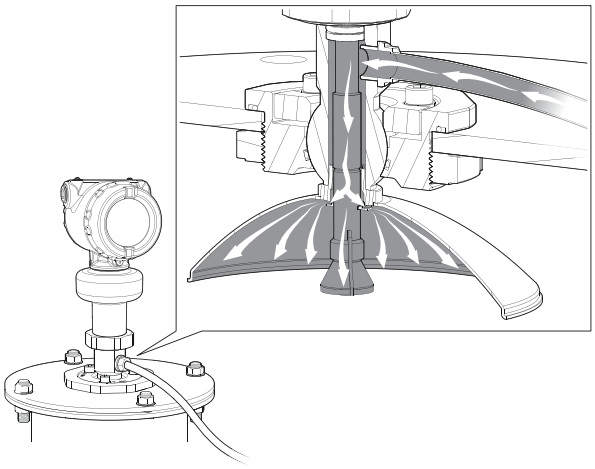
Item	ASME	EN, JIS
Bolting material	UNS N04400	UNS N04400
Gasket	Soft (1a) with min. thickness 1.6 mm or Spiral wound gasket with nonmetallic filler (1b)	Soft (EN 1514-1) with min. thickness 1.6 mm or Spiral wound gasket with nonmetallic filler (EN 1514-2)
Flange material	SB/B564 Gr. N04400 (solution annealed condition) or SB/B127 Gr. N04400 (solution annealed condition)	
Hub material	SB164 Gr. N04400 (solution annealed condition)	

A.2.10 Air purging

An air purge connection can prevent clogging of the antenna in extreme applications with dirt or heavy coating. To determine if air purging is needed, inspect the tank internal conditions at the location intended for the transmitter. If there is normally a thick layer of product build-up there, air purging is most likely needed. Typical purging media to use is air.

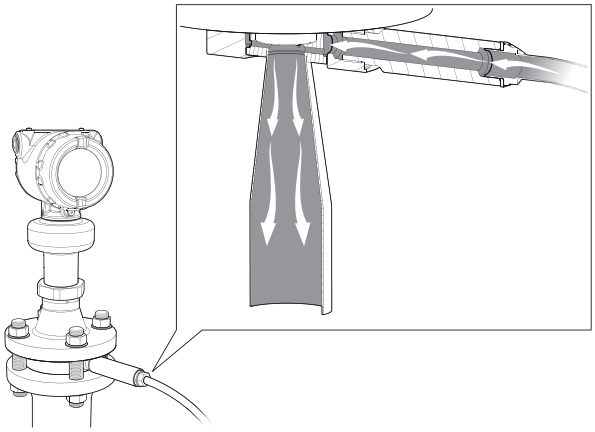
All parabolic antennas come with an integrated air purge connection (see Figure A-10).

Figure A-10: Air Purging for Parabolic Antenna



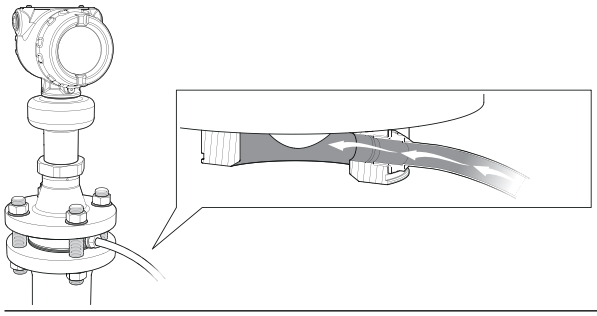
An air purge connection is also available for cone antennas with flanged connection by selecting option code PC1. This option consists of an antenna with purge holes and a separate air purge ring (see Figure A-11).

Figure A-11: Air Purging for Cone Antenna



Flushing connection rings are available as accessory for use with process seal antennas.

Figure A-12: Air Purging for Process Seal Antenna



Incoming air supply specification

- Maximum pressure: 190 psi (13 bar)
- Recommended pressure: 100 to 115 psi (7 to 8 bar)
- Inlet/outlet connection: BSPP (G) ⅜-in.
- Air consumption: 252 gal/min at 65 psi (955 l/min at 4.5 bar)

A.3 Physical specifications

A.3.1 Material selection

Emerson provides a variety of Rosemount products with various product options and configurations, including materials of construction that can be expected to perform well in a wide range of applications. The Rosemount product information presented is intended as a guide for the purchaser to make an appropriate selection for the application. It is the purchaser's sole responsibility to make a careful analysis of all process parameters (such as all chemical components, temperature, pressure, flow rate, abrasives, contaminants, etc.), when specifying product, materials, options, and components for the particular application. Emerson is not in a position to evaluate or guarantee the compatibility of the process fluid or other process parameters with the product, options, configuration, or materials of construction selected.

A.3.2 Transmissible Spongiform Encephalopathy (TSE) declaration

This declaration is applicable to Tri Clamp connections.

Emerson certifies no process wetted components used in this product contain substances of animal origin. Materials used in the production or processing of wetted components for this product meet the requirements stated in EMA/410/01 Rev. 3 and ISO 22442-1:2015. Wetted components in this product are considered free of TSE.

A.3.3 Engineered solutions

When standard model codes are not sufficient to fulfill requirements, please consult the factory to explore possible Engineered Solutions. This is typically, but not exclusively, related to the choice of wetted materials or the design of a process connection. These Engineered Solutions are part of the expanded offerings and may be subject to additional delivery lead time. For ordering, factory will supply a special P-labeled numeric option code that should be added at the end of the standard model string.

A.3.4 Housing and enclosure

Electrical connections

Two cable/conduit entries (½-14 NPT, M20 x 1.5, or G½)

Optional adapters: M12 4-pin male eurofast connector or A size Mini 4-pin male minifast connector

Materials

- Electronics housing: Polyurethane-covered Aluminum or Stainless Steel Grade CF-8M (ASTM A743)
- Sensor module: 316L SST

Weight

- Aluminum housing: 6.2 lb (2.8 kg)[10]
- Stainless steel housing: 10.0 lb (4.5 kg)[10]

Ingress protection

IP 66/67/68[11] and NEMA® 4X

A.3.5 Tank connection

The tank connection consists of a tank seal, a flange, NPT or BSPP (G) threads, Tri Clamp, or a specific welded connection with swivel feature for parabolic antenna.

Flange dimensions

Follows ASME B16.5, JIS B2220, and EN 1092-1 standards.

Related information

Standard flanges

Tri Clamp connection

Follows ISO 2852 standard.

A.3.6 Material exposed to tank atmosphere

Cone antenna, PTFE seal

- 316/316L SST (EN 1.4404), Alloy C-276 (UNS N10276), or Alloy 400 (UNS N04400)
- PTFE fluoropolymer

Cone antenna, PEEK seal

- 316/316L SST (EN 1.4404), Alloy C-276 (UNS N10276), or Alloy 400 (UNS N04400)
- PEEK polyetheretherketone
- FVMQ fluorosilicone, Kalrez® 6375 perfluoroelastomer, FKM fluoroelastomer, or Viton® fluoroelastomer (O-ring)

Process seal antenna

- PTFE fluoropolymer

(10) Fully functional transmitter with sensor module, housing, terminal block, LCD display, and covers.
(11) The transmitter meets IP 68 at 9.8 ft. (3 m) for 30 minutes.

Parabolic antenna

- 316/316L SST (EN 1.4404)
- PTFE fluoropolymer
- FVMQ fluorosilicone (O-ring)

A.4 Spare parts list - transmitter head

A.4.1 Required model components

Model

Code	Description	
5408	Radar Level Transmitter	★

Profile

Code	Description	
A	Standard monitoring & control applications	★
F(1)	Functional safety / SIS applications	★

(1) The Rosemount 5408:SIS has two operational modes: Safety (SIS) and Control/Monitoring. Safety (SIS) mode must be set when used in Safety Instrumented Systems. Control/Monitoring mode is intended for use in a Basic Process Control System (BPCS).

Measurement type

Code	Description	
1	Liquid level measurement	★
3	Solids level measurement	★
4(1)	Liquid & solids level measurement	★

(1) Note that for the Rosemount 5408:SIS (profile code F), solids level measurement is only available when operating in Control/Monitoring mode.

Performance class

Code	Description	Reference accuracy	
A	Ultra accuracy	±0.04 in. (±1 mm)	★
S	Standard	±0.08 in. (±2 mm)	★

Signal output

Code	Description	
H	4–20 mA with HART® communication (default output from factory is HART 7, add option code HR6 for HART 6)	★

Housing material

Code	Description	
A	Aluminum	★
S	Stainless steel (SST)	★

Conduit/cable threads

Code	Description	
1	½-14 NPT	★
2	M20 x 1.5	★
3(1)	G½	

(1) G½ thread form is not available with hazardous locations approvals.

Hazardous locations certifications

Code	Description	
NA	None	★
E1	ATEX/UKEX Flameproof	★
I1	ATEX/UKEX Intrinsic Safety	★
N1	ATEX/UKEX Type n	★
E5	USA Explosion-proof, Dust Ignition-proof	★
I5	USA Intrinsically Safe; Nonincendive	★
E6	Canadian Explosion-proof, Dust Ignition-proof	★
I6	Canadian Intrinsically Safe; Nonincendive	★
E7	IECEx Flameproof, Dust Ignition-proof	★
I7	IECEx Intrinsic Safety	★
N7	IECEx Type n	★
E2	INMETRO Flameproof	★
I2	INMETRO Intrinsic Safety	★
N2	INMETRO Type n	★
E3	China Flameproof	★
I3	China Intrinsic Safety	★
N3	China Type n	★
E4	Japan Flameproof	★
EP	Republic of Korea Flameproof	★
IP	Republic of Korea Intrinsic Safety	★
EM(1)	Technical Regulations Customs Union (EAC) Flameproof	★
IM(1)	Technical Regulations Customs Union (EAC) Intrinsic Safety	★
NM(1)	Technical Regulations Customs Union (EAC) Type n	★

Code	Description	
EW	India Flameproof	★
IW	India Intrinsic Safety	★

(1) Not available with performance class code A (ultra accuracy).

Materials of construction

Code	Description	
Z	None (spare transmitter head)	★

Process connection type

Code	Description	
Z	None (spare transmitter head)	★

Process connection size

Code	Description	
Z	None (spare transmitter head)	★

Process connection rating

Code	Description	
ZZ	None (spare transmitter head)	★

Antenna type

Code	Description	
ZZZ	None (spare transmitter head)	★

Antenna size

Code	Description	
Z	None (spare transmitter head)	★

A.4.2 Additional options

Display

Code	Description	
M5	LCD display	★

Functional safety options

Code	Description	
EF2	Extended SIS package (transmitter's measurement response time calculator)	★

Diagnostic functionality

Code	Description	
DA1	HART Smart Diagnostics Suite	★

Extended measuring range

Code	Description	
ER(1)	Extended	★

(1) Accuracy may be reduced.

Smart proof test

Code	Description	
ET	Smart Echo Level Test	★

HART revision configuration

Code	Description	
HR6	HART revision 6 configuration (default output from factory is HART 7, add option code HR6 for HART 6)	★

Open air applications configuration

This option is only available with parabolic antenna, 3-in. (DN80) and 4-in. (DN100) process seal antennas, and 4-in. (DN100) cone antenna.

Code	Description	
OA	Open air applications configuration; LPR (Level Probing Radar)	★

Factory configuration

Code	Description	
C1	Factory configuration per Configuration Data Sheet	★

Alarm limits

Code	Description	
C4	NAMUR alarm and saturation levels, high alarm	★
C5	NAMUR alarm and saturation levels, low alarm	★
C8(1)	Standard Rosemount alarm and saturation levels, low alarm	★

(1) The standard alarm setting is high.

Special quality assurance

Code	Description	
Q4	Calibration data certificate	★

Hygienic certification

Only available for process seal antennas with Tri Clamp connection.

Code	Description	
QA	Certificate of compliance to 3-A®	★

Quality certification for safety

Code	Description	
QS	Certificate of FMEDA Data	★
QT	Safety-certified to IEC 61508 with certificate of FMEDA data	★

Overfill prevention

Code	Description	
U1	Overfill prevention according to WHG/TUV	★

Shipboard approvals

Transmitters with aluminum housing are not approved for open deck installations; for use only in engine room, pump room, etc.

Code	Description	
SBS	American Bureau of Shipping Type Approval	★
SDN	Det Norske Veritas Germanischer Lloyd (DNV GL) Type Approval	★
SLL	Lloyd's Register Type Approval	★
SBV	Bureau Veritas Type Approval	★
SRS	Russian Maritime Register of Shipping	★

Extended product warranty

Rosemount extended warranties have a limited warranty of three or five years from date of shipment.

Code	Description	
WR3	3-year limited warranty	★
WR5	5-year limited warranty	★

Paint option for aluminum housing

Code	Description	
PY1	Housing and covers in yellow per RAL 1003	★
PY2	Covers in yellow per RAL 1003	★
PR1	Housing and covers in red per RAL 3002	★
PR2	Covers in red per RAL 3002	★
PO1	Housing and covers in orange per Munsell 2.5 YR 6/14	★
PO2	Covers in orange per Munsell 2.5 YR 6/14	★

Conduit electrical connector (shipped uninstalled)

Requires ½-14 NPT conduit/cable threads. Available with Intrinsically Safe approvals only.

Code	Description	
EC	M 12, 4-pin, male connector (eurofast®)	★
MC	A size Mini, 4-pin, male connector (minifast®)	★

Adapter wetted parts

Rosemount 5408 is backward compatible with the full range of Rosemount 5402 antennas, manufactured after September 2013, when ordered with the appropriate adapter (option code A1).

The Rosemount 5408 transmitter head can also pre-configured to an existing Rosemount 5402 antenna. Contact your Emerson sales representative for more information.

Code	Description	
A1	Adapter for Rosemount 5402 Antennas	★

Specials

Code	Description	
PXXXX	Custom engineered solutions beyond standard model codes. Consult factory for details.	

A.5 Spare parts list - antenna

A.5.1 Required model components

Model

Code	Description	
5408	Radar Level Transmitter	★

Profile

Code	Description	
Z	None (Spare Antenna)	★

Measurement type

Code	Description	
9	None (Spare Antenna)	★

Performance class

Code	Description	
Z	None (Spare Antenna)	★

Signal output

Code	Description	
Z	None (Spare Antenna)	★

Housing material

Code	Description	
Z	None (Spare Antenna)	★

Conduit/cable threads

Code	Description	
Z	None (Spare Antenna)	★

Hazardous locations certifications

Code	Description	
NA	None	★

Materials of construction

Code	Description	Available antenna types	
1	316/316L/EN 1.4404	Cone, parabolic	★
7	All PTFE wetted parts	Process seal	★
2	Alloy C-276 (UNS N10276) with protective plate	Cone	
3	Alloy 400 (UNS N04400) with protective plate	Cone	
H	Alloy C-276 (UNS N10276) process connection, flange, and antenna	Cone	
M	Alloy 400 (UNS N04400) process connection, flange, and antenna	Cone	

Process connection type

Code	Description	Available antenna types	
F(1)	Flat Face flange	Cone, parabolic	★
R(2)	Raised Face flange	All	★
N	NPT thread	Cone	★
G	BSPP (G) thread	Cone, parabolic	★
B	Bracket mounting	All	★
C	Tri Clamp	Process seal	★
W	Welded connection	Parabolic	★
T	Ring Type Joint (RTJ) flange	Cone	

(1) Type A flat face for EN 1092-1 flanges.
(2) Type B1 raised face for EN 1092-1 flanges.

Process connection size

Code	Description	Available antenna types	
A	1½-in.	Cone	★
2	2-in./DN50/50A	Cone, process seal	★
3	3-in./DN80/80A	Cone, process seal	★
B	3½-in.	Parabolic	★
4	4-in./DN100/100A	Cone, process seal	★
6	6-in./DN150/150A	Cone	★
8	8-in./DN200/200A	Cone, parabolic	★
T	10-in./DN250/250A	Parabolic	★
Z	None (use when ordering bracket mounting)	All	★

Process connection rating

Code	Description		
ZZ	For use with non-flange process connection type		★
ASME flanges			
AA	ASME B16.5 Class 150		★
AB	ASME B16.5 Class 300		★
AC	ASME B16.5 Class 600		★
AD	ASME B16.5 Class 900		★
EN flanges		Note	
DK	EN1092-1 PN6		★
DA	EN1092-1 PN16	PN10 and PN16 dimensions are identical for DN50 to DN150	★
DB	EN1092-1 PN40	PN25 and PN40 dimensions are identical for DN50 to DN150	★
DC	EN1092-1 PN63		★
DD	EN1092-1 PN100		★
JIS flanges			
JK	JIS 5K		★
JA	JIS 10K		★
JB	JIS 20K		★

Antenna type

For applications where saturated steam may occur, consult factory.

Code	Description	Operating pressure	Operating temperature	
CAA	Cone antenna (PTFE seal)	-15 to 363 psig (-1 to 25 bar)	-76 to 392 °F (-60 to 200 °C)	★
CAB	Cone antenna (PTFE seal)	-15 to 725 psig (-1 to 50 bar)(1)	-40 to 302 °F (-40 to 150 °C)	★
CAC	Cone antenna (PTFE seal)	-15 to 1450 psig (-1 to 100 bar)	-40 to 212 °F (-40 to 100 °C)	★
CAD	Cone antenna (PTFE seal)	-15 to 44 psig (-1 to 3 bar)	-76 to 482 °F (-60 to 250 °C)	★
CBF	Cone antenna (PEEK seal, FVMQ)	-15 to 754 psig (-1 to 52 bar)	-76 to 338 °F (-60 to 170 °C)	★
CBK	Cone antenna (PEEK seal, Kalrez® 6375)	-15 to 754 psig (-1 to 52 bar)	5 to 482 °F (-15 to 250 °C)	★
CBM	Cone antenna (PEEK seal, FKM)	-15 to 754 psig (-1 to 52 bar)	-13 to 428 °F (-25 to 220 °C)	★
CBV	Cone antenna (PEEK seal, Viton®)	-15 to 754 psig (-1 to 52 bar)	-22 to 392 °F (-30 to 200 °C)	★
SAA	Process seal antenna	-15 to 363 psig (-1 to 25 bar)(2)	-76 to 392 °F (-60 to 200 °C)(2)	★
PAS	Parabolic antenna, swivel mount	-7 to 43 psig (-0.5 to 3 bar)	-67 to 392 °F (-55 to 200 °C)	★

(1) Pressure limit is derated for process temperatures above 100 °F (38 °C).
(2) The final rating depends on the selected process connection.

Antenna size

Code	Description	Available antenna types	
A(1)	1½-in. (DN40)	Cone (PTFE seal)	★
2	2-in. (DN50)	Cone, process seal	★
3	3-in. (DN80)	Cone, process seal	★
4	4-in. (DN100)	Cone, process seal	★
8	8-in. (DN200)	Parabolic	★

(1) 1½-in. (DN40) cone antenna is available for 1½-in. NPT threaded connection and materials of construction code 1 (316/316L/EN 1.4404).

A.5.2 Additional options

Antenna extensions

Code	Description	Total length	Available antenna sizes	
S1	Extended cone antenna	23.6-in. (600 mm)	All except 1½-in. (DN40)	★
S2	Extended cone antenna, segmented	47.2-in. (1200 mm)		★

Purging connection

Option code PC1 is for cone antennas only, and requires matching flange and antenna sizes. Note that all parabolic antennas come with an integrated air purge connection.

A minimum gasket thickness of 0.125 in. (3.2 mm) is required for flanges with protective plate design.

Code	Description	
PC1	Purging connector (purge ring)	★

Welding standard for flanges

Only applies to flanged process connections with welded construction or protective plate design; only applicable to cone antennas.

Flanged process connections with protective plate design are only available with ASME IX (option code AW).

Code	Description	
AW	According to ASME IX	★
EW	According to EN-ISO	★

Country certification

CRN is not available with EN1092-1 or JIS B2220 flanges, neither for ASME B16.5 flanges in materials of construction code M, nor 4-in. process connection with Tri Clamp.

Forged one-piece flange will be provided instead of welded construction for ASME B16.5 Class 300 raised face flange size 2-in., 3-in., or 4-in., and ASME B16.5 Class 150 raised face flange size 8-in.

Code	Description	
J1	Canadian Registration (CRN)	★

Hydrostatic testing

Hydrostatic testing is only available for cone antennas and process seal antennas with flanged process connections.

Code	Description	
Q5	Hydrostatic testing, including certificate	★

Material traceability certification

Certificate includes all pressure retaining and wetted parts.

Code	Description	
Q8	Material traceability certification per EN 10204 3.1 (2.1 for non-metallic)	★

Hygienic certification

Only available for process seal antennas with Tri Clamp connection.

Code	Description	
QA	Certificate of compliance to 3-A®	★

Food and Drug Administration (FDA) statement

Only available for process seal antennas with Tri Clamp connection.

Code	Description	
QH(1)	Certificate of compliance to FDA 21CFR110, Subpart C: Food and Drug Administration - Current Good Manufacturing Practice in Manufacturing, Packing, or Holding Human Food	★

(1) Applicable only to wetted parts.

Materials certification

The materials certification is not available with parabolic antenna.

For materials certification with antenna size 1½-in. (DN40), consult factory.

Code	Description	
Q15	NACE® material recommendation per NACE MR0175/ISO 15156	★
Q25	NACE material recommendation per NACE MR0103/ISO 17945	★
Q35	NACE material recommendation per NACE MR0175/ISO 15156 and NACE MR0103/ISO 17945	★

Welding procedure qualification record documentation

Only applies to flanged process connections with welded construction or protective plate design; only applicable to cone antennas.

Code	Description	
Q66	Welding Procedure Qualification Record (WPQR)	★
Q67	Welder Performance Qualification (WPQ)	★
Q68	Welding Procedure Specification (WPS)	★
Q79	WPQR/WPQ/WPS	★

Dye penetration test certificate

Only applies to flanged process connections with welded construction or protective plate design; only applicable to cone antennas.

Code	Description	
Q73	Certificate of liquid penetrant inspection	★

Positive material identification certificate

Code	Description	
Q76	Positive material identification certificate of conformance	★

Shipboard approvals

Transmitters with aluminum housing are not approved for open deck installations; for use only in engine room, pump room, etc.

Code	Description	
SBS	American Bureau of Shipping Type Approval	★
SDN	Det Norske Veritas Germanischer Lloyd (DNV GL) Type Approval	★
SLL	Lloyd's Register Type Approval	★
SBV	Bureau Veritas Type Approval	★
SRS	Russian Maritime Register of Shipping	★

Extended product warranty

Rosemount extended warranties have a limited warranty of three or five years from date of shipment.

Code	Description	
WR3	3-year limited warranty	★
WR5	5-year limited warranty	★

Specials

Code	Description	
PXXXX	Custom engineered solutions beyond standard model codes. Consult factory for details.	

A.6 Availability of process connections

Table A-10: Cone Antenna, ASME B16.5 flanges - 316/316L SST/EN 1.4404 (Type vs. Size and Rating)

R = Raised Face; T = Ring Type Joint

Process connection size	Process connection rating, ASME B16.5 flanges			
	Class 150	Class 300	Class 600	Class 900
1½-in.	N/A	N/A	N/A	N/A
2-in.	R(1)	R(2)	R(2), T(2)	R(1), T(1)
3-in.	R(1)	R(2)	R(1), T(1)	R(1), T(1)
4-in.	R(1)	R(1)	R(1), T(1)	R(1), T(1)
6-in.	R(1)	R(2)	N/A	N/A
8-in.	R(2)	R(1)	N/A	N/A

(1) Forged one-piece flange.
(2) Welded construction.

Table A-11: Cone Antenna, EN1092-1 flanges - 316/316L SST/EN 1.4404 (Type vs. Size and Rating)

F = Flat Face; R = Raised Face

Process connection size	Process connection rating, EN1092-1 flanges			
	PN16(1)	PN40(1)	PN63(2)	PN100(2)
DN50	F	F, R	F, R	F
DN80	F, R	F, R	F, R	F, R
DN100	F, R	F, R	F	F
DN150	F, R	F, R	F	N/A
DN200	F, R	F, R	N/A	N/A

(1) Welded construction for type A flat face; forged one-piece flange or welded construction for type B1 raised face.
(2) Welded construction.

Table A-12: Cone Antenna, JIS B2220 flanges - 316/316L SST/EN 1.4404 (Type vs. Size and Rating)

R = Raised Face

Process connection size	Process connection rating, JIS B2220 flanges	
	10K(1)	20K(1)
50A	R	R
80A	R	R
100A	R	R
150A	R	R
200A	R	R

(1) Welded construction.

Table A-13: Cone Antenna, Thread - 316/316L SST/EN 1.4404 (Type vs. Size and Rating)

G = BSPP (G) thread; N = NPT thread

Process connection size	Process connection rating, Thread
1½-in.	G, N
2-in.	G, N
3-in.	G, N
4-in.	G, N
6-in.	N/A
8-in.	N/A

Table A-14: Cone Antenna - Alloy C-276 and Alloy 400 (Type vs. Size and Rating)

N = NPT thread; R = Raised Face

Process connection size	Process connection rating								
	Thread	ASME B16.5 flanges(1)			EN1092-1 flanges(2)(4)			JIS B2220 flanges(4)	
		Class 150	Class 300	Class 600	PN16	PN40	PN63	10K	20K
1½-in.	N	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2-in./DN50/50A	N	R(3)	R(3)	R(3)	R	R	R	R	R
3-in./DN80/80A	N/A	R(3)	R(3)	R(4)	R	R	R	R	R
4-in./DN100/100A	N/A	R(3)	R(3)	N/A	R	R	R	R	R
6-in./DN150/150A	N/A	R(3)	R(4)	N/A	R	R	R	R	R
8-in./DN200/200A	N/A	R(4)	N/A	N/A	R	R	N/A	R	R

(1) Welded construction for materials of construction codes H and M.
(2) Backing flange in flat face.
(3) Available with materials of construction codes 2, 3, H, and M.
(4) Only available with protective plate design (materials of construction codes 2 and 3).

Table A-15: Process Seal Antenna (Type vs. Size and Rating)

C = Tri Clamp; R = Raised Face

Process connection size	Process connection rating						
	Tri Clamp	ASME B16.5 flanges(1)		EN1092-1 flanges(1)			JIS B2220 flanges(1)
		Class 150	Class 300	PN6	PN16	PN40	10K
2-in./DN50/50A	C	R	R	R	R	R	R
3-in./DN80/80A	C	R	R	R	R	R	R
4-in./DN100/100A	C	R	R	R	R	R	R

(1) Forged one-piece flange.

Table A-16: Parabolic Antenna (Type vs. Size and Rating)

F = Flat Face; G = BSPP (G) thread; R = Raised Face; W = Welded connection

Process connection size	Process connection rating				
	Thread	Welded	ASME B16.5 Class 150 flange	EN1092-1 PN6 flange	JIS B2220 5K flange
3½-in.	G	W	N/A	N/A	N/A
8-in./DN200/200A	N/A	N/A	R	F	R
10-in./DN250/250A	N/A	N/A	R	F	R

Related information

Standard flanges

A.7 Accessories

A.7.1 Flushing connection rings

Only available for process seal antennas.

Not available with Canadian Registration Number (CRN).

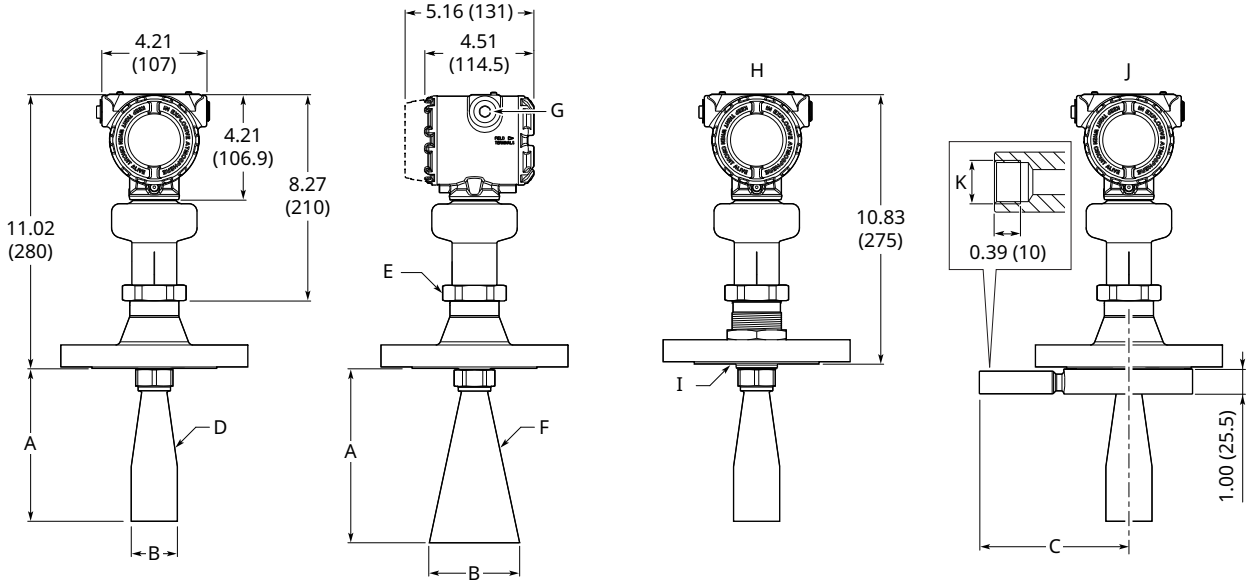
Item number	Description	
DP0002-2111-S6	2-in. ANSI, one ¼-in. NPT connection, 316L	
DP0002-3111-S6	3-in. ANSI, one ¼-in. NPT connection, 316L	
DP0002-4111-S6	4-in. ANSI/DN100, one ¼-in. NPT connection, 316L	
DP0002-5111-S6	DN50, one ¼-in. NPT connection, 316L	
DP0002-8111-S6	DN80, one ¼-in. NPT connection, 316L	

A.7.2 HART modem and cables

Item number	Description	
03300-7004-0002	MACTek® VIATOR® HART Modem and cables (USB connection)	★

A.8 Dimensional drawings

Figure A-13: Cone Antenna with Flanged Process Connection



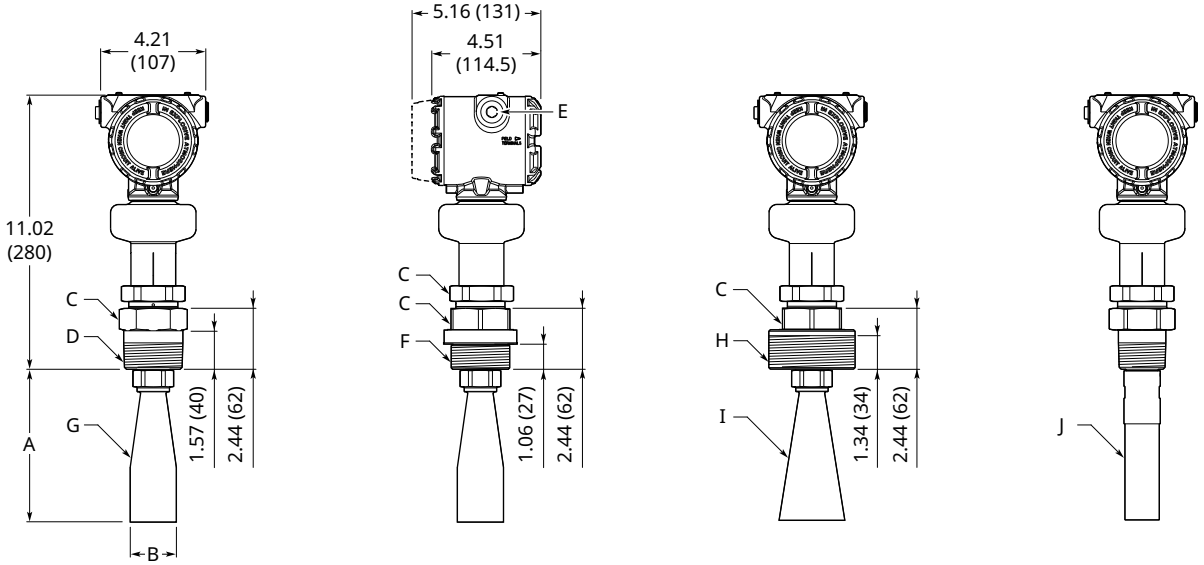
A. See Table A-17 for dimensions.
B. See Table A-17 for dimensions.
C. See Table A-17 for dimensions.
D. 2-in. (DN50) cone style
E. s60
F. 3-in. (DN80) and 4-in. (DN100) cone style
G. ½-14 NPT, M20 x 1.5, or G½; optional adapters: eurofast® and minifast®
H. Protective plate design
I. Protective plate
J. Purging connector (option code PC1)
K. G⅜-in.

Dimensions are in inches (millimeters).

Table A-17: Cone Antenna Dimensions

Cone size	A	B	C
1½-in. (DN40)	5.98 in. (152 mm)	1.38 in. (35 mm)	N/A
2-in. (DN50)	6.10 in. (155 mm)	1.85 in. (47 mm)	5.39 in. (137 mm)
3-in. (DN80)	6.02 in. (153 mm)	2.64 in. (67 mm)	6.77 in. (172 mm)
4-in. (DN100)	6.93 in. (176 mm)	3.62 in. (92 mm)	7.80 in. (198 mm)

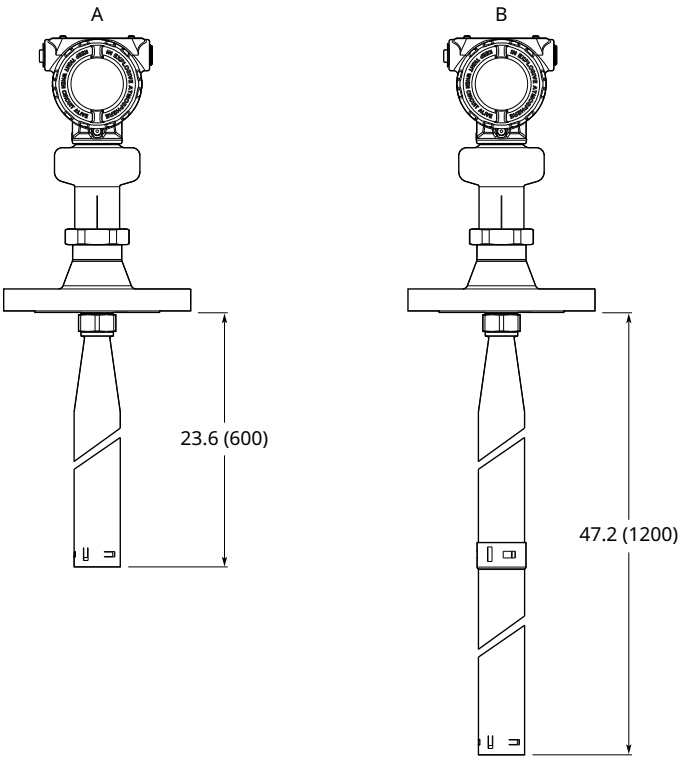
Figure A-14: Cone Antenna with Threaded Process Connection



A. See Table A-17 for dimensions.
B. See Table A-17 for dimensions.
C. s60
D. NPT 1½-, 2-, 3-, 4-in.
E. ½-14 NPT, M20 x 1.5, or G½; optional adapters: eurofast and minifast
F. BSPP (G) 1½-, 2-in.
G. 2-in. (DN50) cone style
H. BSPP (G) 3-, 4-in.
I. 3-in. (DN80) and 4-in. (DN100) cone style
J. 1½-in. (DN40) cone style

Dimensions are in inches (millimeters).

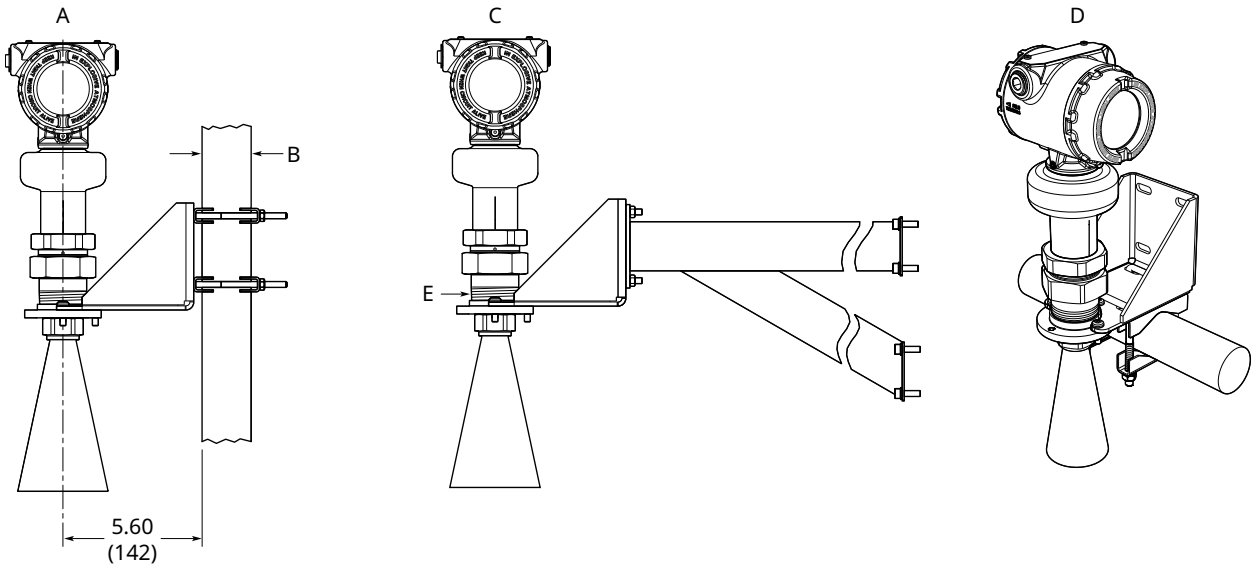
Figure A-15: Extended Cone Antenna



A. Option code S1
B. Option code S2

Dimensions are in inches (millimeters).

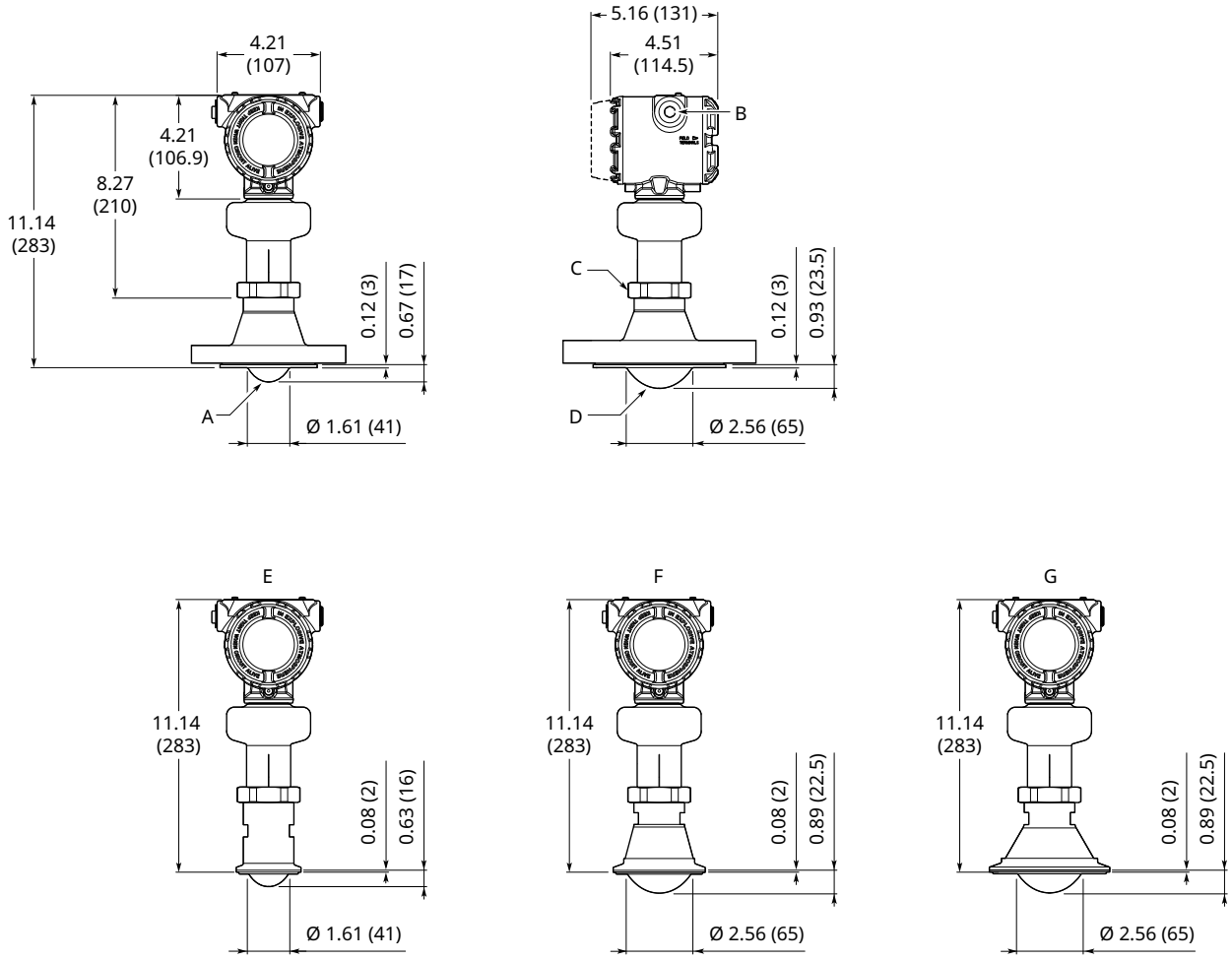
Figure A-16: Cone Antenna with Bracket Mounting



A. Pipe mounting (vertical pipe)
B. Pipe diameter, max 2.52 in. (64 mm)
C. Wall mounting (see Figure A-21 for hole pattern)
D. Pipe mounting (horizontal pipe)
E. NPT 1½-in.

Dimensions are in inches (millimeters).

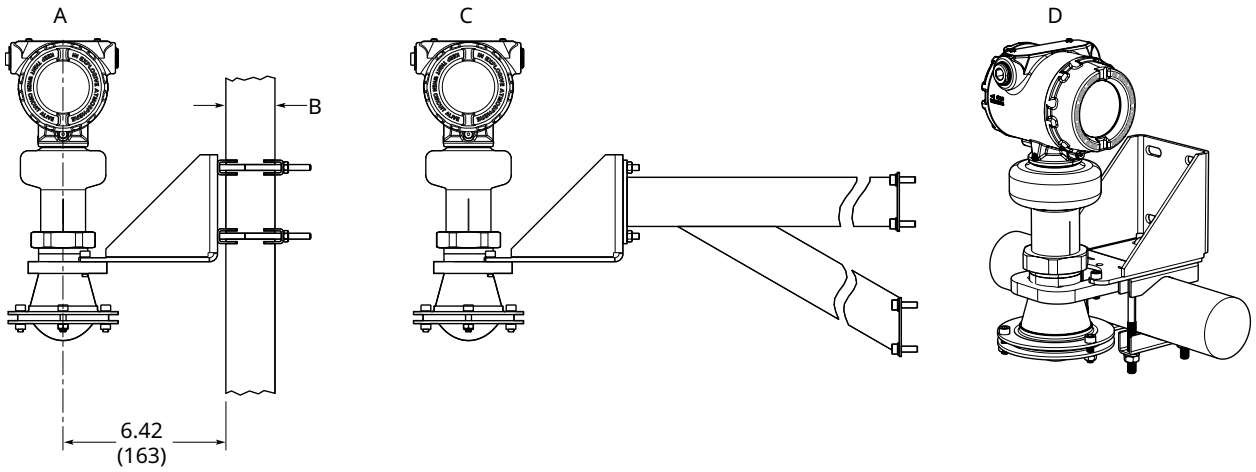
Figure A-17: Process Seal Antenna



A. 2-in. (DN50) process seal style
B. ½-14 NPT, M20 x 1.5, or G½; optional adapters: eurofast and minifast
C. s60
D. 3-in. (DN80) and 4-in. (DN100) process seal style
E. 2-in. Tri Clamp
F. 3-in. Tri Clamp
G. 4-in. Tri Clamp

Dimensions are in inches (millimeters).

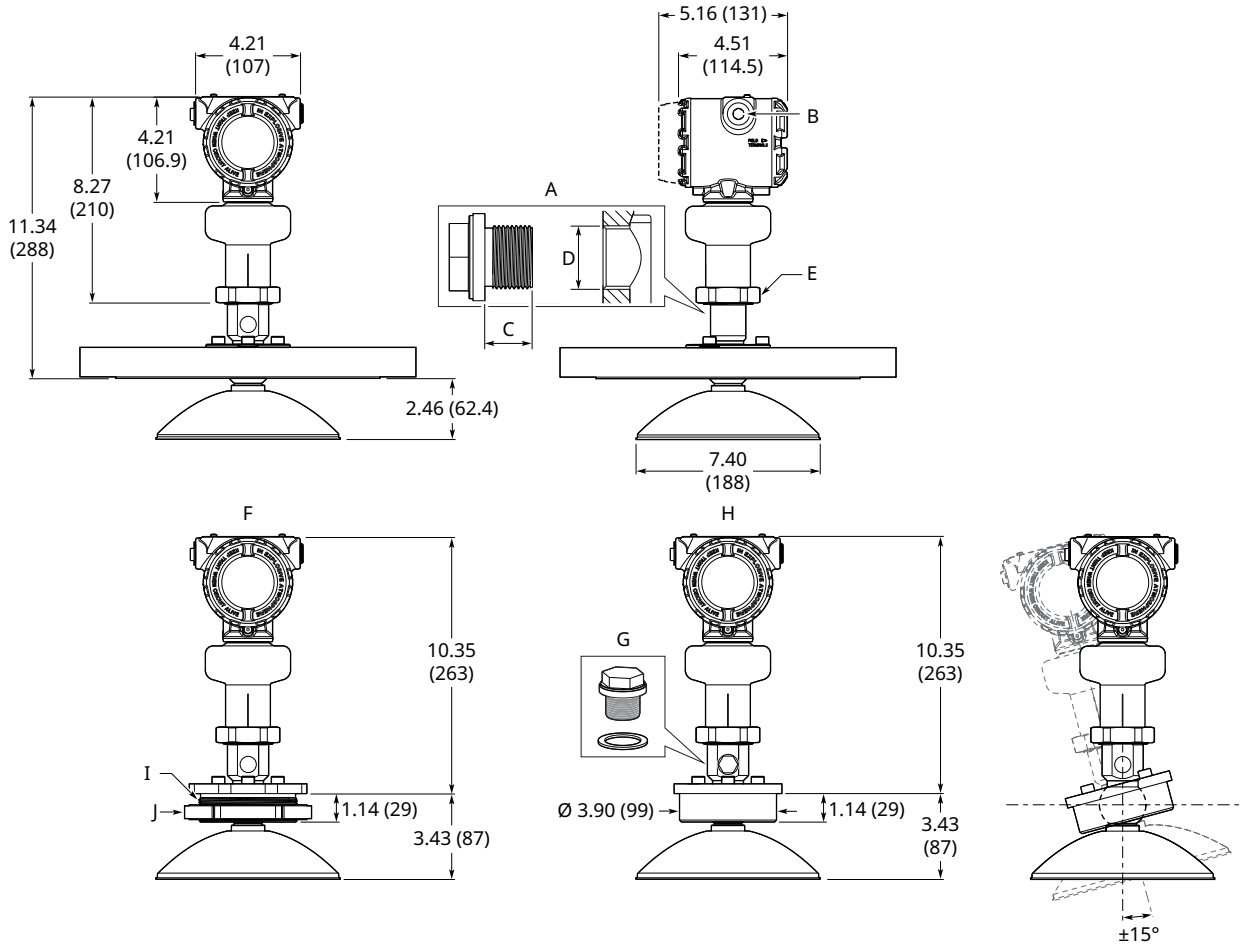
Figure A-18: Process Seal Antenna with Bracket Mounting



A. Pipe mounting (vertical pipe)
B. Pipe diameter, max 2.52 in. (64 mm)
C. Wall mounting (see Figure A-21 for hole pattern)
D. Pipe mounting (horizontal pipe)

Dimensions are in inches (millimeters).

Figure A-19: Parabolic Antenna

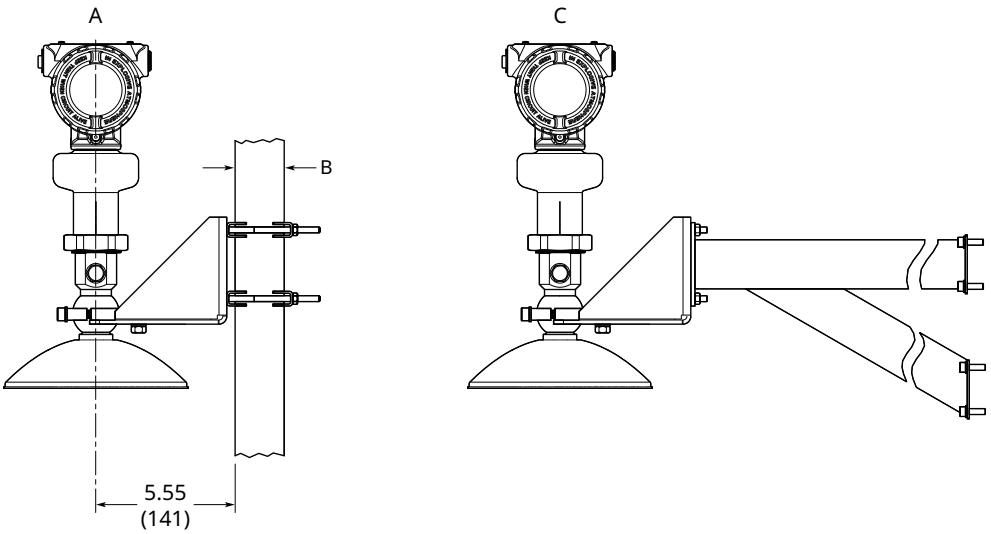


A. Purging connector
B. ½-14 NPT, M20 x 1.5, or G½; optional adapters: eurofast and minifast
C. 0.3-0.4 (8-10) (gasket excluded)
D. G⅜-in.
E. s60
F. Threaded connection
G. Purge plug kit (supplied)
H. Welded connection
I. BSPP (G) 3½-in.
J. Lock nut (supplied)(1)

1. Maximum flange thickness (with lock nut): 0.59 in. (15 mm)

Dimensions are in inches (millimeters).

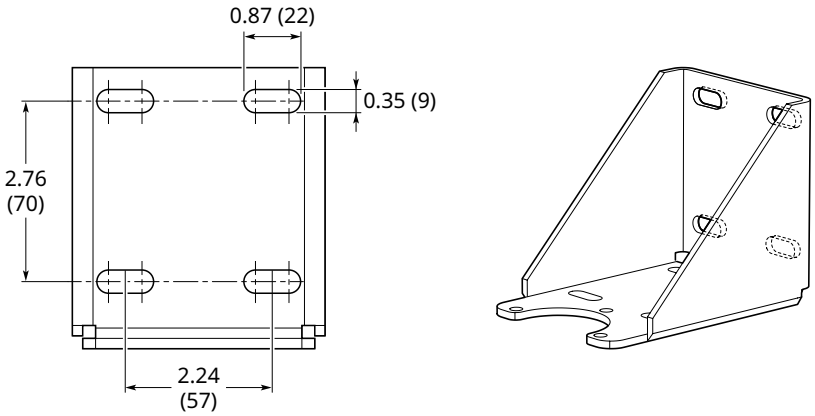
Figure A-20: Parabolic Antenna with Bracket Mounting



A. Pipe mounting (vertical pipe)
B. Pipe diameter, max 2.52 in. (64 mm)
C. Wall mounting (see Figure A-21 for hole pattern)

Dimensions are in inches (millimeters).

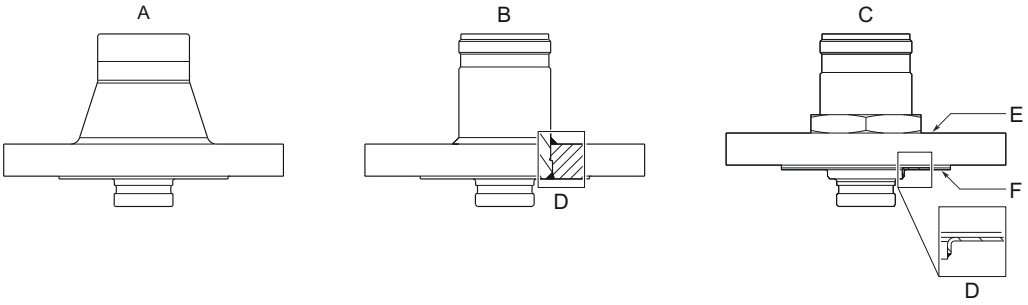
Figure A-21: Hole Pattern for Wall Mounting



Dimensions are in inches (millimeters).

A.8.1 Standard flanges

Figure A-22: Cone Antenna Flange Connection



A. Forged one-piece
B. Welded construction
C. Protective plate design
D. Weld
E. Backing flange
F. Protective plate

Table A-18: Standard Flanges for Cone Antenna

Standard	Face type (1)	Face surface finish, R_a
ASME B16.5	Raised face	125-250 µin
	Ring type joint	< 63 µin
EN 1092-1	Type B1 raised face	3.2-12.5 µm
	Type A flat face	3.2-12.5 µm
JIS B2220	Raised face	3.2-6.3 µm

(1) Face gasket surface is serrated per mating standard.

Table A-19: Cone Antennas with Protective Plate

Standard	Face type including protective plate	Plate surface finish, R_a
ASME B16.5	Raised face	3.2-6.3 µm
EN 1092-1	Raised face	3.2-6.3 µm
JIS B2220	Raised face	3.2-6.3 µm

Figure A-23: Parabolic Antenna Flange Connection

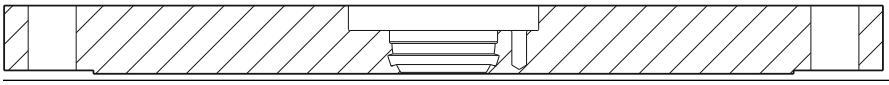


Table A-20: Standard Flanges for Parabolic Antenna

Standard	Face type (1)	Face surface finish
ASME B16.5	Raised face	125-250 µin
EN 1092-1	Type A flat face	3.2-12.5 µm

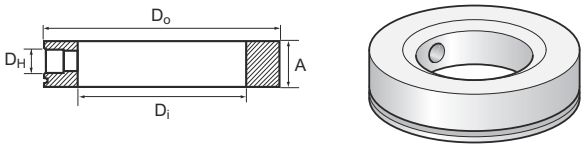
Table A-20: Standard Flanges for Parabolic Antenna *(continued)*

Standard	Face type (1)	Face surface finish
JIS B2220	Raised face	3.2-12.5 µm

(1) Face gasket surface is serrated per mating standard.

A.8.2 Flushing connection rings

Figure A-24: Flushing Connection Rings



A. Height: 0.97 in. (24.6 mm)

Table A-21: Dimensions of Flushing Connection Rings

Flushing connection rings	D_i	D_o	D_H
2-in. ANSI	2.12 (53.8)	3.62 (91.9)	¼-in. NPT
3-in. ANSI	3.60 (91.4)	5.00 (127.0)	¼-in. NPT
4-in. ANSI/DN100	3.60 (91.4)	6.20 (157.5)	¼-in. NPT
DN50	2.40 (61.0)	4.00 (102.0)	¼-in. NPT
DN80	3.60 (91.4)	5.43 (138.0)	¼-in. NPT

B Configuration parameters

B.1 Menu tree

Figure B-1 shows the UIP menu tree for Rosemount Radar Master Plus. See Figure B-2 for the DD menu tree.

Figure B-1: UIP Menu Tree

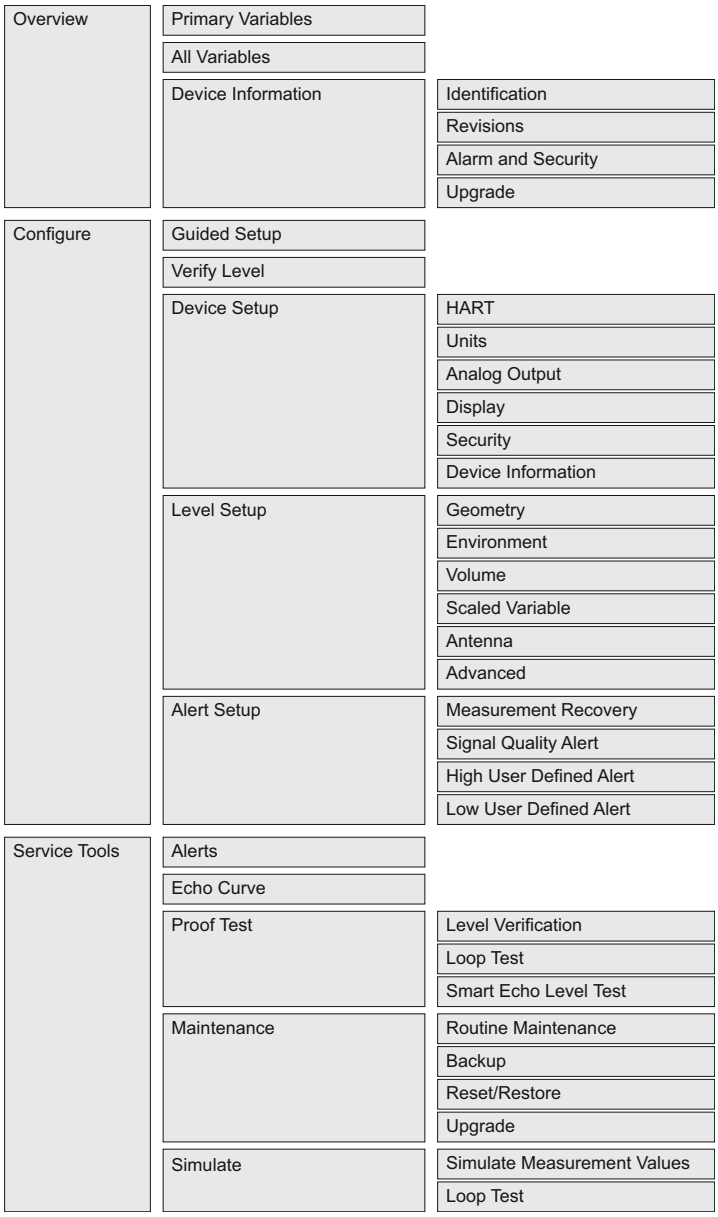
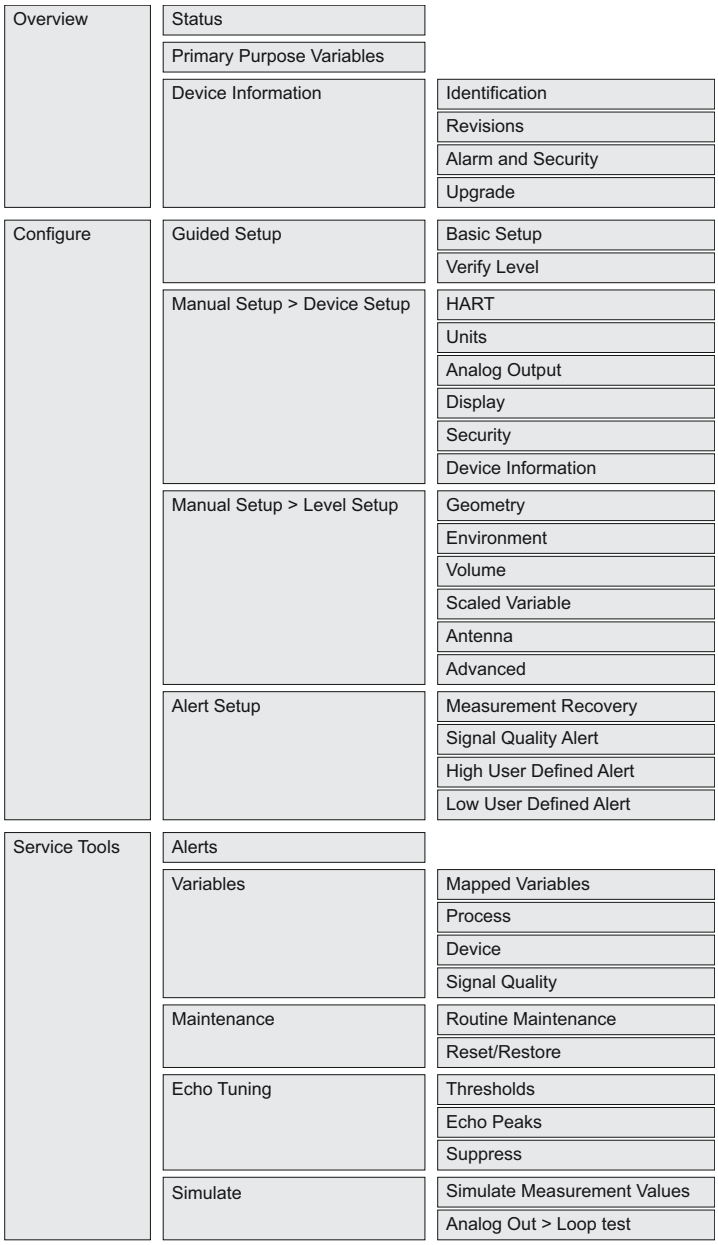


Figure B-2: DD Menu Tree



B.2 Device setup

B.2.1 HART protocol

HART/polling address

The address range is 0 to 63. The transmitter operates in either standard mode with a 4–20 mA output signal or in multidrop. When the transmitter is in multi-drop mode, the current output is fixed to 4 mA.

Burst mode

When set to burst mode, the transmitter regularly sends out messages instead of waiting for the host to request it.

Both the transmitter and host must be configured to operate in burst mode. Almost all HART host systems today are designed to communicate in poll/response mode, not burst mode. However, the Rosemount 333 HART Tri-Loop™ requires burst mode communication.

Related information

Use with the Rosemount 333 HART Tri-Loop

Variable mapping

Up to four device variables can be assigned for the HART protocol. The transmitter outputs a 4-20 mA signal proportional to the primary variable. Additional variables are available through the HART digital signal.

Related information

Output variables

Damping value

This parameter defines how fast the transmitter reacts to a change of the level value (step response). The default value is 2 seconds.

A high value makes the level reading steady, while a low value allows the transmitter to respond to rapid level changes (but the presented level value may be less steady).

Percent of range auxiliary

Set this parameter to output the percent of range for another device variable (in addition to the primary variable).

Table B-1: Percent of range auxiliary

Parameter	Description
Percent of range auxiliary	The variable selected for percent of range auxiliary.
100% auxiliary	Value corresponding to 100 percent range of variable selected for percent of range auxiliary.
0% auxiliary	Value corresponding to 0 percent range of variable selected for percent of range auxiliary.

B.2.2 Units

The units for length, volume, temperature, and level rates are selectable. All configuration parameters and device variables will be expressed in these units.

Related information

Output units

B.2.3 Analog output

The output source (primary variable), range values, and alarm mode are specified for the analog output.

Primary variable

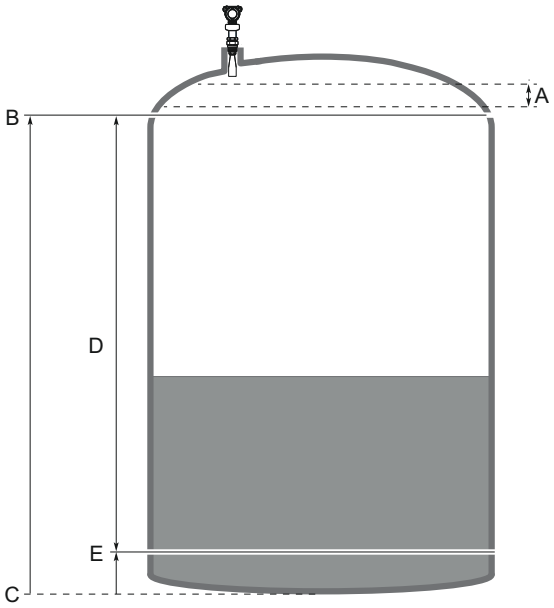
Select the desired device variable to use for the analog output.

Upper/lower range value

Enter the range values that correspond to the analog output values 4 and 20 mA. The transmitter will drive the output to saturation mode if a measured value goes outside the 4-20 mA range values.

Note
The 20 mA point should be set below the reduced accuracy zone at the top of the tank.

Figure B-3: Example of Range Value Settings



A. Reduced accuracy zone
B. 100% (20 mA)
C. Zero Level
D. Level measurement range 0-100%
E. 0% (4 mA)

Related information

Accuracy over measuring range

Alarm mode

The transmitter automatically and continuously performs self-diagnostic routines. If a failure or a measurement error is detected, the transmitter drives the output to selected alarm limit (high or low).

High/low alarm value

The high/low alarm current for the analog output when the device enters the alarm mode.

Related information

Analog signal on alarm

High/low saturation value

The device will continue to set a current that corresponds with the measurement until reaching the upper/lower limit (and then freeze).

Related information

Analog saturation levels

B.2.4 Display

Select variables to show on the optional LCD display. If more than one variable is selected, then the LCD display toggles between the output variables.

Related information

Variable screens
Select the display variables

B.2.5 Security

Write protection

The transmitter can be write protected (with or without a password) to prevent unauthorized changes.

Operational mode

The Rosemount 5408:SIS has two operational modes: Control/Monitoring and Safety (SIS).

If the transmitter is used as safety device in a Safety Instrumented System, the operational mode must be set to Safety (SIS).

Safety mode

When the operational mode is set to Safety (SIS), then the safety mode must be enabled for the transmitter to become operational. When safety mode is enabled, the transmitter is write protected (with or without a password) to prevent unauthorized changes.

Change counter

A counter that increments each time the device enters active Safety Mode.

B.2.6 Device information

Tag

Identifier of up to 8 characters for the device used by host system. The tag is typically a reference number, location, or duty description.

Long tag

Identifier of up to 32 characters for the device used by host system. It is recommended to enter both a short and a long tag (they may be the same).

Date

The date field can be used for any purpose, for example to save the date of the last configuration change.

Descriptor

The 16-character descriptor field can be used for any purpose.

Message

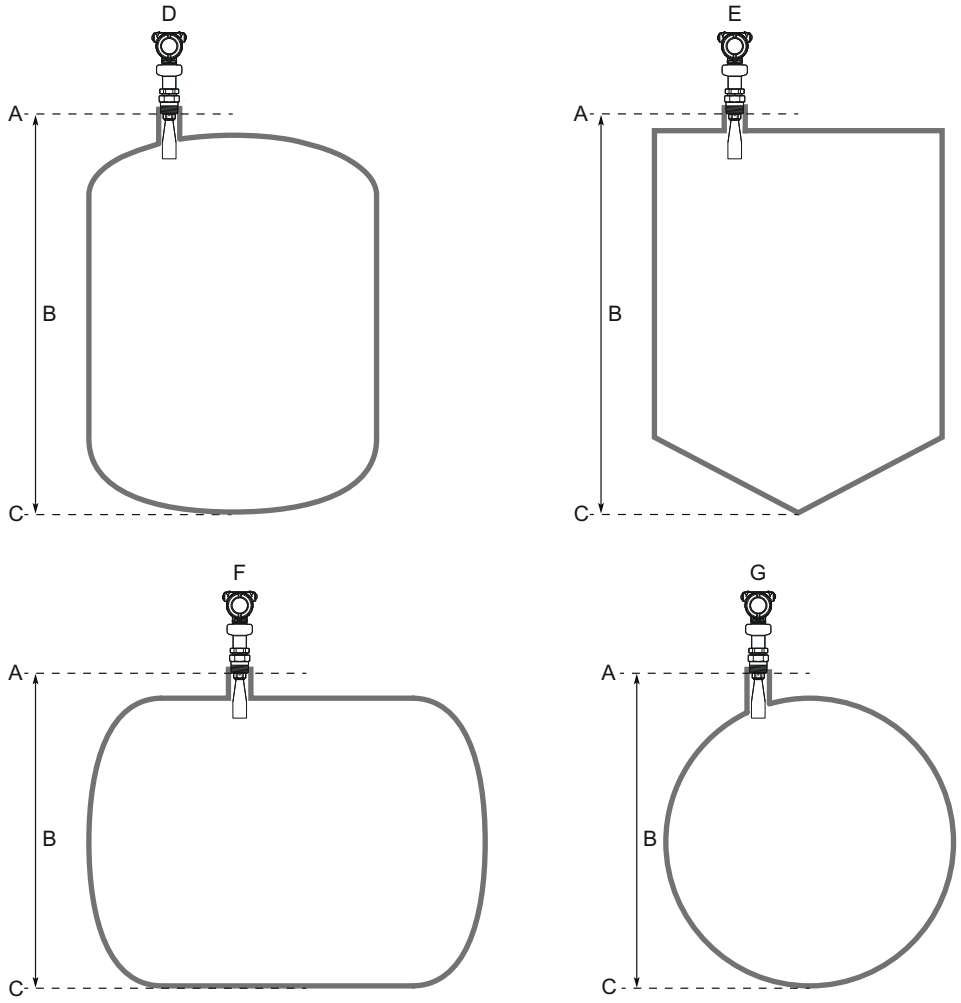
The 32-character message field can be used for any purpose, such as providing details of the last configuration change.

B.3 Level setup

B.3.1 Geometry

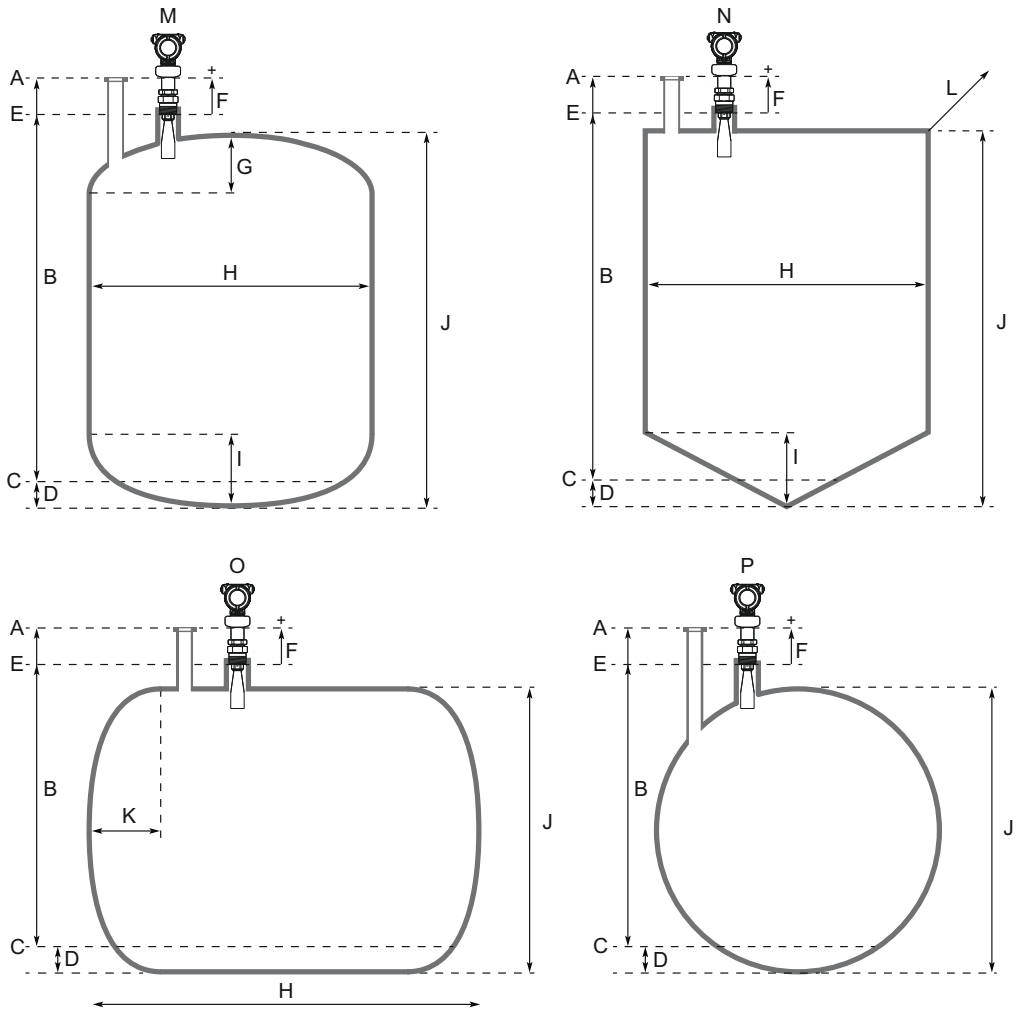
The transmitter configuration includes setting the tank geometry parameters, see Figure B-4 and Figure B-5.

Figure B-4: Tank Geometry, Basic Dimensions



A. Device Reference Point
B. Reference Height
C. Zero Level
D. Vertical cylinder
E. Cubical Tank
F. Horizontal cylinder
G. Spherical tank

Figure B-5: Tank Geometry, All Dimensions



A.	Tank Reference Point	I.	Bottom Shape Height*/Bottom Height**
B.	Reference Height	J.	Height of Tank*/Height (of tank)**
C.	Zero Level	K.	End Shape Length*/End Length**
D.	Bottom Offset	L.	Length of Tank*/Length**
E.	Device Reference Point	M.	Vertical cylinder
F.	Reference Offset	N.	Cubical cylinder
G.	Top Shape Height*/Top Height**	O.	Horizontal cylinder
H.	Width of Tank*/Width**	P.	Spherical cylinder

* DD

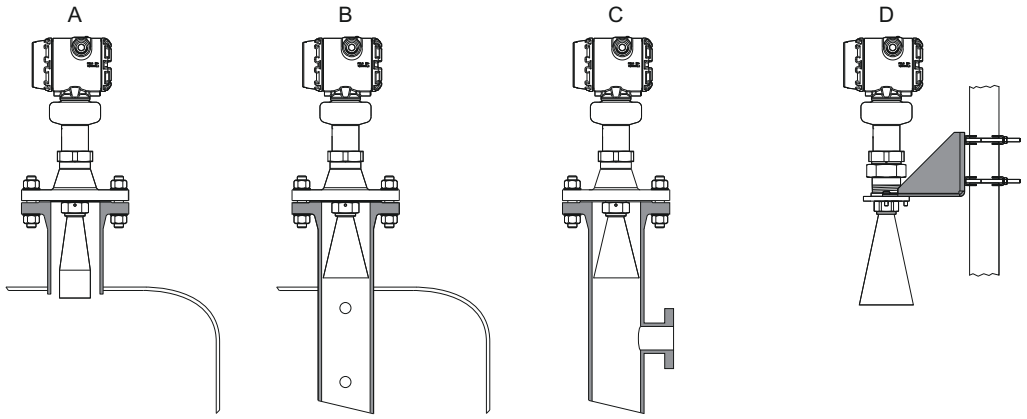
** UIP (Rosemount Radar Master Plus)

Mounting type

Select option best describing how transmitter is mounted on the tank. There are four options to choose from: Nozzle, Still pipe, Chamber, and Bracket.

The Bracket option should be used for measurements in open air installations such as sumps or ponds, or when measuring through a plastic tank roof.

Figure B-6: Mounting Type



A. Nozzle
B. Still pipe
C. Chamber
D. Bracket (open air)

Inner diameter, pipe/chamber

Enter the inner diameter for the pipe or chamber in which the antenna is mounted. The inner diameter value is used to compensate for the lower microwave propagation speed inside the pipe/chamber. An incorrect value will give a scale factor error.

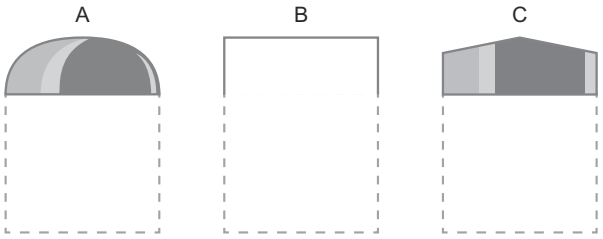
Tank shape

Select a tank shape that corresponds to the actual tank. If the actual tank does not match one of the pre-defined tank shapes, then select Other (e.g. level measurements of sumps, basins, or ponds).

Tank top shape

Form of the upper tank closure.

Figure B-7: Tank Top Shape

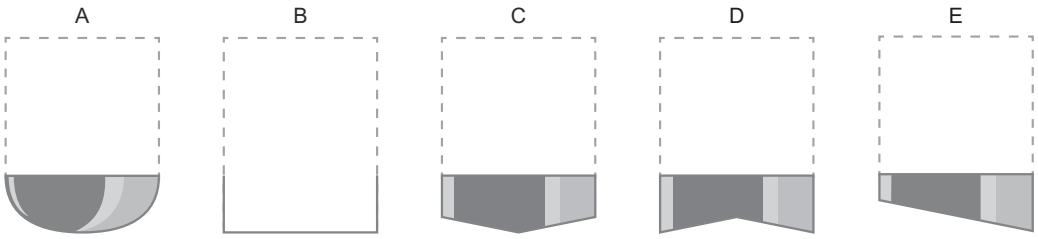


A. Dome
B. Flat
C. Conical

Tank bottom shape

Form of the lower tank closure.

Figure B-8: Tank Bottom Shape



A. Dome
B. Flat
C. Conical/pyramid
D. Flat, inclined (for vertical cylinder)
E. Flat, inclined (for cubical tank)

Tank end shape

For a horizontal tank, form of the tank ends. Same shape is assumed at both ends.

Figure B-9: Tank End Shape

A. Dome
B. Flat

Reference height

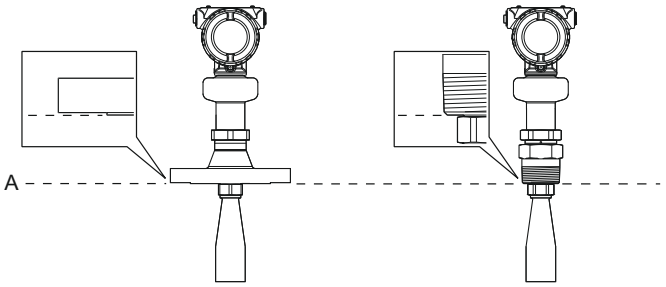
Distance between the Tank Reference Point (typically same as Device Reference Point) and Zero Level.

Ensure the Reference Height is set as accurate as possible. The transmitter measures the distance to the product surface and subtracts this value from the Reference Height to determine the level.

Device reference point

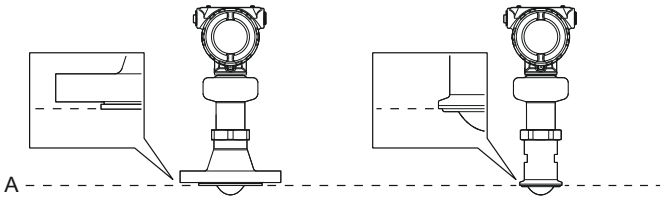
Figure B-10, Figure B-11, and Figure B-12 show the Device Reference Point for various antennas and tank connections.

Figure B-10: Device Reference Point for Cone Antennas



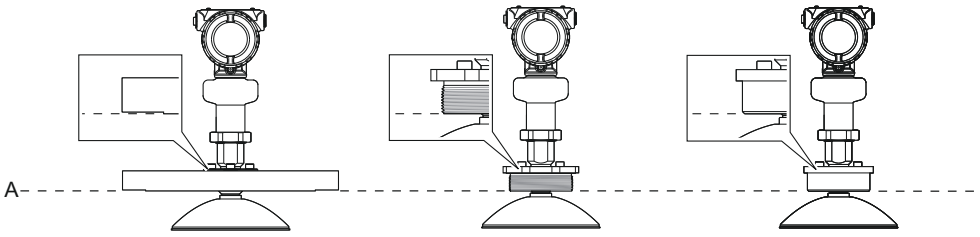
A. Device Reference Point

Figure B-11: Device Reference Point for Process Seal Antennas



A. Device Reference Point

Figure B-12: Device Reference Point for Parabolic Antennas



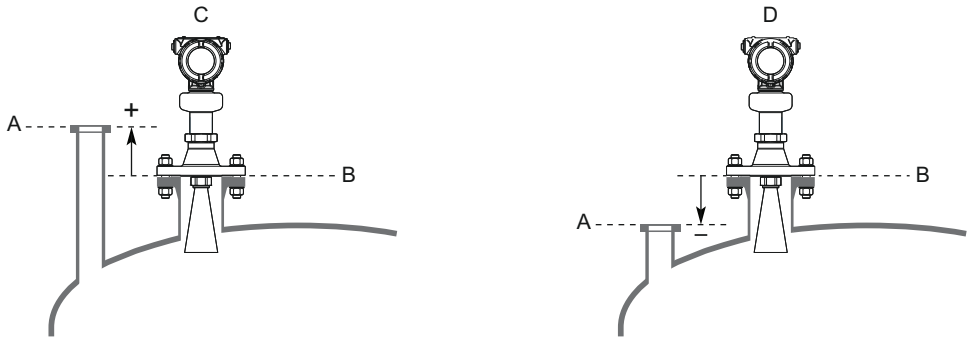
A. Device Reference Point

Reference offset

Distance between the Device Reference Point and the Tank Reference Point (typically the upper side of a customer plug where levels can be manually measured).

The Reference Offset parameter can be used to specify your own reference point, for example when the measured level by the transmitter should correspond with the level value obtained by hand-dipping.

Figure B-13: Reference Offset



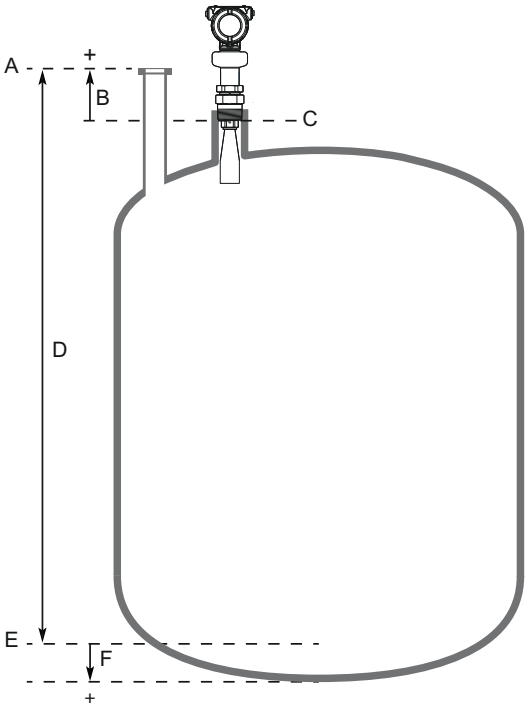
A. Tank Reference Point
B. Device Reference Point
C. Reference Offset > 0
D. Reference Offset < 0

Bottom offset

The Bottom Offset is defined as the distance between Zero Level and the tank bottom. The default value is zero.

If the Zero Level is not located at the tank bottom, then enter a Bottom Offset. It is needed for the transmitter to know the position of the tank bottom echo and for correct volume calculations.

Figure B-14: Bottom Offset



A. Tank Reference Point
B. Reference Offset
C. Device Reference Point
D. Reference Height
E. Zero Level
F. Bottom Offset

Height of tank

The vertical distance between tank bottom and tank roof. For a horizontal cylinder or spherical tank, this is the diameter of the tank.

Width of tank

The horizontal distance between tank ends. For a vertical cylinder, this is the diameter of the tank. The width of tank is also the shortest horizontal side of a box-shaped (cubical) tank.

Length of tank

The longest horizontal side of a cubical tank.

Top shape height

The height of the shape on tank top (typically from shape floor to cap top, measured at cylinder center line).

Bottom shape height

The height of the shape at tank bottom (typically from shape floor to shape bottom, measured at cylinder center line).

End shape length

The width of the spherical cap at tank end (measured at cylinder center line).

Show negative level as zero

When this setting is selected and the product surface is at or below Zero Level, the level measurement output will be zero.

B.3.2 Environment

Product type

The media (liquid/solid) used in the monitored process.

- Liquid (requires measurement type code 1 or 4)
- Solid (requires measurement type code 3 or 4)

The solids measurement mode should never be used for measuring liquid products due to the solids specific signal processing method, and vice versa.

Note
Solid is not supported for a Rosemount 5408:SIS operating in Safety (SIS) mode.

Process conditions

Foam

This parameter should be used if there is, or may be, surface foam. When setting this parameter, the transmitter is optimized for conditions with weak and varying surface echo amplitudes, which is typical for presence of surface foam.

Turbulent surface

Set this parameter to improve the performance of the transmitter when there are small and local rapid level changes caused by surface turbulence. The reason for the turbulence might be splash loading, agitators, mixers, or boiling product.

Maximum level rate

Fastest rate that may occur in the monitored process to (partially) fill or empty this tank. Note that product level rate may be higher during upset conditions.

Product dielectric range

Select the range of the dielectric constant for the product in the tank. If the range is not known, or if the product in the tank is changed on a regular basis, then select Default.

B.3.3 Volume

Volume calculation method

Select if the volume measurement should be calculated from the configured tank dimensions or a strapping table.

Strapping table

Strapping tables can be used for irregularly shaped tanks, to eliminate errors due to bulging when product is added to a tank, or if a pre-defined tank type does not provide sufficient accuracy.

Strapping table requires entering level-volume pairs in a table (maximum 50 points). Use most of the strapping points in regions where the tank shape is non-linear. Starting at the bottom of the tank, for each new point, enter the total volume up to the specified level value.

Volume offset

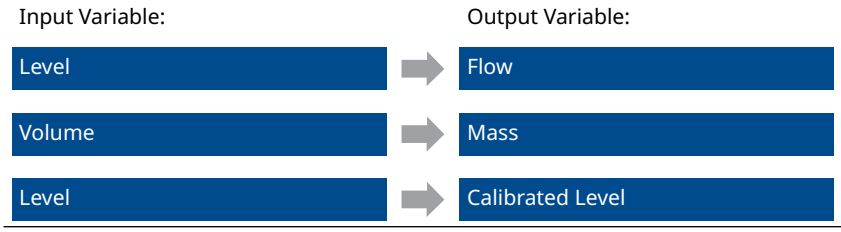
Use this parameter to add a volume to each calculated volume value, for example a sump volume below the Zero Level in the tank.

B.3.4 Scaled variable

The scaled variable can be used to convert a device variable into an alternative measurement, such as open channel flow, mass, or calibrated level (e.g. 5 point verification). This variable is available only for transmitters ordered with Smart Diagnostics Suite.

The scaled variable is defined by creating a table of device variables and corresponding output variables. A maximum of 50 points can be specified. Between the points linearly interpolated values are calculated.

Figure B-15: Scaled Variable Examples



As an example, consider a product with a density of 900 kg/m^3. In this case, the volume to mass conversion is given by the following table:

Table B-2: Example of Scaled Variable Table

Number	Input value (volume)	Output value (mass)
1	0 m^3	0 kg
2	100 m^3	90 000 kg

Scaled variable name

Name of the scaled variable. It is recommended to enter a short name to fit into the LCD display area.

Scaled variable unit

Units of measurement of the scaled variable.

Number of scaled values

Number of values in the scaled variable table.

Input variable

Select the input variable to use for scaled variable calculation.

B.3.5 Antenna

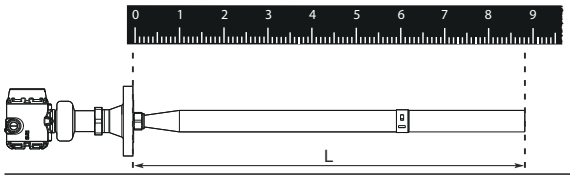
Antenna type

The transmitter is designed to optimize measurement performance for each available antenna type. This parameter is pre-configured at factory; it only needs to be set if the antenna is changed to another type, or if you have installed a spare transmitter.

Antenna extension length

This parameter is pre-configured at factory. The Antenna Extension Length (see Figure B-16) must be changed if the extension is shortened, or if you have ordered a spare transmitter head. Enter zero (0) for antennas without extensions.

Figure B-16: Antenna Extension Length (L)



User defined antenna options

These antenna parameters are applicable to customized antennas only. The settings are typically provided by factory.

Legacy (Rosemount 5402) antenna parameters

When a Rosemount 5408 transmitter head is mounted on a Rosemount 5402 antenna, then select the Legacy (Rosemount 5402) antenna type and specify the antenna parameters according to the settings in Table B-3 and Table B-4.

Table B-3: Legacy (Rosemount 5402) Antenna Parameters, Free Propagation

Antenna type	Model code	Tank connection length		Antenna gain	Nearzone threshold (mV)	Nearzone range		Upper null zone[1]	
		ft	m			ft	m	ft	m
2-in. SST cone	2S	0.509	0.155	2.45	4500	5.09	1.55	0.541	0.165
2-in. cone with protective plate	2H, 2M, 2N	0.509	0.155	2.45	5000	5.25	1.60	0.492	0.150
2-in. process seal	2P	0.929	0.283	3.4	3400	4.13	1.26	0.492	0.150
3-in. SST cone	3S	0.509	0.155	1.4	1170	3.38	1.03	0.492	0.150
3-in. cone with protective plate	3H, 3M, 3N	0.509	0.155	1.4	4400	5.41	1.65	0.591	0.180
3-in. process seal	3P	1.191	0.363	1.7	3400	4.13	1.26	0.492	0.150
4-in. SST cone	4S	0.509	0.155	0.9	1170	3.38	1.03	0.738	0.225
4-in. cone with protective plate	4H, 4M, 4N	0.509	0.155	0.9	2400	4.27	1.30	0.820	0.250
4-in. process seal	4P	1.316	0.401	0.8	1000	3.48	1.06	0.492	0.150

(1) Default setting. The Upper Null Zone may need to be increased if there are disturbance echoes in the region close to the antenna.

Table B-4: Legacy (Rosemount 5402) Antenna Parameters, Still Pipe/Chamber Installation

Antenna type	Model code	Tank connection length		Antenna gain	Nearzone threshold (mV)	Nearzone range		Upper null zone[1]	
		ft	m			ft	m	ft	m
2-in. SST cone	2S	0.509	0.155	0.035	800	2.03	0.62	0.541	0.165
2-in. cone with protective plate	2H, 2M, 2N	0.509	0.155	0.035	900	3.28	1.00	0.492	0.150
2-in. process seal	2P	0.929	0.283	0.035	930	2.56	0.78	0.492	0.150
3-in. SST cone	3S	0.509	0.155	0.035	800	2.03	0.62	0.492	0.150
3-in. cone with protective plate	3H, 3M, 3N	0.509	0.155	0.035	1100	4.27	1.30	0.591	0.180
3-in. process seal	3P	1.191	0.363	0.035	1000	2.53	0.77	0.492	0.150
4-in. SST cone	4S	0.509	0.155	0.035	800	2.03	0.62	0.738	0.225
4-in. cone with protective plate	4H, 4M, 4N	0.509	0.155	0.035	1000	3.61	1.10	0.820	0.250
4-in. process seal	4P	1.316	0.401	0.035	900	4.59	1.40	0.492	0.150

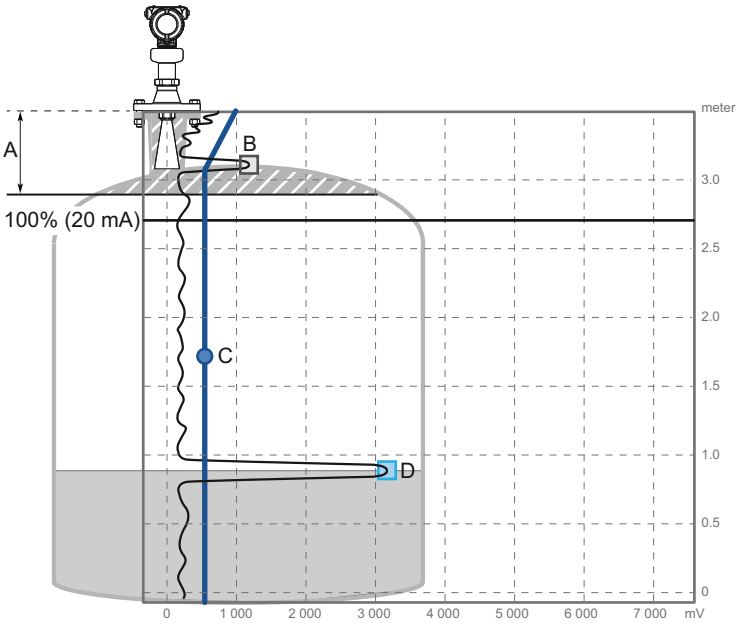
(1) Default setting. The Upper Null Zone may need to be increased if there are disturbance echoes in the region close to the antenna.

Upper null zone

The Upper Null Zone defines how close to the device's reference point a level value is accepted. You can extend this value to block out disturbing echoes close to the antenna, for example from the tank nozzle or bypass well inlet.

Note
Make sure the 20 mA value is below the Upper Null Zone. Measurements are not performed within the Upper Null Zone (UNZ).

Figure B-17: Upper Null Zone



A. Upper Null Zone
B. Disturbance echo
C. Amplitude threshold
D. Product surface echo

Related information

Change the upper null zone

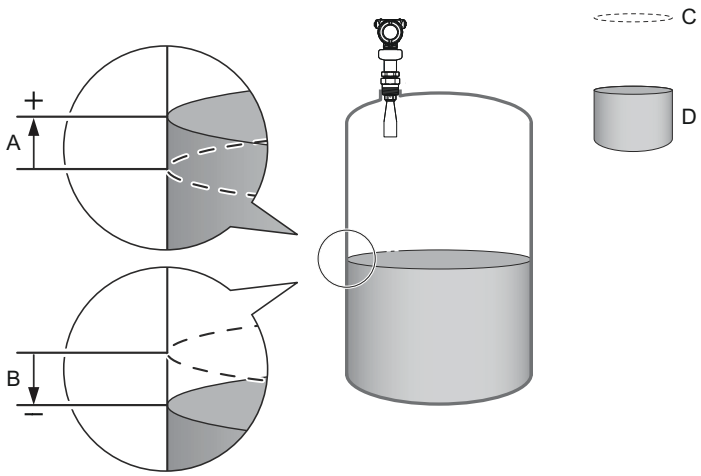
B.3.6 Advanced

Calibration offset

Difference between surface distance measured by transmitter and the same distance measured by, for example, hand-dipping with a measurement tape. A positive Calibration Offset value will increase the presented level value.

It is recommended to run the Verify Level tool to match the product level reported by the transmitter to a reference measurement.

Figure B-18: Calibration Offset



A. Positive Calibration Offset value
B. Negative Calibration Offset value
C. Reported level
D. Actual level

Related information

Run verify level

User defined variable setup

This section applies only to transmitters ordered with Smart Diagnostics Suite.

Name

Name of the user defined variable. It is recommended to enter a short name to fit into the LCD display area.

Input register

Enter the number of the input register that contains value of the user defined variable. See Table B-5 for a list of suitable input registers.

The default value is 20210 (Distance).

Table B-5: List of Input Registers to the User Defined Variable

Variable	Register	Description
Min Electronics Temperature	20146	Minimum electronics temperature measured by the device (°C)
Max Electronics Temperature	20148	Maximum electronics temperature measured by the device (°C)
Min Signal Quality	21034	Minimum signal quality measured by the device since last signal quality reset. Signal quality calculation must be enabled to use this variable.
Max Signal Quality	21036	Maximum signal quality measured by the device since last signal quality reset. Signal quality calculation must be enabled to use this variable.
Distance to Upper Surface	21042	Distance to the upper product surface (m) when measuring on multiple products in the tanks. Double Surface function must be enabled to use this variable.
Distance to Lower Surface	21044	Distance to the lower product surface (m) when measuring on multiple products in the tanks. Double Surface function must be enabled to use this variable.
Surface Signal/Noise Ratio	21054	Ratio between surface echo signal strength and signal noise (dB). A high value (>20 dB) indicates very good margin to noise.
Product Dielectric Constant	22800	Square root of the product dielectric constant estimated by the transmitter when the Bottom Projection function is enabled. The product dielectric constant is calculated when both the bottom and surface echoes are found by device, and when surface echo is within the Max Projection Distance. Product dielectric constant estimation is frozen if any of these conditions are not fulfilled.

Unit

Units of measurement of the user defined variable.

More advanced options

More advanced options are only available in Rosemount Radar Master Plus.

By default, these parameters are automatically set based on current configuration. It is recommended that these parameters should remain at the default settings, unless there is a good understanding of the function and capability of the parameters.

Empty tank handling

The Empty Tank Handling functions handle situations when the surface echo is close to the tank bottom.

Table B-6: Empty Tank Handling

Parameter	Description
Empty tank detection area	The Empty Tank Detection Area defines a range where it is accepted to lose the echo from the product. If the echo is lost in this range, the tank is considered empty and the level is presented as 0. When the tank is empty, the transmitter looks in this range for the product surface. When a new echo is found in this range, it is considered to be the product surface. Therefore, if there are disturbance echoes in this area, they may need to be filtered out. This function requires the Bottom echo visible when tank is empty parameter to be disabled.
Bottom echo visible when tank is empty	Only enable this parameter if the bottom echo is visible when tank is empty. By setting this parameter, the bottom echo will be treated as a disturbance echo to facilitate tracking of weak surface echoes close to the tank bottom.

Related information

Enable bottom echo visible when tank is empty

Tank bottom projection

The Tank Bottom Projection is used to enhance measurement performance near the bottom of the tank. When the tank bottom echo is strong (typical for flat tank bottoms) and the dielectric constant of the product is low (e.g. oil), the transmitter may lock on the bottom echo and report a false level measurement (empty tank). This problem can be solved by using the Tank Bottom Projection function.

Table B-7: Tank Bottom Projection

Parameter	Description
Bottom product dielectric constant	Enter the product dielectric constant for the product in the bottom of the tank.
Maximum projection distance	This defines the range where the function is active. Enter the maximum distance from the zero level (tank bottom).
Minimum tank bottom amplitude	Enter the minimum allowed amplitude for the echo from the tank bottom before this function is activated.

Related information

Use tank bottom projection

Echo tracking

Surface echo tracking

Use these settings to configure how the transmitter should keep track of the surface. These are advanced settings. Normally, they should not be changed.

Table B-8: Surface Echo Tracking

Parameter	Description
Search window size	This parameter defines a window centered at the current surface position where new surface echo candidates can be selected. The size of the window is ±Search Window Size. Echoes outside this window will not be considered as surface echoes. If there are rapid level changes in the tank, the value of the Search Window Size can be increased to prevent the transmitter from missing level changes. On the other hand, a large value may cause the transmitter to select an invalid echo as the surface echo.
Track first echo	Select the Track First Echo check box if the first echo above the amplitude threshold always should be considered as the surface echo. **Note** Before enabling Track First Echo, analyze the echo curve and check amplitude thresholds.

Related information

Handling ghost echoes in still pipes

Double surface handling

If there are multiple products in the tank, the Double Surface Handling function can be manually set to allow user to select if the upper or lower product should be used as output.

The upper and lower surface echoes must be stronger than any disturbance echoes in the search region for Double Surface Handling to function properly.

Table B-9: Double Surface Handling

Parameter	Description
Track upper surface	Track upper surface when there are multiple products in the tank (for example thin oil layer on top of water).
Track lower surface	Track the lower product surface, such as the interface when there are multiple products in the tank, or the product surface instead of a foam layer.
Upper product dielectric constant	Enter the dielectric constant for the upper product. A more precise value results in better accuracy for the lower surface level.

Double bounce handling

Use this function to prevent transmitter from locking on strong double bounce echoes (may occur in spherical and horizontal cylinder tanks).

Related information

Handling strong double bounce echoes

Overfill prevention

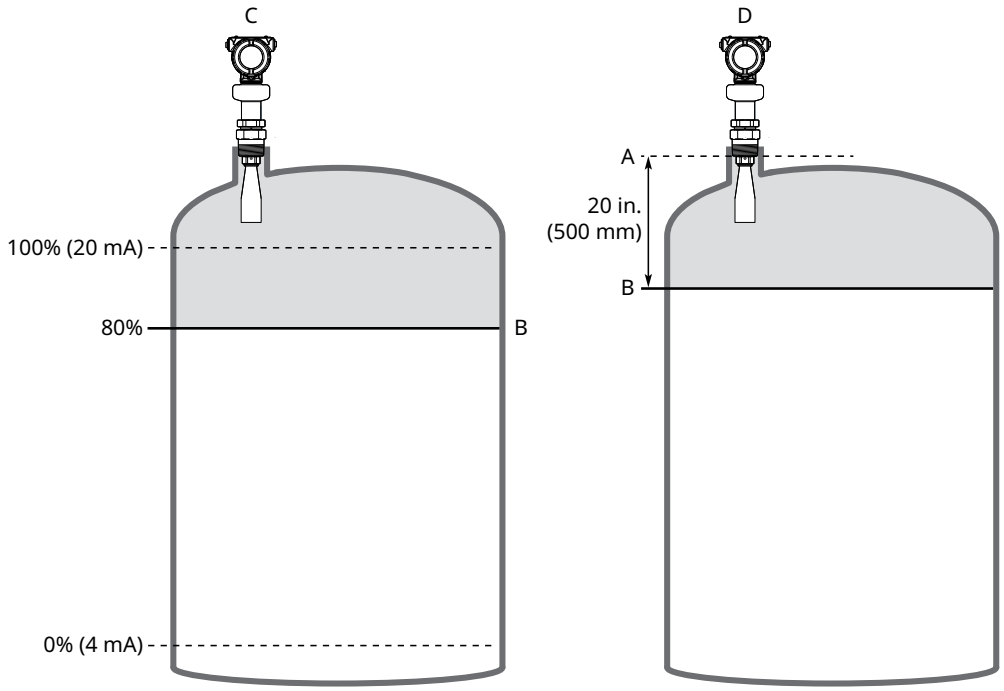
The Overfill Prevention function adds an extra layer of protection to prevent tank overfills. The function uses an independent echo logic algorithm to identify the surface echo close to the top of the tank.

In the unlikely event there is a conflict between the normal and the overfill prevention echo logic, the Overfill Prevention function will have a precedence in determining the position of the surface. The transmitter will then output this new value, or generate an alarm if the normal echo logic is not able to find the surface echo at the new position.

The Overfill Prevention Range defines the lower end of the range in which the function operates. The range is configurable.

See Figure B-19 for default factory settings.

Figure B-19: Overfill Prevention Range



A. Device Reference Point
B. Overfill Prevention Range
C. Rosemount 5408:SIS
D. Rosemount 5408

Expert options

Use the expert options to view input registers, and to view and edit holding registers.

Note
Instructions for how to use Expert options are typically provided by factory and should only be modified if required.

Related information

View input registers
View holding registers

B.4 Alert setup

B.4.1 Measurement recovery

Measurement recovery time

The Measurement Recovery Time (Echo Timeout) parameter controls the maximum time from when measurement is lost (e.g. due to process conditions such as foam or turbulence) until it is annunciated. If measurement is recovered within the time specified by this parameter, then it will not be annunciated.

Measurement recovery handling

By default, the Measurement Recovery Time is set up automatically by the device based on the transmitter configuration.

It is recommended to leave the Measurement Recovery Handling at default unless required by your application. A higher value may be entered to increase robustness and avoid nuisance alarms. Only enter a lower value if lost measurement is required to be annunciated within a certain time for your application.

Used measurement recovery time

This is the value used by the transmitter.

B.4.2 Signal quality alert

This section applies only to transmitters ordered with Smart Diagnostics Suite.

Signal Quality is a measure of the product surface echo amplitude compared to the surface threshold and noise.

The Signal Quality spans from 0 to 10. A low value means that there is a risk for the noise peak to be mistaken for the product surface peak.

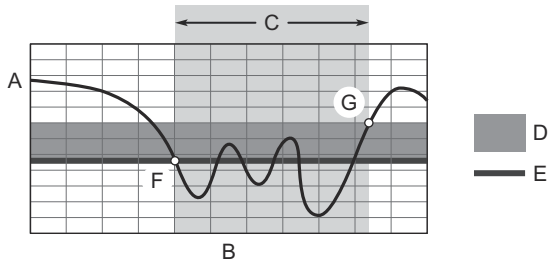
Note
The Signal Quality may not be 10 even if the antenna is clean. The value depends on antenna type, application conditions, configured surface threshold, as well as the condition of the antenna.

Build up on the antenna and different surface conditions are factors that can result in a low Signal Quality value. By setting an alert, the Signal Quality value can be used to schedule maintenance to clean the antenna, fine-tune the surface threshold, or detect and monitor adverse surface conditions such as turbulence or foam.

Note
Signal strength fluctuations are common when measuring solids, so Signal Quality alerts may not be appropriate in this case.

Suitable alert limits vary from application to application. Appropriate value can be determined by logging Signal Quality over time and viewing maximum/minimum values. The Signal Quality Alert limit should be at least 1, but a better guideline is 2-3.

Figure B-20: Signal Quality Alert



A. Signal quality
B. Time
C. Alert ON
D. Deadband
E. Limit
F. The Signal Quality drops below the alert limit and an alert message is triggered.
G. The alert message is reset once the Signal Quality value rises above the Deadband range.

Limit

The Signal Quality value that will trigger the alert.

Deadband

The Deadband is a buffer zone so the alerts do not toggle on and off when the Signal Quality fluctuates around the alert limit. The alert is set when value falls below the alert limit. The alert is then cleared when value rises above the Deadband range.

B.4.3 High/low user defined alert

A high and low alert may be established to output an alert message when the measurement readings exceed the specified limits.

Variable

Select the device variable to use for the alert.

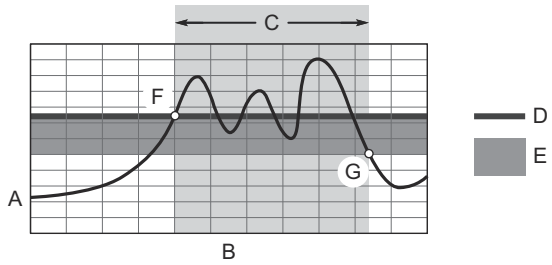
Limit

The value that will trigger the alert.

Deadband

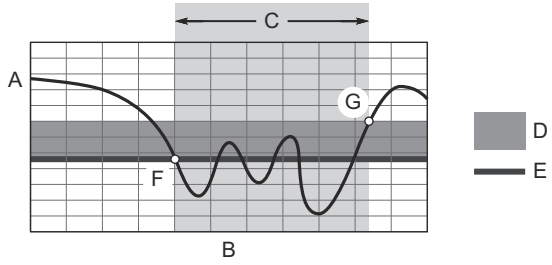
The Deadband is a buffer zone so the alerts do not toggle on and off when the measurement value fluctuates around the alert limit. The alert is set when the value exceeds the alert limit. The alert is then cleared when the value falls outside the Deadband range.

Figure B-21: High User Defined Alert



A. User Defined Alert
B. Time
C. High Alert ON
D. Limit
E. Deadband
F. The alert is active when the level value rises above the alert limit.
G. The alert turns off when the value falls below the deadband.

Figure B-22: Low User Defined Alert



A. User Defined Alert
B. Time
C. Low Alert ON
D. Deadband
E. Limit
F. The alert is active when the level value falls below the alert limit.
G. The alert turns off when the value rises above the deadband.

00809-0100-4408
Rev. CE
2023

For more information: **Emerson.com**

ROSEMOUNT™

EMERSON™