

# **Rosemount Process Radar in Refining Applications**

## **Best Practices for Installation and Commissioning**



**ROSEMOUNT®**

[www.rosemount.com](http://www.rosemount.com)



**EMERSON™**  
Process Management



## Rosemount Process Radar in Refining Applications

### Best Practices for Installation and Commissioning

#### 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.

This product is designed to meet FCC and R&TTE requirements for a non-intentional radiator. It does not require any licensing whatsoever and has no tank restrictions associated with telecommunications issues.

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

*Cover Photo: Cover.tif*



## Table of Contents

<b>SECTION 1</b> <b>Introduction</b>	Introduction . . . . .	1-1
<b>SECTION 2</b> <b>Installation</b> <b>Considerations</b>	Safety Messages . . . . . Introduction . . . . . Installation Considerations . . . . . Chambers . . . . . Transmitter Selection . . . . . Flushing Connections and Vents . . . . . Chamber Fabrication and Probe Selection . . . . . Existing Chambers . . . . . Setting Range Values - Three Options . . . . . Insulation . . . . . Pipes . . . . . Tanks . . . . . Recommended Mounting Position . . . . . Nozzle Considerations . . . . . Process Isolation for Service . . . . . Probe and Antenna Selection . . . . .	2-1 2-2 2-2 2-2 2-3 2-4 2-5 2-8 2-8 2-10 2-10 2-12 2-12 2-14 2-17 2-17
<b>SECTION 3</b> <b>Refining Applications</b>	Safety Messages . . . . . Introduction . . . . . Refining Applications . . . . . Chambers . . . . . High temperature at low to moderate pressure - Level Measurement . . . . . High Temperature and High Pressure - Level Measurement . . . . . High Temperature and High Pressure - Level and Interface Measurement . . . . . Standard Temperature and Standard Pressure - Level Measurement . . . . . Standard Temperature and Standard Pressure - Interface Measurement . . . . . Pipes . . . . . Desalters . . . . . Liquefied Gases . . . . .	3-1 3-2 3-2 3-2 3-2 3-2 3-4 3-6 3-6 3-7 3-7 3-8 3-9 3-9 3-9

# Rosemount Radar Level Transmitters

---

	Tanks . . . . .	3-10
	Ammonia . . . . .	3-10
	Solids . . . . .	3-10
	Storage Tanks . . . . .	3-12
	Tanks with agitators . . . . .	3-12
	Compressor tanks . . . . .	3-13
	Tanks with very rapid level changes . . . . .	3-13
	Applications to limit . . . . .	3-14
<b>SECTION 4</b>		
<b>Commissioning</b>	Safety Messages . . . . .	4-1
	Introduction . . . . .	4-2
	Commissioning . . . . .	4-2
	Trim Near Zone (5300 Series only) . . . . .	4-2
	Store Backup and Verification Files . . . . .	4-3
	On the Bench Test (optional) . . . . .	4-3
	Example . . . . .	4-4
<b>SECTION 5</b>		
<b>Measurement Validation</b>	Safety Messages . . . . .	5-1
<b>at Operating Conditions</b>	Introduction . . . . .	5-2
	Measurement Validation at Operating Conditions . . . . .	5-2
	Step 1: Verify the Correctness of Level Reading . . . . .	5-2
	Step 2: Analog Output Signal Validation . . . . .	5-3
	Step 3: Echo-Curve Verification at Operating Conditions . . . . .	5-4
	Step 4: Transmitter Diagnostics Review . . . . .	5-4
	Step 5: Monitor Level while Emptying . . . . .	5-5
	Step 6: Echo-Curve Verification with Empty Tank . . . . .	5-6
	Step 7: Monitor Level while Filling . . . . .	5-6
<b>SECTION 6</b>		
<b>Troubleshooting</b>	Safety Messages . . . . .	6-1
<b>Procedures</b>	Introduction . . . . .	6-2
	Echo Curve Analysis . . . . .	6-3
	Echo Curve Constituents . . . . .	6-3
	5300 Threshold Settings . . . . .	6-5
	5400/5600 Threshold Settings . . . . .	6-5
	Common Problems . . . . .	6-6
	Sources of Measurement Error . . . . .	6-11
	Installation and Location Errors . . . . .	6-11
	Geometries . . . . .	6-12
	Analog Output Settings . . . . .	6-12
	Incorrect Dielectric Constant of the Upper Product . . . . .	6-13
	Submerged Probes with Air gap . . . . .	6-14
	Incorrect Vapor Compensation . . . . .	6-15
	Reconciling Radar with other Level Measurements . . . . .	6-15
<b>APPENDIX 7</b>		
<b>Checklists</b>	Safety Messages . . . . .	7-1
	Checklists . . . . .	7-2
	Commissioning Procedure Checklist . . . . .	7-2
	Measurement Validation at Operating Conditions	
	Procedure Checklist . . . . .	7-3

## Section 1 Introduction

---

Introduction .....	page 1-1
--------------------	----------

---

### INTRODUCTION

This document describes some of the best practices learned during the installation of thousands of Rosemount process radar level transmitters in refining applications. However, it is not a complete set of instructions; for more detailed information refer to the respective product manual:

- Rosemount 5300 Series Reference Manual (Document No. 00809-0100-4530)
- Rosemount 5400 Series Reference Manual (Document No. 00809-0100-4026)
- Rosemount 5600 Series Reference Manual (Document No. 00809-0100-4024), and
- Rosemount 9901 Reference Manual (Document No. 00809-0100-4601).

Local restrictions, regulations, or best practices may also apply and should be taken into consideration.

This best practices guide focuses on continuous level and interface measurement applications used in refinery chambers. It also, where appropriate, covers best practices for measurements in tanks and pipes.

# Rosemount Radar Level Transmitters

---

## Section 2 Installation Considerations

Safety Messages .....	page 2-1
Introduction .....	page 2-2
Installation Considerations .....	page 2-2
Chambers .....	page 2-2
Pipes .....	page 2-10
Tanks .....	page 2-12

### SAFETY MESSAGES

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Please 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 environment of the gauge is consistent with the appropriate hazardous locations certifications.

Before connecting a HART®-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.

Do not remove the gauge cover in explosive atmospheres when the circuit is alive.

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

Make sure only qualified personnel perform the installation.

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

Do not perform any service other than those contained in this manual unless you are qualified.

**High voltage that may be present on leads could cause electrical shock.**

Avoid contact with leads and terminals.

Make sure the main power to the transmitter is off and the lines to any other external power source are disconnected or not powered while wiring the gauge.

Probes covered with plastic and/or with plastic discs may generate an ignition-capable level of electrostatic charge under certain extreme conditions. Therefore, when the probe is used in a potentially explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.

# Rosemount Radar Level Transmitters

## INTRODUCTION

In addition to selecting the appropriate radar level transmitter, mechanical installation is one of the most critical steps of the commissioning procedure. When done correctly, the subsequent transmitter configuration will be considerably simplified.

Because of the wide usage and application in the refining industry, this section provides a framework for chamber installations. The basics of pipe and tank installation are also covered.

## INSTALLATION CONSIDERATIONS

### Chambers

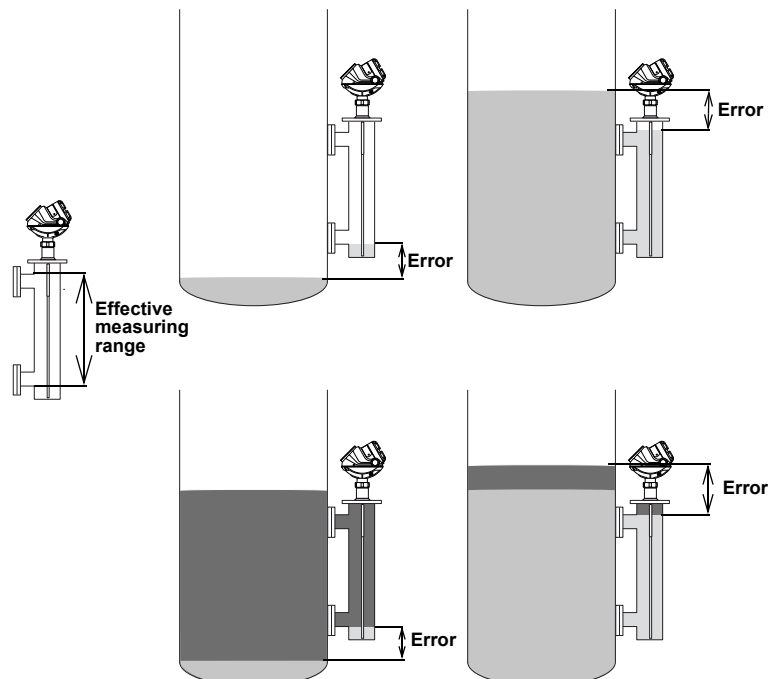
Chambers - also known as bridles, side-pipes, bypass-pipes, and cages - are typically used because:

- External mounting with valves allows for servicing of the level device, even in pressurized tanks that are in continuous operation for many years
- They allow for radar measurement in tanks or regions with side-connections only, such as towers
- They provide a calmer surface in case of turbulence, boiling, or other conditions that upset the product

However, chambers also have some disadvantages:

- Inlet pipes may clog and generate a discrepancy between the level inside the chamber and the actual level in the tank
- The effective measuring range is limited to the region between the upper and lower inlet pipes

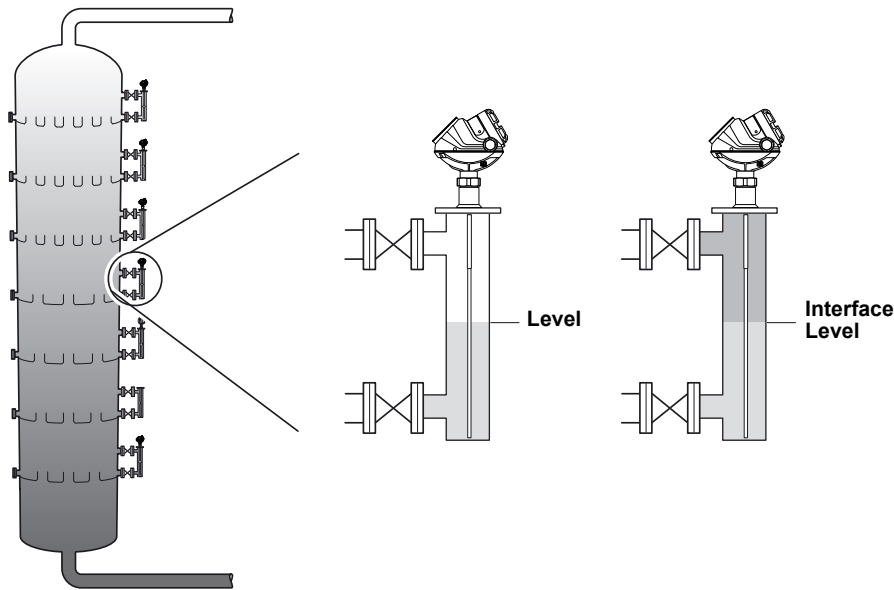
Figure 2-1. Effective measuring range and possible error sources



# Rosemount Radar Level Transmitters

Generally, Guided Wave Radar (GWR) is favored in these applications since non-contacting radar may be disturbed by the inlet-pipes. The Rosemount 5300 Series can be used in chambers to measure either level or interface level.

Figure 2-2. The Rosemount 5300 Series is an ideal choice for continuous measurement of level or interface in most chamber applications



## Transmitter Selection

The Rosemount 5300 Series can measure the level of oil, the interface of oil and water, or other liquids with significant dielectric differences and a clear interface between the two products.

For application guidelines, refer to "Refining Applications" on page 3-2 or to the Rosemount 5300 Series PDS (Document No. 00813-0100-4530).

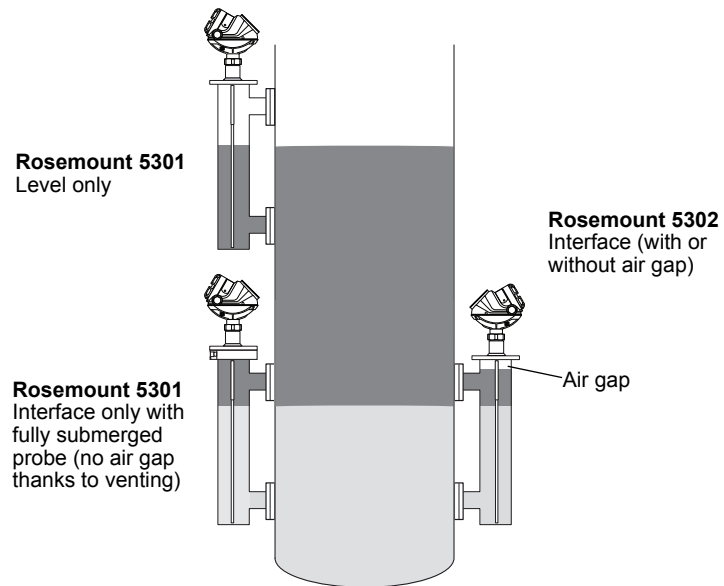
There are two different transmitter versions, Rosemount 5301 and Rosemount 5302. The required measurement variable will determine which transmitter should be used:

Table 2-1. Measured variable options

<b>Level only</b>	Use the Rosemount 5301 (or alternatively Rosemount 5302 configured for level only measurement)
<b>Interface Level with fully submerged probe</b>	<p>The Rosemount 5301 can be used in this case. If there is an air gap, it will generate an offset in the interface level measurement according to:</p> $\text{Interface Level offset} = \text{Air gap distance} \times \left( 1 - \frac{1}{\sqrt{\text{dielectric constant of upper product}}} \right)$ <p>For example, an air gap of 4 in. (100 mm) with oil as upper product (dc=2) generates a 1 in. (29 mm) positive interface level offset. In case the air gap is constant, the interface level output can be compensated by reducing the reference height with this offset.</p>
<b>Interface Level</b>	In case there is an air-gap or the air gap is changing, the Rosemount 5302 should be used.

# Rosemount Radar Level Transmitters

Figure 2-3. Rosemount 5300 Series for Level and Interface Measurement

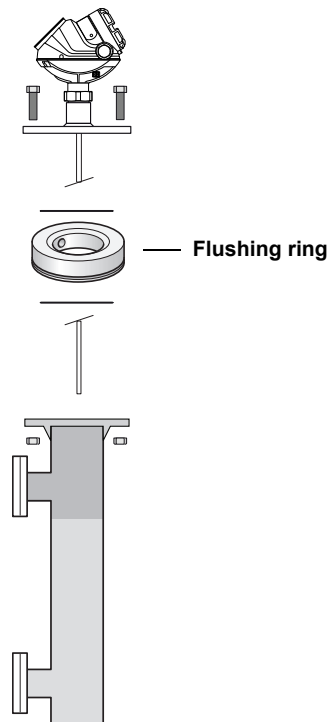


## Flushing Connections and Vents

These options are recommended to remove the air-gap in interface applications with fully submerged probes (5301):

- A separate flushing ring may be inserted between the 5300 flange and cages that use ANSI or DIN flanges

Figure 2-4. Rosemount 5300 Series transmitter with a flushing ring



- Proprietary flanges are available with an integrated vent option that are used with 1½ in. (37.5 mm) NPT threaded probes

For further details and ordering information, see the Rosemount 5300 PDS (Document No. 00813-0100-4530).

Venting may be needed to manipulate the level in the cage to verify the output of the 5300, or to drain the cage. If this is the only purpose, a standard integral cage vent is suitable, refer to the 9901 PDS (Document No. 00813-0100-4601).

## **Chamber Fabrication and Probe Selection**

Dimensioning the chamber correctly and selecting the appropriate probe is key to success in these applications. Either follow the recommendations below and have the chamber manufactured accordingly, or purchase the Rosemount 5300 Series transmitter bundled with the Rosemount 9901 chamber where Emerson has already incorporated these best practices.

The recommended chamber diameter is 3 in. (75 mm) or 4 in. (100 mm). Chambers with a diameter less than 3 in. (75 mm) may cause problems with build-up and it may also be difficult to center the probe. Chambers larger than 6 in. (150 mm) can be used, but provide no advantages for the radar measurement.

With the Rosemount 5300 Series it is recommended that single probes in 3 in. (75 mm) and 4 in. (100 mm) cages be used. Other probe types are more susceptible to build-up and should not be used in this application.<sup>(1)</sup>

The probe must not touch the chamber wall and should extend the full height of the chamber, but does not need to touch the bottom of the chamber. Probe type selection depends on the probe length:

**Probe length is less than 3 ft (1 m):** Use Single Rigid Probe and no centering disk is needed.<sup>(2)</sup>

**Probe length is between 3 ft (1 m) and 10 ft (3 m):** Use either Rigid Single or Flexible Single Probe with the weight and centering disk. Rigid Single is easier to clean and has smaller transition zones, while the Flexible Single requires less head-space during installation and is less likely to be damaged.

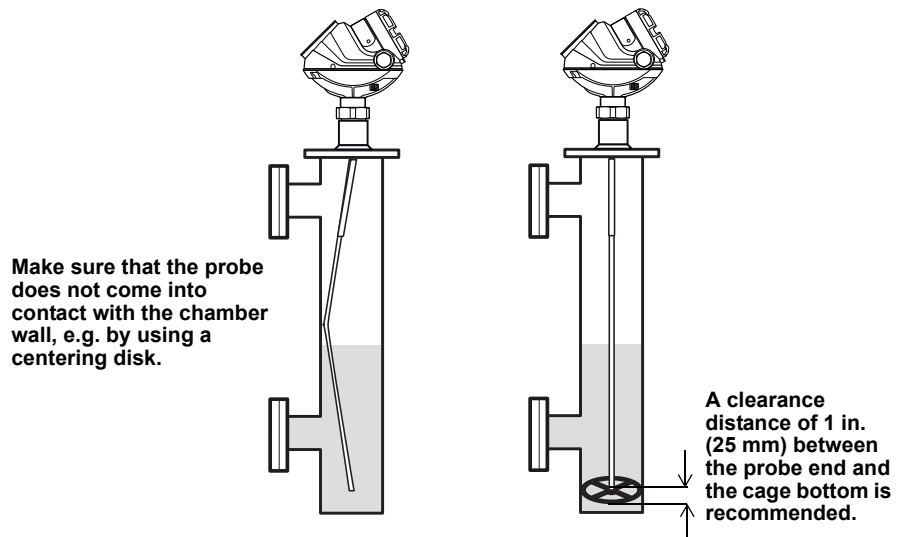
**Probe length is more than 10 ft (3 m):** Use Flexible Single Probe with weight and centering disk.

(1) The single probe creates a virtual coaxial probe with the chamber as the outer tube. The extra gain provided by the twin and coaxial probes is not necessary; the electronics in the 5300 Series is very sensitive and is not a limiting factor.

(2) The transition zones, and the height of the weight, limit the usage of single flexible probes shorter than 3 ft (1 m).

# Rosemount Radar Level Transmitters

Figure 2-5. Improper and proper probe positions



To avoid bending the probe (rigid probes), or twisting and coming into contact with the chamber wall (flexible probes), a small clearance distance between centering disk and chamber bottom is recommended. The clearance distance of 1 in. (25 mm) is selected with a dome shaped chamber bottom in mind, which may prevent the centering disk from reaching the bottom.

The location of the side-pipes and the effective measurement range is determined by the mating tank connections. There are no diameter requirements for the side-pipes, but build-up and clogging should be taken into consideration. Ensure that the inlet pipes do not protrude into the chamber because they may interfere with the radar measurement. Always use the same material of construction for the chamber and the tank or mechanical tensions can arise in the side-connections.

Figure 2-6. Transition Zones and Measuring Range

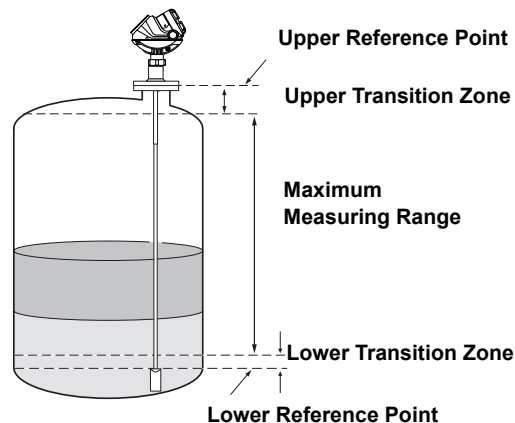


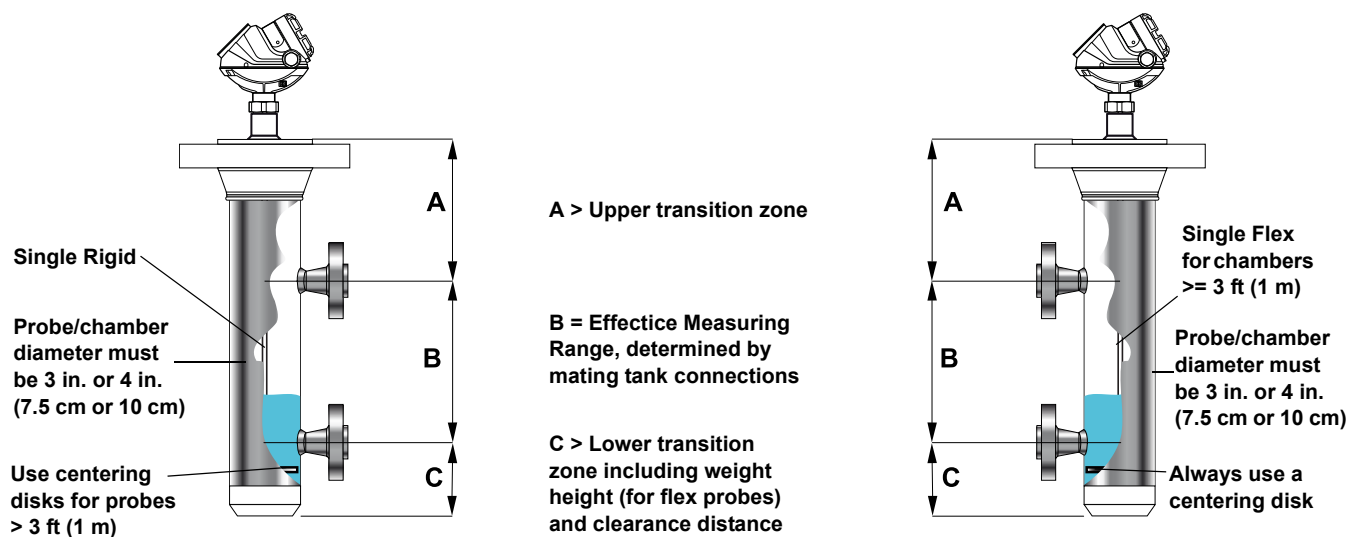
Table 2-2. Transition zones for Rosemount 5300 Series

	Dielectric Constant	Rigid Single Lead <sup>(1)</sup>	Rigid Single Lead, with metallic centering disk	Flexible Single Lead
<b>Upper<sup>(2)</sup> Transition Zone</b>	80 (water)	4.3 in. (11 cm)	4.3 in. (11 cm)	4.3 in. (11 cm)
	2 (oil)	6.3 in. (16 cm)	6.3 in. (16 cm)	7.1 in. (18 cm)
<b>Lower<sup>(3)</sup> Transition Zone</b>	80 (water)	2 in. (5 cm)	2 in. (5 cm)	0 in. <sup>(4)(5)</sup> (0 cm <sup>(4)(5)</sup> )
	2 (oil)	2.8 in. <sup>(5)</sup> (7 cm)	8 in. (20 cm)	2 in. <sup>(4)</sup> (5 cm <sup>(4)</sup> )

- (1) Rigid Single Lead probe without SST centering disk or with PTFE centering disk.  
(2) The distance from the upper reference point where measurements have reduced accuracy, see picture above.  
(3) The distance from the lower reference point where measurements have reduced accuracy, see picture above.  
(4) Note that the weight length adds to non-measurable area and is not included in the diagram. See section Dimensional Drawings in the 5300 Product Data Sheet (Document No. 00813-0100-4530).  
(5) The measuring range for the PTFE covered Flexible Single Lead probe includes the weight when measuring on a high dielectric media.

Transition zones, located at the very top and bottom of the probes, are regions where measurement performance is reduced. Different factors affect the size of the transition zones - probe type, centering disk or no centering disk, and the material and media measured. See Table 2-2. The weight on the flexible probes reduces the measurement range. Therefore, it is recommended to dimension the cage (A, C) so it does not interfere with the effective measurement range (B). The transition zones also limit the minimum probe length.

Figure 2-7. Measuring zones in chambers



## An example using the guidelines for fabrication of cages

(see Table 2-2 on page 2-7 for transition zones)

Assuming level measurement of oil (worst-case);  $A > 6.3$  in. (16 cm) and  $C > 9.8$  in. (25 cm) for rigid single probe with a metallic centering disk, and  $A > 7.1$  in. (18 cm) and  $C > 9.4$  in. (24 cm) for single flexible with a standard weight. There is a 2 in. (5 cm) clearance between the cage bottom and the end of the probe included in the C- dimensions.

## Existing Chambers

Retrofitting of existing chambers is very common, especially when replacing old mechanical devices such as displacers. For further information, refer to the Technical Note "Replacing Displacers with Guided Wave Radar" (Document No. 00840-2200-4811).

## Setting Range Values - Three Options

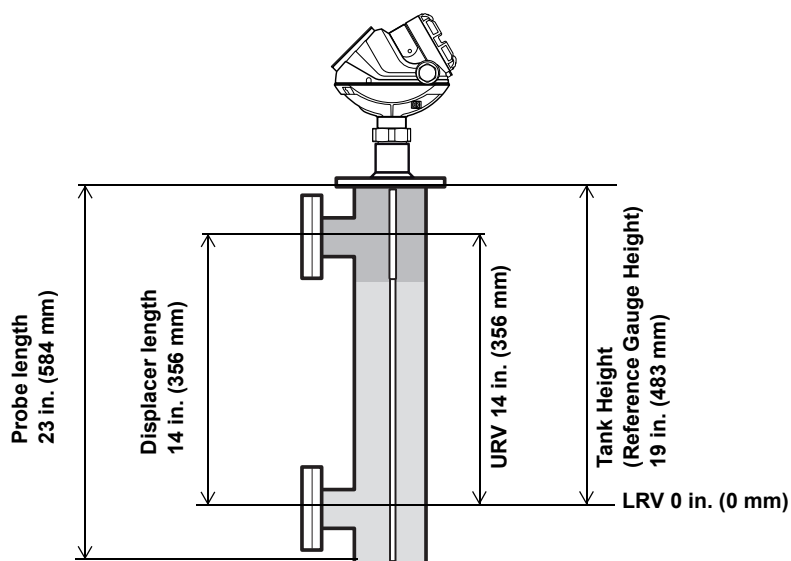
Chambers are mounted onto the tank to correspond with the desired measurement and area of control. This is often a small portion of the overall height.

For displacers, the output span corresponds to the displacer length, with lower (LRV) and upper range values (URV) representing the bottom and top of the displacer. In side-to-side chambers, this corresponds to center-of-the-pipe connections to the vessel.

### Option 1 - Setting LRV to 0 in. (0 mm) at the Lower Tap

The Tank Height should be set to the distance to the zero level point. In this example, it is the lower side-pipe, located 19 in. (483 mm) below the reference point. Output range values will equal the pipe connection heights relative to the zero level point. LRV should be set at 0 in. (0 mm), the URV should be set at 14 in. (356 mm), and the probe should be set to the correct probe length.

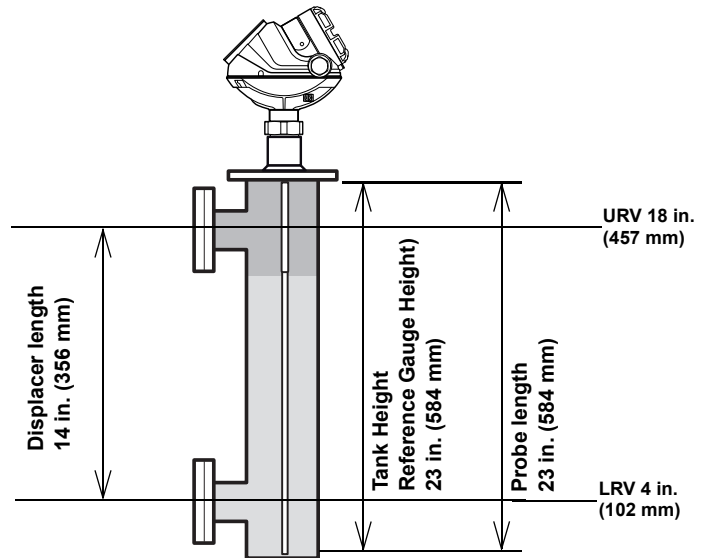
Figure 2-8. Setting range values, Option 1 - Setting LRV to 0 in. (0 mm) at the lower tap



## Option 2 - Matching Displacer Output

The tank height (reference gauge height) and the probe length should be set to the same value. The LRV is the distance from the bottom of the probe to the lower tap. The URV is the LRV plus the distance to the upper tap. In this example, Tank Height (Reference Gauge Height) equals the probe length of 23 in. (584 mm), the LRV is 4 in. (102 mm), and the URV is 18 in. (457 mm).

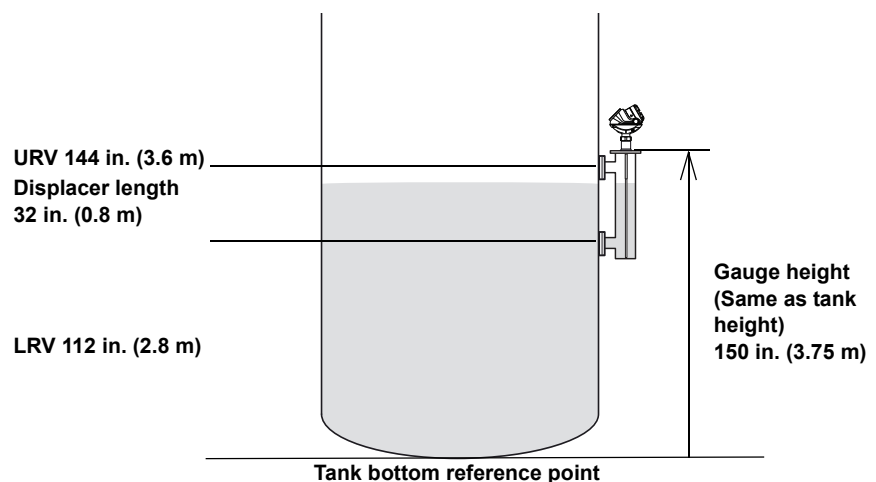
Figure 2-9. Setting range values, Option 2 - Matching displacer output



## Option 3 - Matching Actual Tank Level

For the level measurement to correspond to the actual level, the correct gauge height needs to be entered. The LRV is the distance from the bottom of the tank, or the common reference line, to the lower tank connection tap. For the URV, add the tank connection distance, and the actual probe length needs to be entered.

Figure 2-10. Setting range values, Option 3 - Actual tank level



# Rosemount Radar Level Transmitters

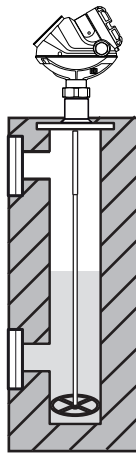
**Example:** Replacing a 32 in. (813 mm) displacer with a 41 in. (1041 mm) probe. The gauge height is the distance from the top flange to the tank bottom reference point. The probe length will be the actual probe length. The LRV setting will be the height of the lower tank connection relative to the tank bottom.

## Insulation

The chamber should always be insulated in hot application to prevent personal injuries and reduce the amount of energy needed for heating. It is often an advantage, and sometimes even required, for the radar measurement:

- In hot applications, insulation will reduce the amount of condensation, since it prevents the upper part of the chamber from becoming a cold spot
- Insulation prevents the product from solidifying inside the chamber, and clogging the inlet-pipes

Figure 2-11. Always use insulation in hot applications



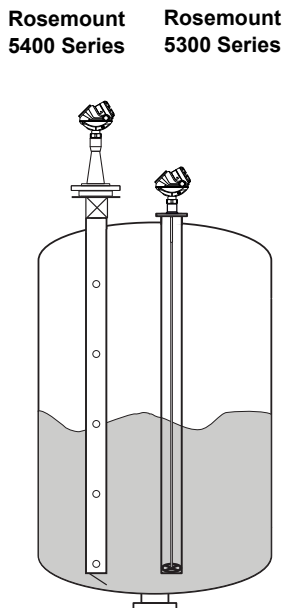
## Pipes

Stilling wells or pipes are used in many applications and many different types of tanks and vessels. The reasons for having the pipes differ, but are typically beneficial from an application standpoint, since pipes will offer a calmer, cleaner surface and eliminate issues with disturbing obstacles.

Both Guided Wave and non-contacting Radar perform well in pipes:

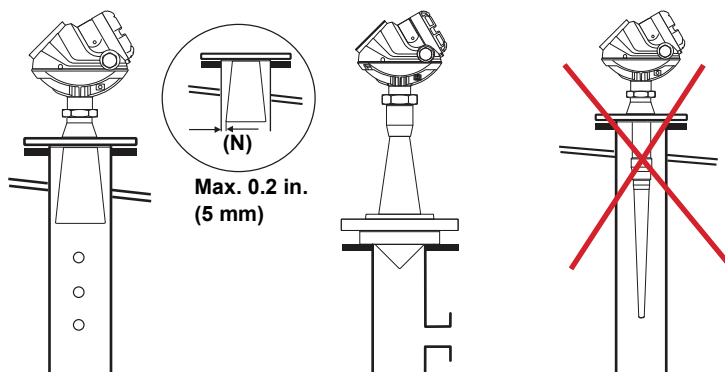
- Use the 5300 Series in shorter pipes (less than 10 ft [3 m]) or if interface measurement is required
- Use the 5400 Series in longer pipes (over 10 ft [3 m]) or if there is a risk for build-up on a GWR probe
- The 5300 Series cannot be isolated; use the Rosemount 5402 with a full-port ball valve for applications that cannot be taken out of operation for service

Figure 2-12. Pipes in a tank



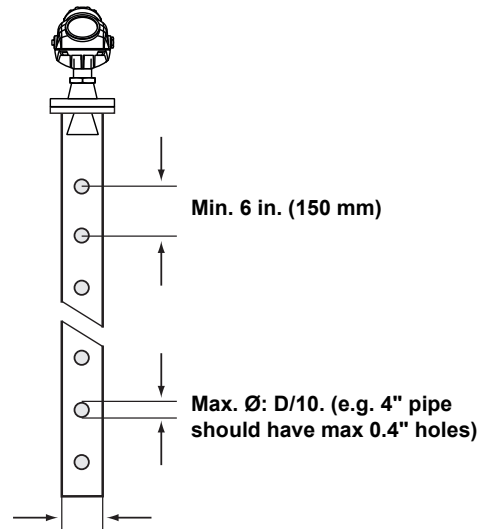
With the 5400 Series, ensure that the cone antenna or process seal antenna is used in the pipes, and that the size of the holes or slots is limited in size. See Figure 2-14 on page 2-12. Holes should be drilled on one side of the pipe. The gap between the cone-antenna and the pipe should not be larger than 2 in. (5 mm). If needed, buy an oversized cone and cut on site. With non-contacting radar in pipe installations with low dielectric fluids, install a deflection plate with an approximate angle of 45° at the bottom of the pipe. Failure to follow these requirements may affect the reliability of the level measurement.

Figure 2-13. 5400 in pipes and slot size



# Rosemount Radar Level Transmitters

Figure 2-14. Rosemount 5400 Series recommended hole sizes for pipe installations



For the 5300 Series the installation considerations are virtually identical with chambers, as covered in the previous section of this document.

For more details, refer to the Technical Note "Guidelines for Choosing and Installing Radar in Stilling Wells and bypass pipes" (Document No. 00840-0200-4024).

## Tanks

### Recommended Mounting Position

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

For the Rosemount 5300 Series:

- Do not mount close to inlet pipes and ensure that the probe does not come in contact with the nozzle (X)
- If there is a chance that the probe may come in contact with the tank wall, nozzle or other tank obstructions, the coaxial probe is the only recommended choice. Minimum clearance is given in Table 2-3 on page 2-13
- Generally, the Rosemount 5400 Series is recommended in tanks with agitators. If the probe sways due to turbulent conditions, the probe should be anchored to the tank bottom (Y). Refer to the 5300 Series Reference Manual (00809-0100-4530) for anchoring options. Also note that violent fluid movements that cause high sideways forces may break rigid probes

# Rosemount Radar Level Transmitters

Figure 2-15. Tank with agitator

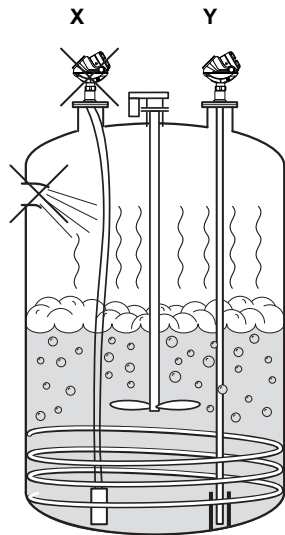


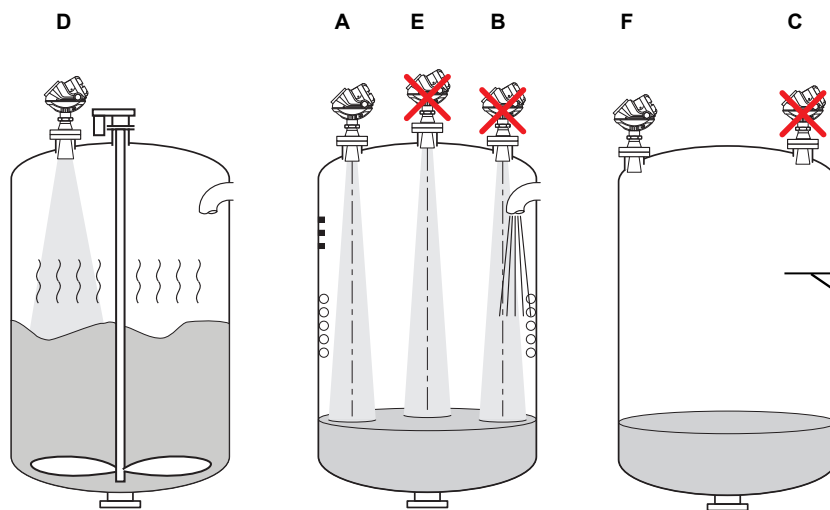
Table 2-3. Minimal clearances of probes

	Coaxial	Rigid Twin Lead	Flexible Twin Lead	Rigid Single Lead	Flexible Single Lead
Min. clearance to tank wall or obstruction	0 in. (0 cm)	4 in. (10 cm)	4 in. (10 cm)	4 in. (10 cm) in the case of smooth metallic wall. 20 in. (50 cm) in the case of disturbing objects, rugged metallic or concrete/plastic wall.	4 in. (10 cm) in the case of smooth metallic wall. 20 in. (50 cm) in the case of disturbing objects, rugged metallic or concrete/plastic wall.

The Rosemount 5400 Series should be installed in locations with a clear and unobstructed view of the level surface (A) for optimum performance:

- Filling inlets creating turbulence (B), and stationary metallic objects with horizontal surfaces (C) should be kept at a distance, outside the signal beam. See the 5400 PDS for more information (Document No. 00813-0100-4026)
- Agitators with large horizontal blades may reduce the performance of the transmitter, so install the transmitter in a location where this effect is minimized. Vertical or slanted blades are often invisible to radar, but create turbulence (D)
- Do not install the transmitter in the center of the tank (E)
- Because of circular polarization, there is no clearance distance requirement from the tank wall if it is flat and free from obstructions, such as heating coils and ladders (F). Usually, the optimal location is 1/3 of the radius from the tank wall

Figure 2-16. Proper and improper locations for the Rosemount 5400 Series transmitter



## Nozzle Considerations

Depending on the selection of transmitter model and probe/antenna, special considerations may have to be taken because of the nozzle.

### Rosemount 5300 Series

The coaxial probe signal is unaffected by the nozzle.

The single and twin probes have some nozzle restrictions, e.g. avoid using nozzles with reducers, and nozzles that are too tall or too narrow.

# Rosemount Radar Level Transmitters

Figure 2-17. Mounting in nozzles

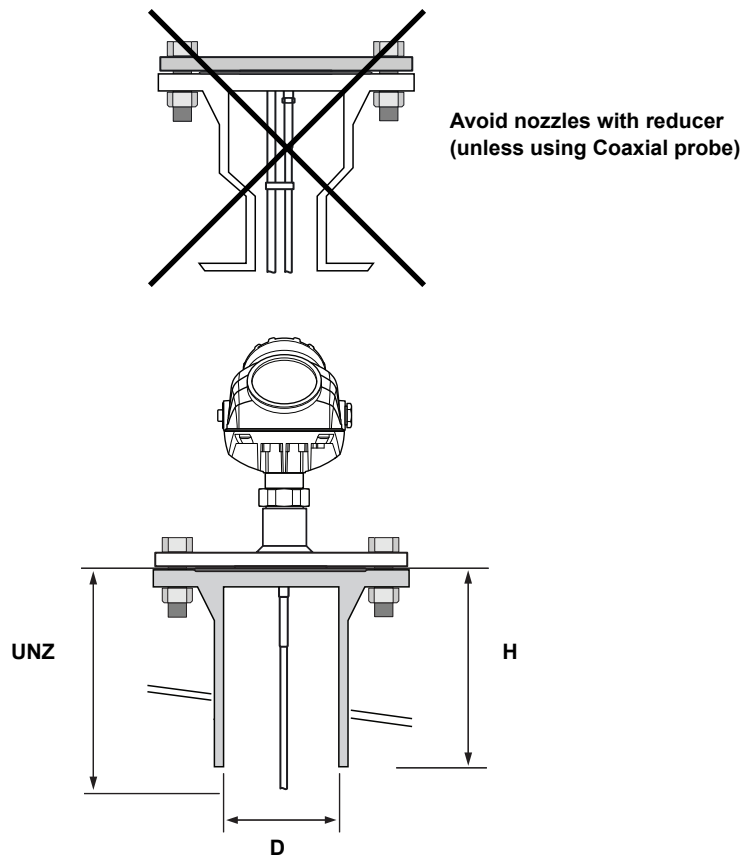


Table 2-4. Nozzle considerations

	Single (Rigid/Flexible)	Coaxial	Twin (Rigid/Flexible)
Recommended Nozzle Diameter (D)	4-6 in. (100-150 mm)	> Probe Diameter	4-6 in. (100-150 mm)
Minimum Nozzle Diameter (D) <sup>(1)</sup>	2 in. (50 mm)	> Probe Diameter	2 in. (50 mm)
Maximum Nozzle Height (H)	4 in. + Nozzle Diameter	N/A	4 in. + Nozzle Diameter <sup>(2)</sup>

(1) An Upper Null Zone setup may be required to mask the nozzle, which may reduce the measuring range.

(2) When using single flexible probes in tall nozzles, it is recommended to use the Long Stud (LS).

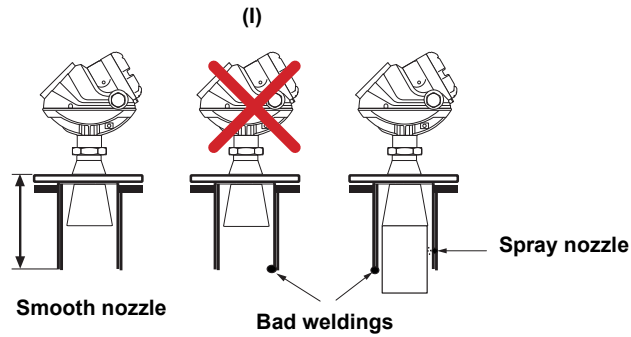
## Rosemount 5400 Series

### 5402 with Cone Antenna

The antenna can be used in nozzles equal to or larger than 2 in. (50 mm). It can be recessed in smooth nozzles up to 6 ft (2 m). If the inside of the nozzle contains disturbing objects, use the extended cone (I).

# Rosemount Radar Level Transmitters

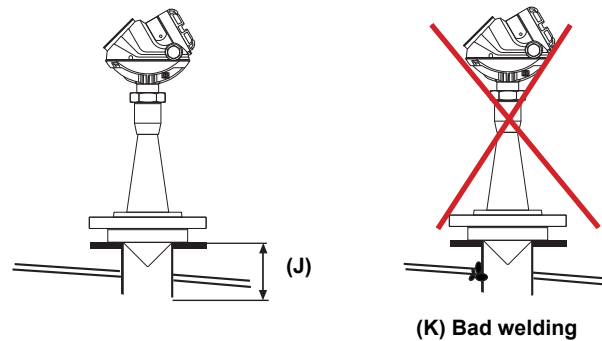
Figure 2-18. Rosemount 5402  
with Cone Antenna



## 5402 with Process Seal Antenna

The antenna can be used in 2, 3, and 4 in. (50, 75, and 100 mm) nozzles up to 6 ft (2 m) tall (J), but disturbing objects inside the nozzle (K) may impact the measurement, and should be avoided. The flange on the tank should have a flat or raised face, but other tank flanges may be possible. Consult your local Emerson Process Management representative for assistance.

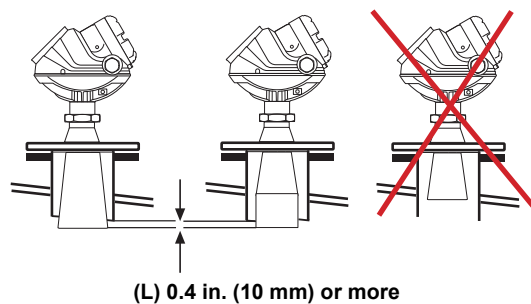
Figure 2-19. Rosemount 5402  
with Process Seal Antenna



## 5401 with Cone Antenna

This antenna can be used in tanks with nozzles equal to or larger than 4 in. (100 mm) and can extend 0.4 in. (10 mm) or more below the nozzle (L). If required, use the extended cone solution.

Figure 2-20. Rosemount 5401  
with Cone Antenna



Process Isolation for Service

It is recommended that the Rosemount 5400 Series use a full-port ball valve in applications that cannot be taken out of operation for service.

The 5402 is required, and the preferred choice is the Process Seal Antenna, since it does not require a spool piece. The cone antenna can also be used, but a spool piece will be needed.

Ensure there is no edge between the ball valve and the nozzle/pipe. The inside should be smooth.

The 5300 Series cannot be used with valves because of the protrusion of the probe into the tank. If process isolation is needed with the 5300 Series, a chamber is recommended.

Probe and Antenna Selection

Besides mounting position, nozzle considerations, and process isolation, there are other factors that need to be taken into consideration when selecting the probe or antenna:

- Single probes and cone-antennas are recommended in most applications. Always use the largest possible antenna
- In case of turbulent surface conditions or foam, consider using the coaxial probe with GWR. When using non-contacting radar, consider using a stilling well
- The coaxial and twin lead probes have longer measuring ranges than the single probes, but are more sensitive to build-up and coating

Table 2-5. Factors of probe selection

Coaxial	Twin Lead	Single Lead
Maximum Viscosity		
500 cP <sup>(1)</sup>	1500 cP <sup>(2)</sup>	8000 cP <sup>(3)</sup>
Coating/Build-up		
Coating not recommended	Thin coating allowed, but no bridging	Coating allowed

(1) About the same viscosity as motor oil SAE30 at room temperature.  
(2) About the same viscosity as motor oil SAE70 at room temperature.  
(3) About the same viscosity as molasses at room temperature.

Always ensure that the wetted materials are compatible with the process and that the probe/antenna will withstand the application's temperature and pressure range.

For more information, refer to the Level Selection Guide (Document No. 00803-0100-6112).

# Rosemount Radar Level Transmitters

---

## Section 3 Refining Applications

Safety Messages .....	page 3-1
Refining Applications .....	page 3-2
Chambers .....	page 3-2
Pipes .....	page 3-9
Tanks .....	page 3-10
Applications to limit .....	page 3-14

### SAFETY MESSAGES

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Please 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 environment of the gauge is consistent with the appropriate hazardous locations certifications.

Before connecting a HART®-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.

Do not remove the gauge cover in explosive atmospheres when the circuit is alive.

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

Make sure only qualified personnel perform the installation.

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

Do not perform any service other than those contained in this manual unless you are qualified.

**High voltage that may be present on leads could cause electrical shock.**

Avoid contact with leads and terminals.

Make sure the main power to the transmitter is off and the lines to any other external power source are disconnected or not powered while wiring the gauge.

Probes covered with plastic and/or with plastic discs may generate an ignition-capable level of electrostatic charge under certain extreme conditions. Therefore, when the probe is used in a potentially explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.

# Rosemount Radar Level Transmitters

## INTRODUCTION

This section covers refining applications in chambers, pipes, and tanks regarding pressure, temperature and measurement.

Besides the list of typical applications, application characteristics, and best practices suggested here, there is also a description on the applications to avoid at the end of the section.

## REFINING APPLICATIONS

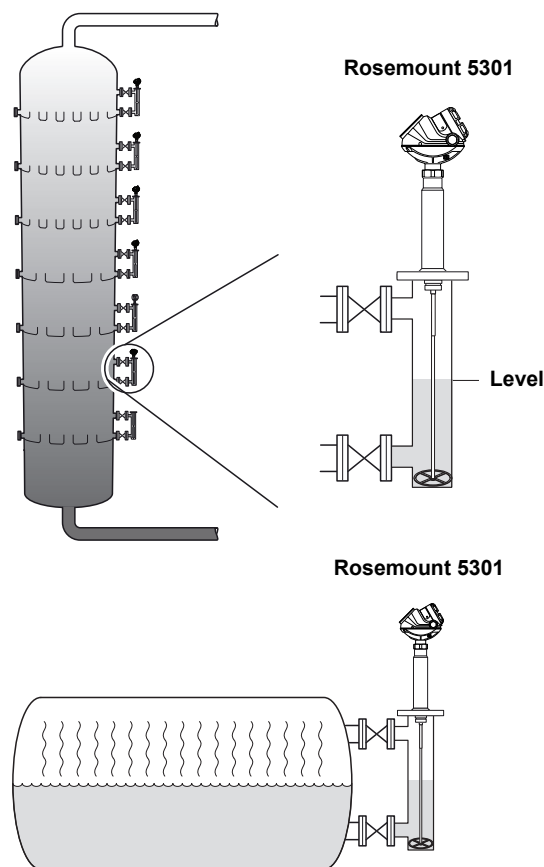
### Chambers

#### High temperature at low to moderate pressure - Level Measurement

##### *Typical Applications*

- Distillation Towers (Lower Portions)
- Reflux/Reboilers
- Accumulator

Figure 3-1. Tower bridges and reboiler application with Rosemount 5301 transmitters



## *Application characteristics*

- Boiling fluid results in a low signal return for the radar, especially hydrocarbon products, e.g. Oils and Diesel in crude oil distillation towers
- The product may be very viscous and cause heavy build-up in the chamber
- Heavy vapors may result in build-up on the probe

## *Best Practices*

- A Rosemount 5301 with a single lead probe, option code "4A" or "5A" is recommended. A centering disk should be included, if needed
- Temperature considerations:
  - The high-temperature high-pressure (HTHP) tank seal, option code 'H' should be used. It has a maximum temperature of 750 °F (400 °C)
  - Use metallic centering disks, option code 'Sx'
- In applications with very low signal strength, it is recommended to activate the transmitter firmware function Probe End Projection (PEP). For more information, refer to Rosemount 5300 Series Reference Manual (Document No. 00809-0100-4530)
- Insulate the chamber to reduce the amount of condensation

---

## **NOTE**

In some processes, e.g. vacuum residue towers, the fluid may be too viscous for practical use in a chamber. For these cases, a DP with flushing connections is recommended.

If the temperature is lower than 300 °F (150 °C), the standard tank seal may be used instead of the HTHP option. For example, this may apply to the upper portion of a distillation tower. See Section 4 "Commissioning" on page 4-2.

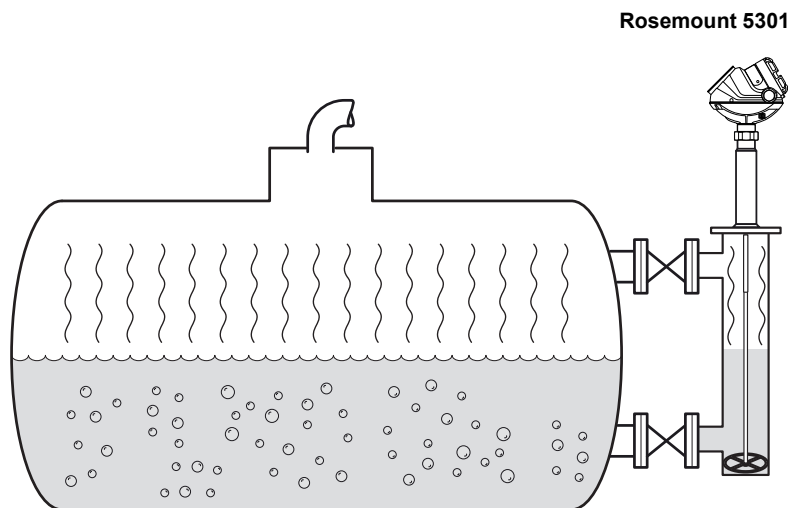
---

## High Temperature and High Pressure - Level Measurement

### Typical Applications

- Boiler feedwater systems

Figure 3-2. Boiler feedwater system



### Application characteristics

- Boiling water with saturated steam vapors
- Heavy water condensation
- Water and saturated steam have certain properties, see Table 3-1

- The returned signal from the surface becomes weaker as water temperature increases.

- If not taken into account, the saturated steam alters the propagation velocity of the radar signal and generates an error in the level reading proportional to the measured distance. Increased pressure and temperature will affect the error in measured distance.

Table 3-1. Properties of water and saturated steam

Temperature °F (°C)	Pressure psia	DC of liquid	DC of saturated steam	Error in distance (%) if uncorrected
100 (38)	0.95	74	1.001	0.0
200 (93)	11.5	57	1.005	0.2
300 (149)	67	44	1.022	1.1
400 (204)	247	34	1.069	3.4
500 (260)	680	25	1.180	8.6
600 (315)	1543	18	1.461	20.9

## Best Practices

- It is recommended that the Rosemount 5301 use a single lead probe, option-code "4A" or "5A", and a centering disk if needed

### Temperature considerations:

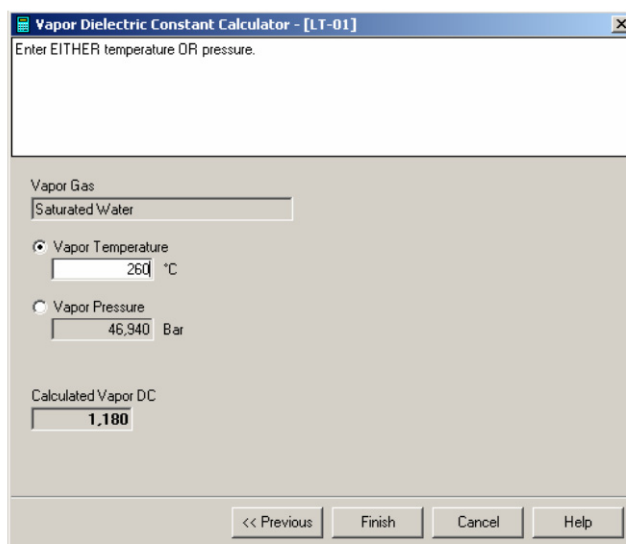
- Use the high-temperature high-pressure (HTHP) tank seal, option code 'H', with maximum P/T 2940 psig at 752 °F (203 bar at 400 °C)
  - Use metallic centering disks, option-code 'Sx'
- Insulate the chamber to reduce condensation
  - When commissioning the transmitter, the specific properties of water and saturated steam must be taken into account:

Configure the transmitter when the tank is in operation, otherwise the signal returned from the surface will be too high and the transmitter will not be configured correctly.

Rosemount Radar Master (RRM) can be used to compensate for the error induced by the saturated steam:

*Setup > Tank > Environment > Activate Advanced Mode > Vapor Dielectric Constant Calculator*

Figure 3-3. Vapor Dielectric Constant Calculator (LT-01)



## NOTE

The saturated steam compensation is fixed and will only adjust the level reading at specified conditions. This means that the transmitter shows a correct level reading during operation, but not during startup and shutdown when these conditions are not fulfilled. See Table 3-2 on page 3-6.

# Rosemount Radar Level Transmitters

Table 3-2. Level Reading Errors during shutdown, with fixed saturated water steam correction activated

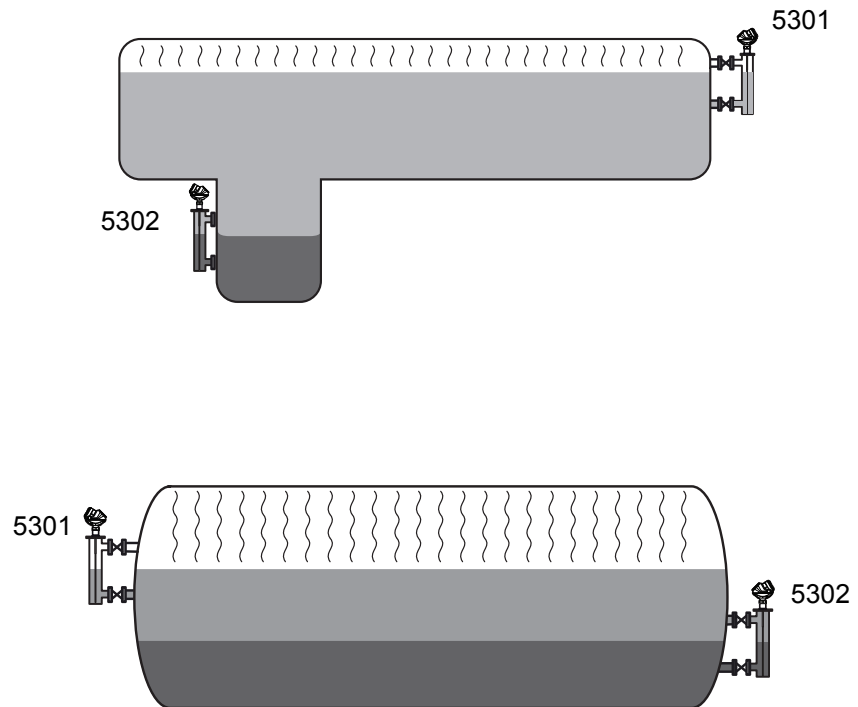
Entered Vapor DC	Error in reading, when actual Vapor DC is 1 (corresponding to water at room temperature)		Offset in reading, if Vapor DC is configured correctly
	Surface at 15 in (380 mm) from flange	Surface at 30 in. (760 mm) from flange	
1.001	0 in. (0 mm)	0 in. (0 mm)	0 in. (0 mm)
1.022	0.2 in. (4 mm)	0.3 in. (8 mm)	0 in. (0 mm)
1.180	1.3 in. (33 mm)	2.6 in. (65 mm)	0 in. (0 mm)

## High Temperature and High Pressure - Level and Interface Measurement

### Typical Applications

- Separators, such as cold HP, hot LP in the hydrotreater
- Coalescers

Figure 3-4. Separators with Rosemount 5300 Series transmitters



### Application characteristics

- There may be a fairly large emulsion between the products, which may make the interface indistinct
- Vapors may generate build-up

## *Best Practices*

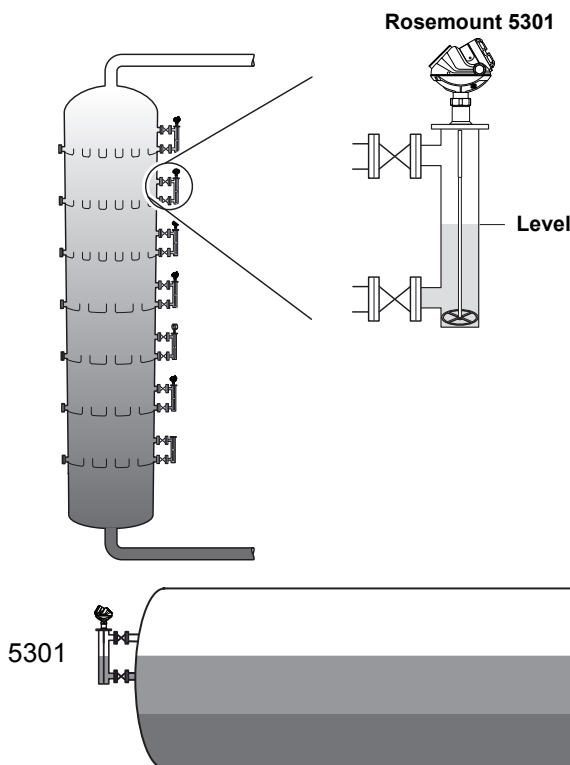
- Use the Rosemount 5301 with a separate flushing ring or flange and the integrated venting option. Alternatively, if there is an air gap, use the 5302
- Refer to the 5300 Product Data Sheet (Document No. 00813-0100-4530) to ensure that the conditions for interface measurement are fulfilled, especially with respect to the emulsion layer
- For chambers, it is recommended that the single lead probe, option-code "4A" or "5A" is used along with a centering disk, if needed
- Temperature and pressure considerations:
  - Use the high-temperature high-pressure (HTHP) tank seal, option code 'H', maximum P/T 2940 psig at 752 °F (203 bar at 400 °C).
  - Use metallic centering disks, option-code 'Sx'
- Because of the emulsion layer, Interface Threshold may need manual adjustment

## **Standard Temperature and Standard Pressure - Level Measurement**

### *Typical Applications*

- Distillation Towers (Upper portions)
- Separators
- Knock-out drums
- Accumulators/Feed tanks

Figure 3-5. Distillation tower and separator with Rosemount 5300 Series transmitter



## *Best Practices*

- It is recommended that the Rosemount 5301 with a single lead probe, option-code "4A" or "5A" is used along with a centering disk, if needed
- Use the standard tank seal, option code 'S', with pressure and temperature range 15 psig (-1bar) to 580 psig (40 bar) @ 302 °F (150 °C)
- Besides the metallic centering disk, PTFE may also be used, option code 'Px'

## **Standard Temperature and Standard Pressure - Interface Measurement**

### *Typical Applications*

- Accumulators
- Settling Tanks
- Skimmers
- Separators

### *Best Practices*

- Use the Rosemount 5301 with a separate flushing ring or flange and integrated venting option. Alternatively, if there is an air gap, use the 5302
- For chambers, it is recommended that the single lead probe, option code "4A" or "5A" is used along with a centering disk, if needed
- Use the standard tank seal, option code 'S', with pressure and temperature range 15 psig (-1bar) to 580 psig (40 bar) @ 302 °F (150 °C)
- Besides the metallic centering disk, PTFE may also be used, option code 'Px'

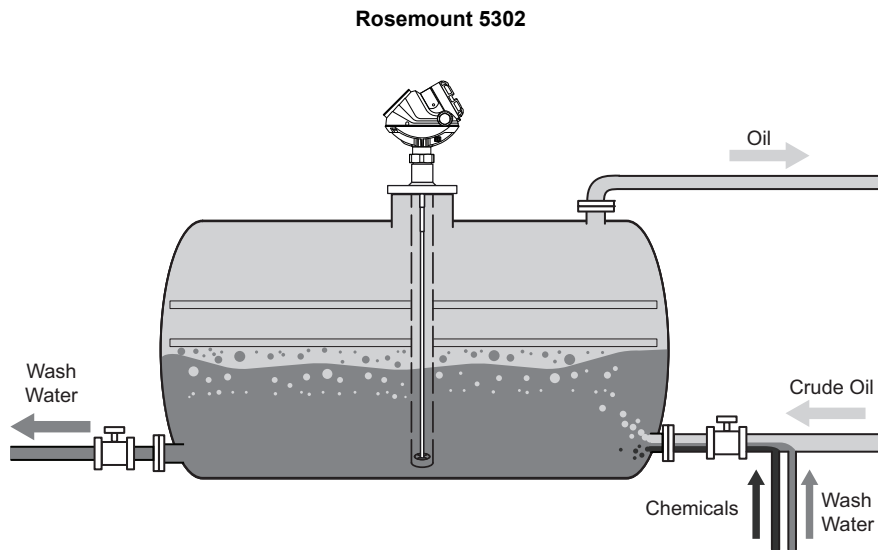
Figure 3-6. Interface measurement in a separator using a Rosemount 5302 transmitter



## Pipes

## Desalters

Figure 3-7. Desalter with a Rosemount 5302 transmitter



### *Application characteristics*

- The crude oil is viscous and dirty with solids and water content
- The interface is indistinct, because of a large emulsion layer between the two products

### *Best Practices*

- Use the Rosemount 5302 with multivariable output for measurement of both level and interface
- It is required to insert the probe in a 4 in. (100 mm) stilling-well to reduce the emulsion layer. Drill as many holes as possible, since these effectively set the resolution for the interface measurement
- It is recommended to use a single lead probe, option code "4A" or "5A", with a centering disk, option-code 'Px' or 'Sx'
- Use the standard tank seal, option code 'S', with pressure and temperature range -15 psig (-1 bar) to 580 psig (40 bar) @ 302 °F (150 °C)
- Ensure that the electronics housing does not get warmer than the specified temperature limit; if needed, use the high-temperature high-pressure (HTHP) tank seal, option code 'H', to move the transmitter housing further away from the process
- Besides the metallic centering disk, PTFE may also be used, option code 'Px'
- Because of the emulsion layer, it is likely that the Interface Threshold will need manual adjustment

## **Liquefied Gases**

### *Typical Applications*

- Small containers of LNG, LPG

## *Application Characteristics*

- Liquefied gases have a very low dielectric constant and a very small signal return
- Boiling fluid reduces the signal return additionally

## *Best Practices*

- For non-inventory measurements, the Rosemount 5402 with cone- or process-seal antenna can be used
- A 2-4 in. (50-100 mm) stilling well is required to calm the surface
- A full-port ball-valve should be used for process isolation

## **Tanks**

### **Ammonia**

#### *Application characteristics*

- Anhydrous ammonia has heavy vapors that attenuate the signal

#### *Best Practices*

- Use 5301 with any of the probe-types
- Ensure the wetted materials are compatible with the process. For example, many users consider Viton® and Buna-N® O-rings to be incompatible with this process. The High Pressure tank seal, option code 'P', can be used if a solution without O-rings is preferred.
- For further information, see Technical Note (Document No. 00840-0100-4811).

### **Solids**

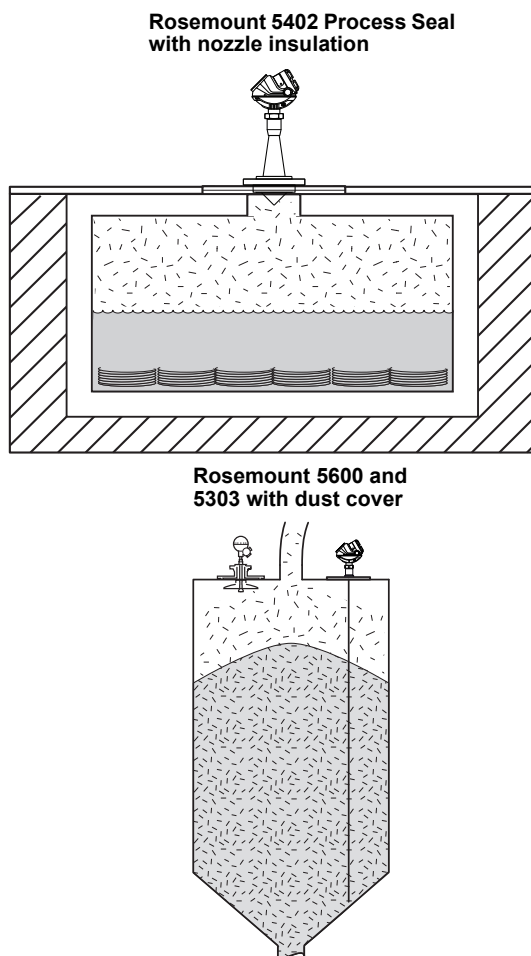
#### *Typical Applications*

- Coke Bins
- Spent Catalyst Hopper
- Sulfur pits

# Rosemount Radar Level Transmitters

Figure 3-8. A sulfur pit with a Rosemount 5402 transmitter (above)

Catalyst Hopper with a Rosemount 5600 transmitter (below)



## Application characteristics

- The surface of solid materials is rarely flat or horizontal, and the angle of repose, or surface inclination, will change as the vessel fills and empties
- The dielectric value of most solids is fairly low. For radar, this is a key indicator of the amount of signal that will be reflected back to the gauge
- There is often a lot of dust during the fill cycle
- Heavier materials can create a pull force that can break cables. This can be an issue in vessels taller than 50 ft (15 m), and should be taken into account to guard against this

## Best Practices

- Sulfur pits: use Rosemount 5402 with process-seal antenna. Purge, insulate, heat-trace the nozzle or similar to reduce the amount of build-up
- Spent catalyst hopper  
under 60 ft (18 m): use Rosemount 5303 with long-stud and standard 6A-probe  
over 60 ft (18 m): use Rosemount 5601 parabolic with dust-cover
- Coke bins: use Rosemount 5600 parabolic with dust-cover

# Rosemount Radar Level Transmitters

---

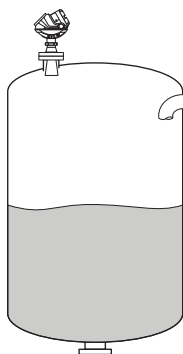
## Storage Tanks

### *Typical Applications*

- Chemical storage - acids, caustics, fuels, ..
- Waste water
- Crude oil buffer storage

Figure 3-9. Chemical storage

**Rosemount 5402**



### *Best Practices*

- Use Rosemount 5402 with Cone antenna
- Consider material compatibility

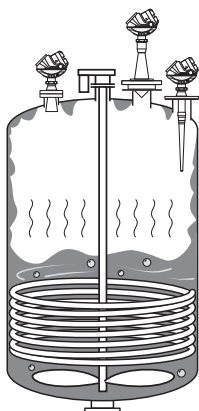
## Tanks with agitators

### *Typical Applications*

- Mixing tanks - acids, catalysts
- Blending tanks
- Reactors

Figure 3-10. Tank with agitator using Rosemount 5400 Series transmitters

**Rosemount 5400 Series**



*Application characteristics*

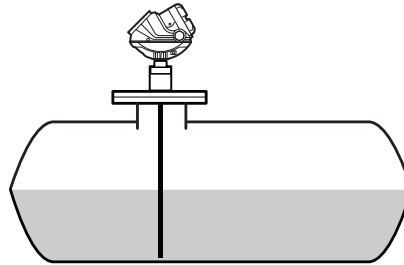
- May be corrosive, vapors, turbulence, foam

*Best Practices*

- Typically 5400 is used

**Compressor tanks**

Figure 3-11. Compressor tank



*Application characteristics*

- Small tank containing oil
- The tank may be too small to fit a chamber - direct connection is more likely

*Best Practices*

- Rosemount 5301 standard single is recommended

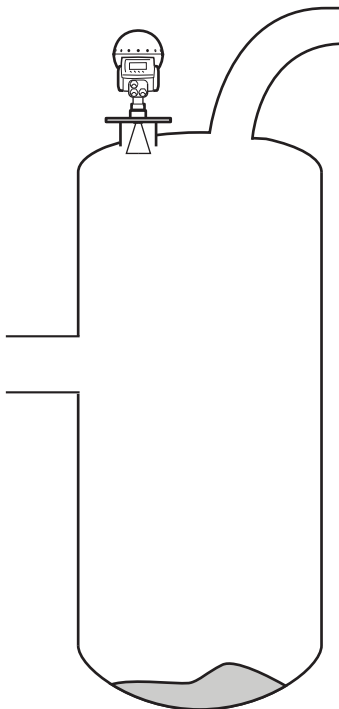
**Tanks with very rapid level changes**

*Typical Applications*

- Blowdown drum

# Rosemount Radar Level Transmitters

Figure 3-12. Blowdown drum with a Rosemount 5600 Series transmitter



## *Application characteristics*

- Tank may fill up very rapidly, for example because of upset in the process

## *Best Practices*

- Use Rosemount 5600

## **Applications to limit**

Generally, GWR is not suitable for extremely viscous products where fluid flow is minimal. If GWR is used in a chamber with very viscous fluids, the chamber should be heat traced and insulated to ensure fluidity. A vacuum residue unit is an example of this type of application. Coke drums, where the fluid hardens, is not a suitable application for GWR. Applications where heavy coating is likely, such as asphalt, are more suitable for non-contacting radar.

Very small vessels (less than 18 inches [450 mm]) may cause measurements that are more within the transition zones than the active measurement region. In addition, if the fluid has a low dielectric constant and is hot, and/or turbulent, then threshold settings may require more care. Contact your local Emerson Process Management representative for assistance.

## Section 4 Commissioning

Safety Messages .....	page 4-1
Safety Messages .....	page 4-1
Commissioning .....	page 4-2
Trim Near Zone (5300 Series only) .....	page 4-2
Store Backup and Verification Files .....	page 4-3
On the Bench Test (optional) .....	page 4-3

### SAFETY MESSAGES

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Please 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 environment of the gauge is consistent with the appropriate hazardous locations certifications.

Before connecting a HART®-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.

Do not remove the gauge cover in explosive atmospheres when the circuit is alive.

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

Make sure only qualified personnel perform the installation.

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

Do not perform any service other than those contained in this manual unless you are qualified.

##### **High voltage that may be present on leads could cause electrical shock.**

Avoid contact with leads and terminals.

Make sure the main power to the transmitter is off and the lines to any other external power source are disconnected or not powered while wiring the gauge.

Probes covered with plastic and/or with plastic discs may generate an ignition-capable level of electrostatic charge under certain extreme conditions. Therefore, when the probe is used in a potentially explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.

# Rosemount Radar Level Transmitters

## INTRODUCTION

This section is a brief outline of commissioning, and does not provide comprehensive information on the whole procedure.

For the commissioning process, follow the steps of the product-related Quick Installation Guides. For your convenience, a checklist is provided in the Appendix of this Manual Supplement.

## COMMISSIONING

The transmitter installation should be carried out as described in the Quick Installation Guide that is enclosed with every transmitter. Even though the transmitter may be installed on the bench, it must be configured to the actual process conditions.

For a 5300 Series transmitter, do not bend the probe during any part of the installation. It may be necessary to shorten the probe, mount a centering disk, or anchor the probe during the mechanical installation. For more information, see the Reference Manual (00809-0100-4530).

Beside these required steps, the procedures below are recommended as best practices.

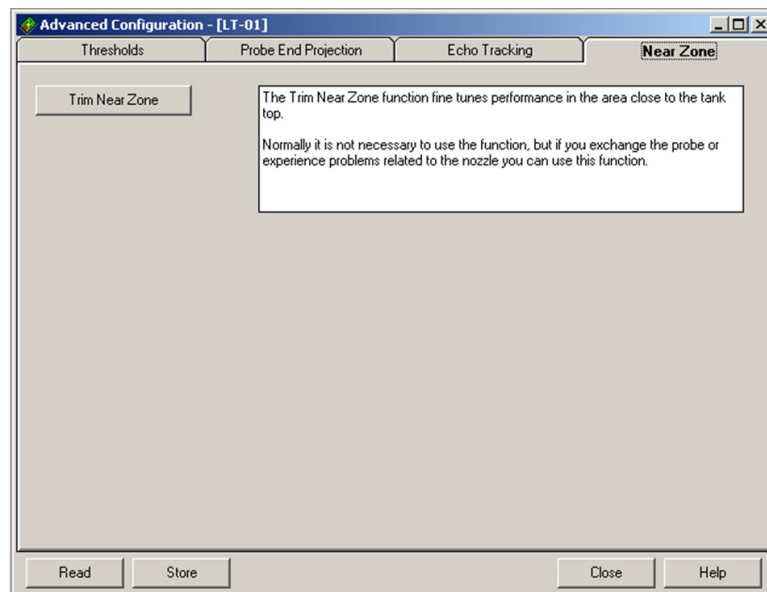
### Trim Near Zone (5300 Series only)

The Rosemount 5300 Series is equipped with a firmware functionality that minimizes the Upper Transition Zone based on actual mounting conditions. Best practice in refining applications, where short chambers are often used, this function is advised.

To activate this function, ensure that the tank or chamber is empty, and that the (upper) product is not closer than 40 in. (1 m). Then execute the Trim Near Zone command.

*Rosemount Radar Master > Advanced > Near Zone > Trim Near Zone*

Figure 4-1. Advanced Configuration - [LT-01]



For detailed information on the Trim Near Zone function, refer to 5300 Series Reference Manual (Document No. 00809-0100-4530).

## Store Backup and Verification Files

As the last step of the commissioning procedure, it is recommended that both the transmitter settings and the echo curve be stored. For example, these can be used for subsequent transmitter verification or troubleshooting.

*Rosemount Radar Master > Device > Backup Config to file*

*Rosemount Radar Master > Tools > Echo Curve > Record*

## On the Bench Test (optional)

Sometimes the actual process is not available and the transmitter is pre-commissioned on the bench. In this case, the level is often simulated using metal-plates, water, or other targets.

Although, these tests provide a basic verification of the transmitter, they do not verify that the transmitter functions properly at the actual process conditions.

Bench tests complement verification tests, but do not replace them. The instructions in Section 5 "Measurement Validation at Operating Conditions" should be followed and the bench test is considered optional.

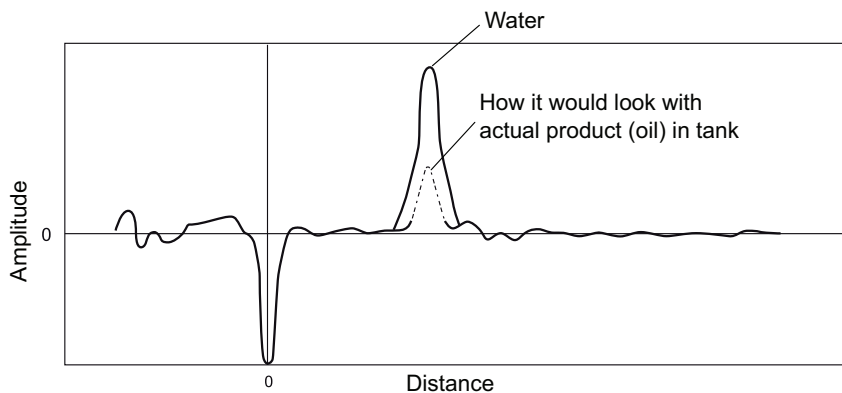
One of the largest differences between the simulated level and the actual level during operating conditions is the amplitude of the surface peak. For example, in a 4 in. (100 mm) chamber using the 5300 Series transmitter and a single probe, the peak of water can be 10,000 mV, while oil would be 2,000 mV under the same conditions.

**Never set the thresholds according to simulated level values since there is a major risk that the thresholds are set too high.**

Generally, it is advised to accept the automatic settings. If it is necessary to adjust the thresholds, do the adjustments the first time the process is started at actual operating conditions.

Normally, the thresholds do not require any adjustments on the custom settings.

Figure 4-2. The difference between the amplitude of surface peaks in the case of simulated and actual liquid levels



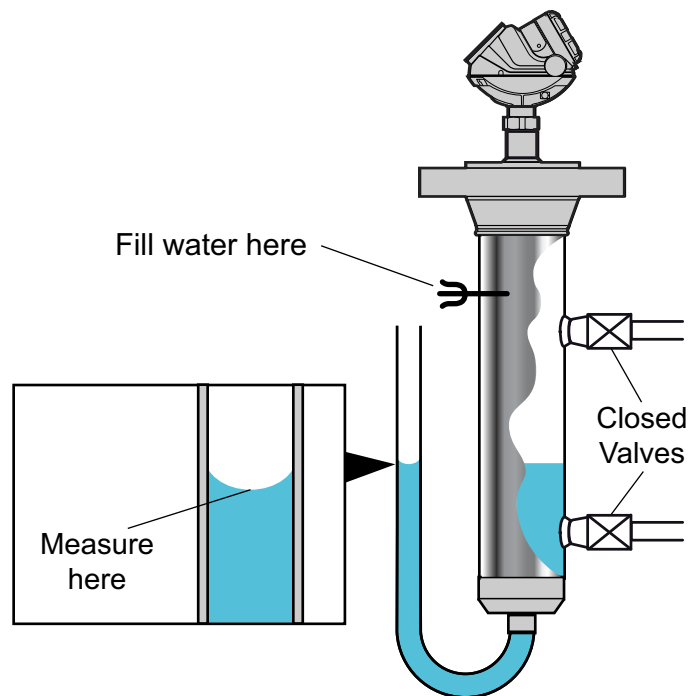
## Example

A 5300 Series transmitter mounted in a chamber can be verified by connecting flexible transparent tubing to the bottom drain, ensuring that there are no crimps or folds in the bend to impede the flow.

The inlet-pipes are sealed by closing the valves, and filling the chamber with water using the upper vent hole. The level is varied between the 4-20 mA set-points to verify that the basic transmitter settings have been configured correctly.

Once the chamber is mounted on the actual tank and the process is started, a complete verification is carried out according to Section 5, "Measurement Validation at Operating Conditions".

Figure 4-3. Verification of transmitter measurement in bridle application using tubing



## Section 5 Measurement Validation at Operating Conditions

Safety Messages .....	page 5-1
Introduction .....	page 5-2
Step 1: Verify the Correctness of Level Reading .....	page 5-2
Step 2: Analog Output Signal Validation .....	page 5-3
Step 3: Echo-Curve Verification at Operating Conditions .....	page 5-4
Step 4: Transmitter Diagnostics Review .....	page 5-4
Step 5: Monitor Level while Emptying .....	page 5-5
Step 6: Echo-Curve Verification with Empty Tank .....	page 5-6
Step 7: Monitor Level while Filling .....	page 5-6

### SAFETY MESSAGES

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Please 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 environment of the gauge is consistent with the appropriate hazardous locations certifications.

Before connecting a HART®-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.

Do not remove the gauge cover in explosive atmospheres when the circuit is alive.

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

Make sure only qualified personnel perform the installation.

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

Do not perform any service other than those contained in this manual unless you are qualified.

**High voltage that may be present on leads could cause electrical shock.**

Avoid contact with leads and terminals.

Make sure the main power to the transmitter is off and the lines to any other external power source are disconnected or not powered while wiring the gauge.

Probes covered with plastic and/or with plastic discs may generate an ignition-capable level of electrostatic charge under certain extreme conditions. Therefore, when the probe is used in a potentially explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.

# Rosemount Radar Level Transmitters

## INTRODUCTION

In this section, the steps of measurement validation at operating conditions are described.

For measurement validation, the actual liquid must be used to ensure the accuracy of the measurement data.

## MEASUREMENT VALIDATION AT OPERATING CONDITIONS

Once a Rosemount Radar transmitter has been installed and configured, it will continuously deliver measurements with a minimum of maintenance. The electronics are self-adjusting, so no re-calibration is needed.

This sample procedure is intended to be a part of the startup process, or as a re-occurring functional check, to validate the integrity of the transmitter during actual operating conditions. If the verification fails, refer to Section 6, "Troubleshooting Procedures".

All of the steps in this sample verification procedure are independent and although it is not recommended, single steps may be omitted.

Before you start the verification procedure, ensure that proper actions have been taken so as not to affect the safety or performance of the process.

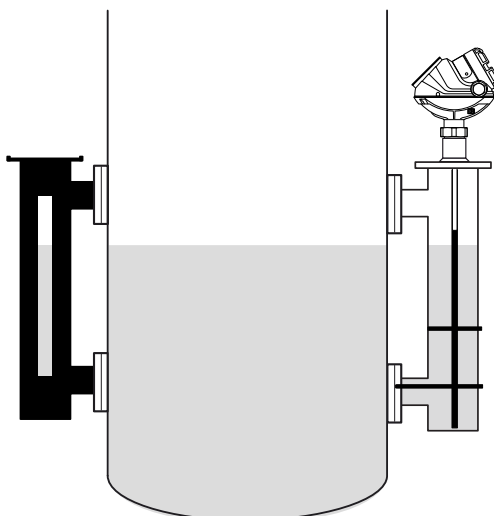
A checklist is provided in the Appendix for this stage of the process for your convenience.

### Step 1: Verify the Correctness of Level Reading

At normal operating conditions, compare the transmitter level, or interface reading, with an independent measurement. Unfortunately, it often happens that two independent measurements will not match up perfectly, but check the sanity and the acceptable deviation.

The independent measurement can be done using a number of different complementary devices, ranging from sight-glasses and hand-dipping to redundant differential-pressure and displacer.

Figure 5-1. The verification of measurement data using a sight-glass



## Step 2: Analog Output Signal Validation

### NOTE

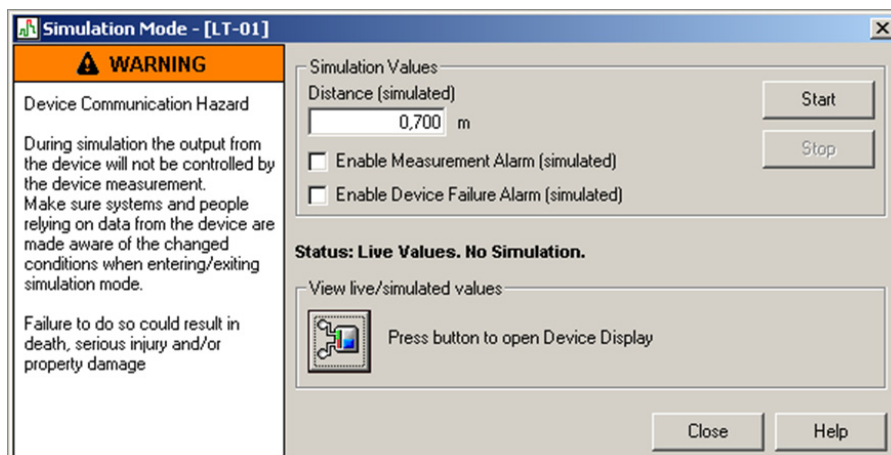
This section refers to 4-20 mA/HART units only.

Ensure that the loop has been set to manual mode in the DCS for the applicable transmitter.

Use the transmitter's built-in simulation mode to verify the analog output settings. Output at least one arbitrary level or interface and verify that the reading in the DCS match up.

*Rosemount Radar Master > Tools > Simulation Mode*

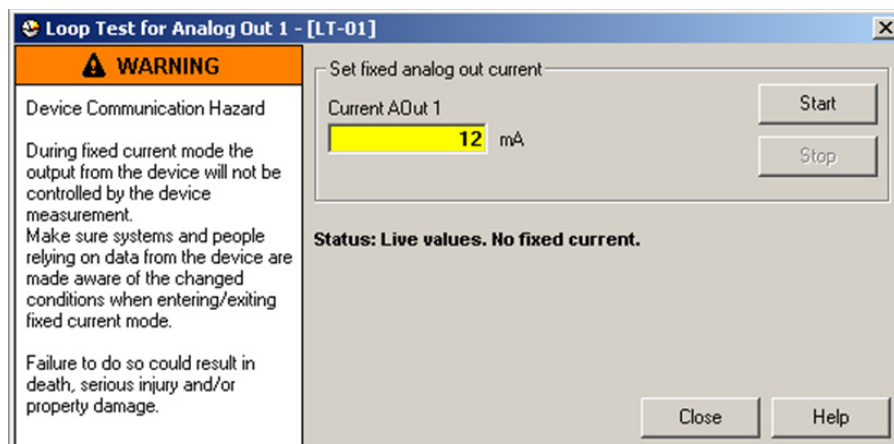
Figure 5-2. Simulation Mode - [LT-01]



Also, or alternatively, activate the transmitter's loop test function. Output 4, 12, and 20 mA and verify that the reading in the DCS match up.

*Rosemount Radar Master > Output > Analog Out > Loop Test*

Figure 5-3. Loop test for Analog Out 1 - [LT-01]



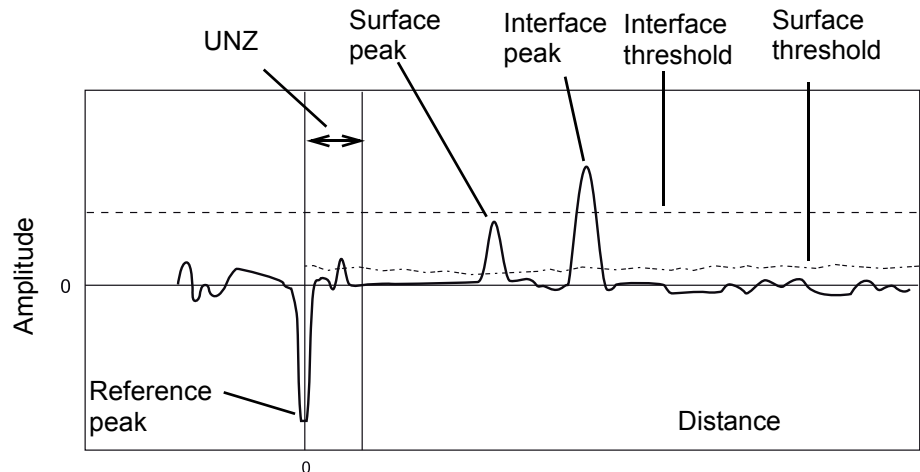
# Rosemount Radar Level Transmitters

## Step 3: Echo-Curve Verification at Operating Conditions

At normal operating conditions, download and review the echo-curve according to the following steps:

1. *Check Reference Pulse amplitude and position*  
Compare the result against the previous plots, taken during commissioning, and previous verification rounds.
2. *Review peak amplitudes and threshold settings*  
Verify that the surface and/or interface peaks are visible and that the thresholds have been set according to the best practices in Section 6, "Troubleshooting Procedures". If possible, compare the current echo-curve with previously stored echo-curves taken during operating conditions. There should be no major differences.
3. *Store the echo-curve*  
Permanently store the echo-curve for future use, with re-occurring verification procedures.

Figure 5-4. Peak amplitudes and threshold settings

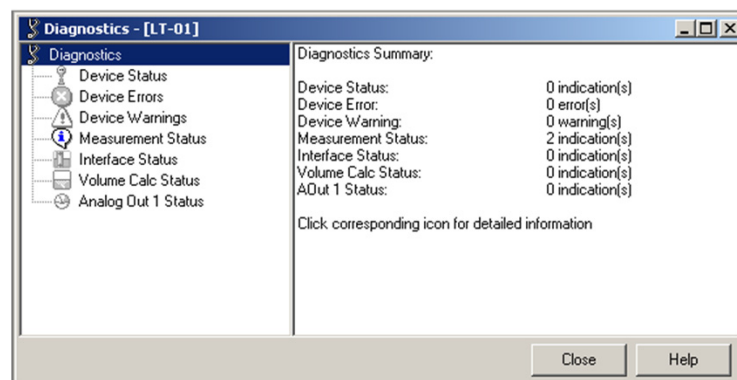


## Step 4: Transmitter Diagnostics Review

The transmitter contains valuable diagnostics that monitor the health of the device to make sure that it does not report any errors or warnings.

*Rosemount Radar Master > Tools > Diagnostics*

Figure 5-5. Diagnostics - [LT-01]



# Rosemount Radar Level Transmitters

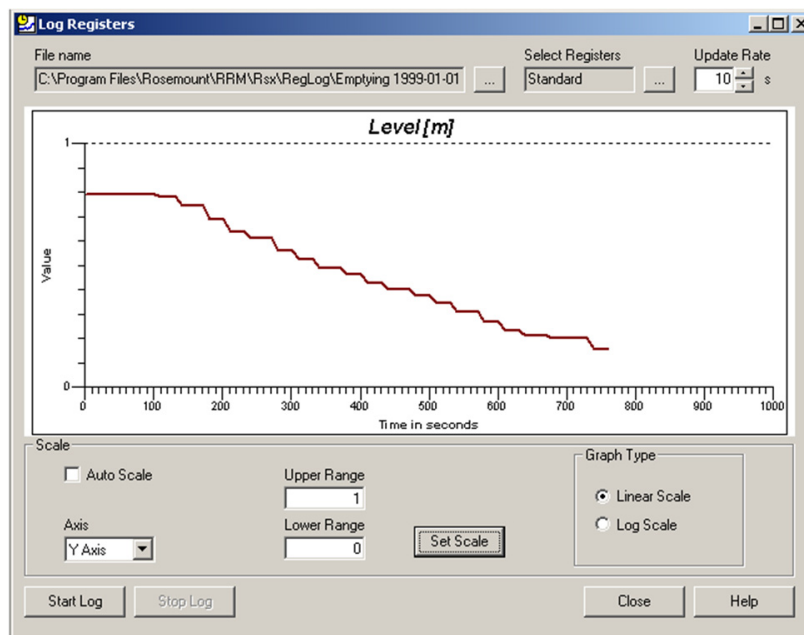
## Step 5: Monitor Level while Emptying

During Step 1, the current level/interface reading was verified correct. This step will verify that the transmitter correctly tracks the surface during the emptying of the tank.

Begin by activating log functionality for the transmitter level/interface output. Either the DCS-trend or a stand-alone tool can be used:

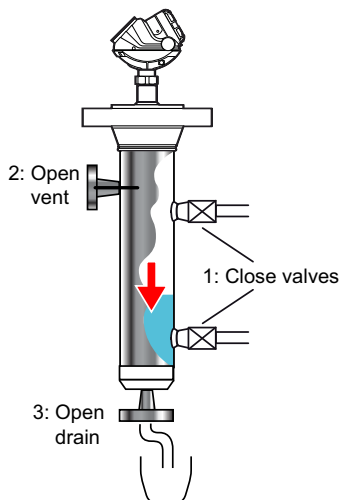
*Rosemount Radar Master > Tools > Log*

Figure 5-6. Log Registers



Start emptying the tank or chamber making sure not to stop until it is completely empty. With a chamber, do not forget to close the process valves before draining.

Figure 5-7. Emptying a tank or chamber



# Rosemount Radar Level Transmitters

---

Finally, review the level/interface trend for accuracy.

## **Step 6: Echo-Curve Verification with Empty Tank**

When the tank or chamber is empty, download and review the echo-curve according to the following steps:

1. *Compare echo-curve with previous plots*  
Compare the echo-curve with previous plots, taken during commissioning. There should be no major differences. Especially make sure to review:
  - the amplitude and position of the reference pulse
  - if all noise is below the threshold
  - the amplitude and position of the bottom or probe-end pulse.
2. *Store the echo-curve*  
Permanently store the echo-curve for future use, with re-occurring verification procedures.

## **Step 7: Monitor Level while Filling**

Repeat Step 5, but fill the tank or chamber instead of emptying it.

## Section 6 Troubleshooting Procedures

Safety Messages .....	page 6-1
Introduction .....	page 6-2
Echo Curve Analysis .....	page 6-3

### SAFETY MESSAGES

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Please 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 environment of the gauge is consistent with the appropriate hazardous locations certifications.

Before connecting a HART-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.

Do not remove the gauge cover in explosive atmospheres when the circuit is alive.

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

Make sure only qualified personnel perform the installation.

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

Do not perform any service other than those contained in this manual unless you are qualified.

**High voltage that may be present on leads could cause electrical shock.**

Avoid contact with leads and terminals.

Make sure the main power to the transmitter is off and the lines to any other external power source are disconnected or not powered while wiring the gauge.

Probes covered with plastic and/or with plastic discs may generate an ignition-capable level of electrostatic charge under certain extreme conditions. Therefore, when the probe is used in a potentially explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.

## INTRODUCTION

This section provides helpful information in identifying the most common problems found with radar level transmitters.

A typical work-flow may look like this (local restrictions and variations may apply):

1. View DCS-trends and question the relevant people to understand when the problem occurs and the effect of the problem. Could it be related to any other activities?
2. Do a tank survey to identify the application. Ensure that the transmitter has been selected according to Section 2 "Installation Considerations", and Section 3 "Refining Applications".
3. Check for basic errors, such as wiring and transmitter diagnostics, then complete relevant parts of Section 4 "Commissioning" again.
4. If necessary, execute the verification procedure described in Section 5 "Measurement Validation at Operating Conditions", or other procedure that recreates the problem.
5. A) If the measurement is reliable, but there is an offset or the accuracy is poor, refer to "Echo Curve Analysis" on page 6-3.

B) Do an echo curve analysis as described in "Echo Curve Analysis" on page 6-3 to try to identify the problem.

When the problem has been resolved, the validation procedure described in Section 5 "Measurement Validation at Operating Conditions" should be completed, or any other procedure that verifies the integrity of the transmitter.

In case the problem cannot be resolved, contact your local Rosemount representative for assistance with a description of the problem, and be able to submit the echo curve (.dat) and the transmitter backup file (.bak).

## NOTICE

Read the product 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 the product.

Within the United States, Rosemount Inc. has two toll-free assistance numbers.

**Customer Central:** 1-800-999-9307 (7:00 a.m. to 7:00 p.m. CST)

Technical support, quoting, and order-related questions.

**North American Response Center:**

Equipment service needs.

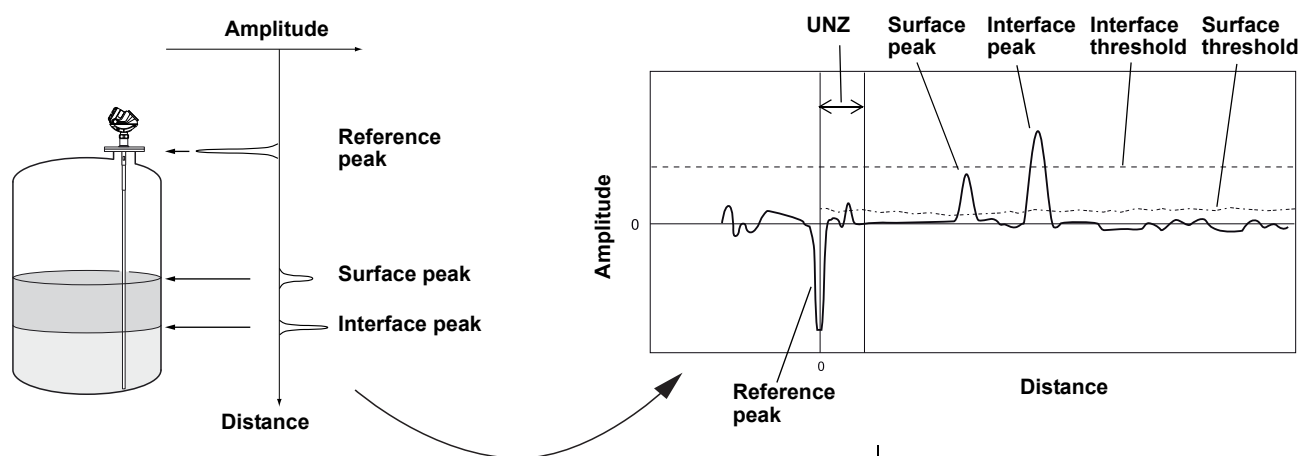
1-800-654-7768 (24 hours a day – Includes Canada)

For equipment service or support needs outside the United States, contact your local Rosemount representative.

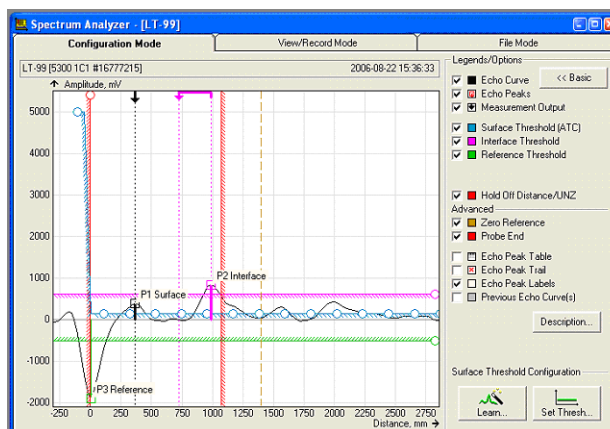
## Echo Curve Analysis

The echo curve represents the tank, as seen by the radar transmitter. Each peak corresponds to a reflection of the radar signal - the surface of the level or interface, an obstacle, or something else. By viewing single instances or movies of the echo curve, how and why the transmitter behaves as it does can be understood, and it can be configured accordingly to achieve a reliable level measurement. Usually, an echo curve analysis is not needed; the transmitter automatically sets the appropriate parameters based on the start-up information such as tank height and tank media; however, it is a very valuable tool for troubleshooting difficult applications.

### Echo Curve Constituents



As presented in  
Rosemount RadarMaster



In a typical measurement situation the following peaks appear in the echo curve:

**Reference peak.** This reference pulse is caused by the transition between transmitter head and probe/antenna. For the 5300 Series, the pulse is negative, while for the 5400 and 5600 Series, the pulse is positive.

**Surface peak.** This pulse is caused by a reflection from the product surface.

**Interface peak (5302 only).** This pulse is caused by the reflection from the interface between the upper and lower product. This peak will only be identified by the transmitter when it is configured for Measurement Mode *Level & Interface*.

Table 6-1. Typical peak amplitudes for Rosemount 5300 Series with single lead probe in 4 in. chambers

Peak	Approximate signal strength, ideal conditions for single lead probe in 4 in. (100 mm) chambers
Reference peak	~10,000 mV <sup>(1)</sup>
Surface peak, 5301 with oil (DC=2)	~2,000 mV
Surface peak, 5301 with water (DC=80) at 3 ft (1 m) distance	~10,000 mV
Interface peak, 5302 with oil and water	~8,000 mV

*(1) This value does not apply and may be considerably lower when the probe is completely submerged in product.*

Various amplitude thresholds are used to filter out unwanted signals and pick up the different peaks. The transmitter uses certain criteria to select which peaks correspond to the actual level and interface surfaces.

Counting from the top of the tank, the first echo above the Surface Threshold is considered the product surface. Pulses further away from the top, although above the Surface Threshold, are ignored. When the surface echo is found, the next pulse below the product surface with a signal strength above the Interface Threshold is considered the Interface.

**Surface Threshold** - amplitude threshold for detection of the Product level peak. The surface threshold is designed as a number of individually adjustable amplitude threshold points, the Amplitude Threshold Curve (ATC).

**Interface Threshold (5300 only)** - known as amplitude threshold for detection of the Interface level peak.

**Upper Null Zone / Hold Off Distance** - measurements are not performed within the Upper Null Zone (UNZ) / Hold Off Distance, so consequently, the UNZ / Hold Off can be used to avoid measurements above a certain level, for example because of disturbances in the nozzle.

## 5300 Threshold Settings

Recommendations for the Rosemount 5300 Series:

1. Use the automatic threshold settings and ensure that the dielectric constants of the upper and lower products have been entered correctly
2. If needed, apply the 'Measure & Learn' function
3. If needed, use the following best practices to apply custom threshold adjustments:
  - Generally, the threshold should be at 40-50% of the surface peak.  
Example: If the surface is 2000 mV, the threshold should be set at 800-1000 mV.
  - It should never be closer than 300 mV to any disturbing objects.  
Example: If there is a 1100 mV peak from an inlet-pipe, the threshold around it should be 1400 mV.
  - The threshold should never be below 800 mV in the range 0-1 ft (0.3 m) and never below 500 mV from 1 ft (0.3 m) upwards.

For products with very low dielectric constants, such as boiling hydrocarbons and solids, it may be required to lower the threshold additionally, and/or to activate the Probe End Projection (PEP) function.

## 5400/5600 Threshold Settings

Recommendations for the Rosemount 5400 and 5600 Series:

1. Apply the 'Measure & Learn' function (only 5400 Series)
2. If needed, use the following best practices to apply custom threshold adjustments:
  - Generally, the threshold should be at 20% of the surface peak.  
Example: If the surface is 2000 mV, then the threshold should be set at 400 mV.
  - It should never be closer than 200 mV to any disturbing objects.  
Example: If there is a 500 mV peak from an obstacle, the threshold around it should be 700 mV.
  - The threshold should never be below 300 mV.

For products with very low dielectric constants, such as solids, it may be required to lower the threshold additionally.

## Common Problems

### Threshold below the surface peak

In this example, the threshold has incorrectly been set above the surface peak (Figure 6-1). The problem can be corrected by lowering the threshold (Figure 6-2).

Figure 6-1. Surface peak is below the surface threshold

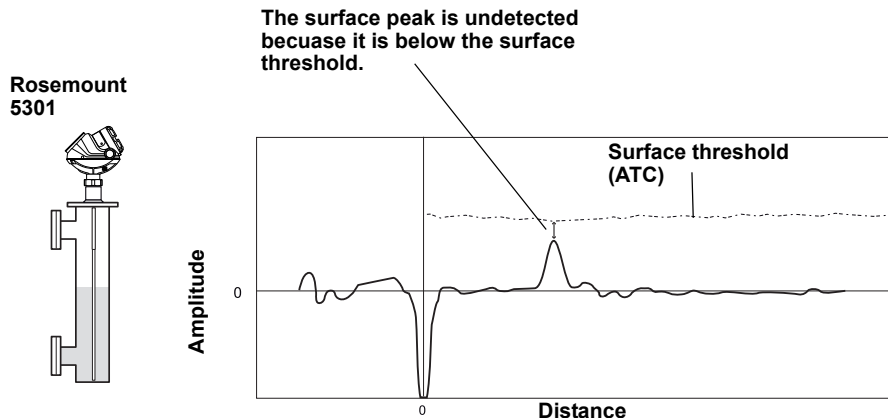
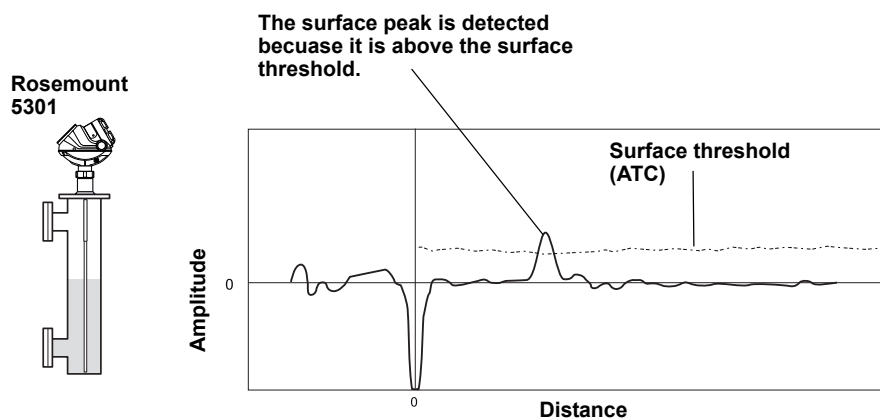


Figure 6-2. Surface peak is above the surface threshold



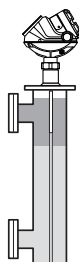
# Rosemount Radar Level Transmitters

## Air-gap misinterpreted as interface level

In this example, the transmitter incorrectly identifies the reflection from the air-gap as the interface level (Figure 6-3). The problem can be corrected by increasing the UNZ (Figure 6-4) or increasing the threshold (Figure 6-5).

Figure 6-3. The interface level is the reflection from the air gap

Rosemount  
5301



The reflection from the air gap is selected as the interface level because it is the first peak above the surface threshold.

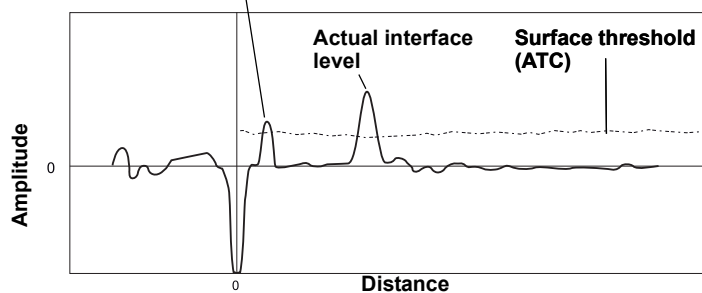
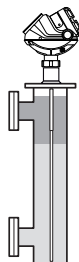


Figure 6-4. Peak above the surface threshold outside the UNZ

Rosemount  
5301



The peak from the interface level is now correctly identified; it is the first peak above the surface threshold outside the UNZ.

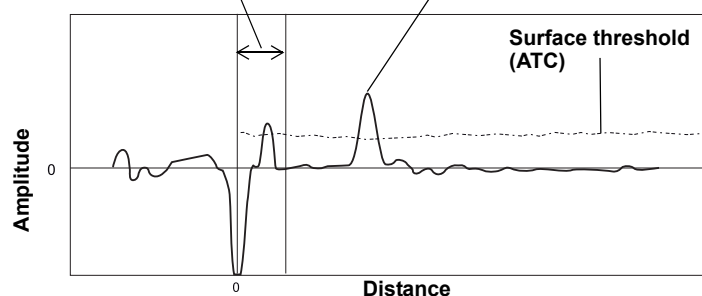
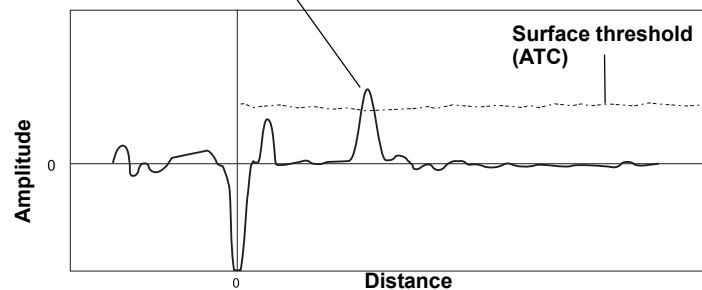


Figure 6-5. Peak above the surface threshold

Rosemount  
5301



The peak from the interface level is now correctly identified; it is the first peak above the surface threshold.



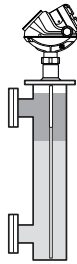
## Interface misinterpreted as level

# Rosemount Radar Level Transmitters

In this example, the transmitter incorrectly identifies the reflection from the interface as the product surface, because it is the first peak above the surface threshold (Figure 6-6). The problem can be solved by lowering the surface threshold (Figure 6-7), and ensuring that the interface threshold is below the interface peak.

Figure 6-6. Incorrect interface level, surface threshold set too high

Rosemount  
5302



The interface level is incorrectly identified as the product surface because the surface threshold is set too high.

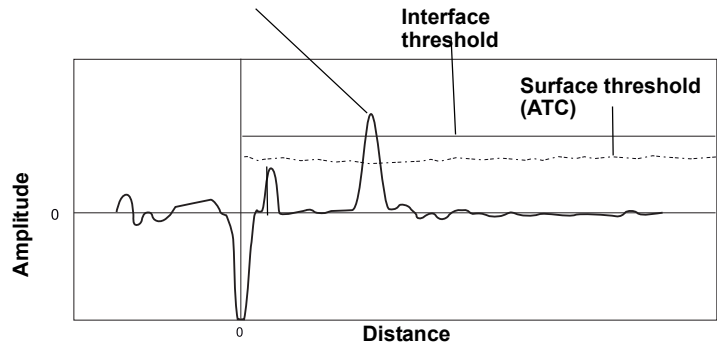
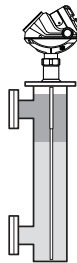
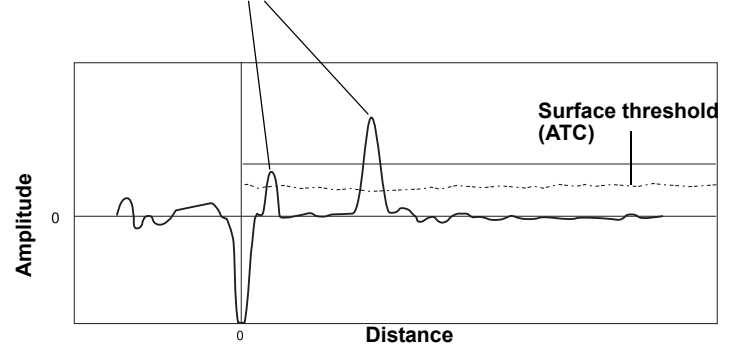


Figure 6-7. Correct identification of surface and interface peaks

Rosemount  
5302



Correct identification of surface and interface peaks.



## Disturbance misinterpreted as level

In this example, the transmitter incorrectly identifies the reflection from an inlet-pipe as the product surface, because it is the first peak above the surface threshold (Figure 6-8). The problem can be solved by increasing the surface threshold (Figure 6-9) or, in some cases where the disturbance is close to the transmitter flange, by increasing the UNZ or performing the 'Near Zone Trim' command.

Figure 6-8. The surface is the reflection from the inlet-pipe

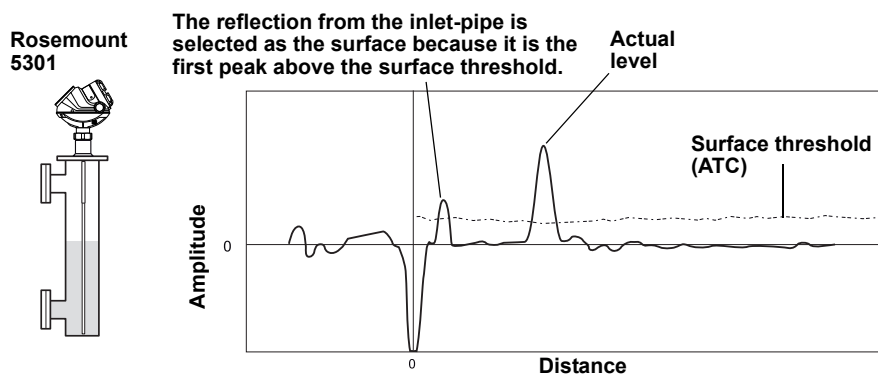
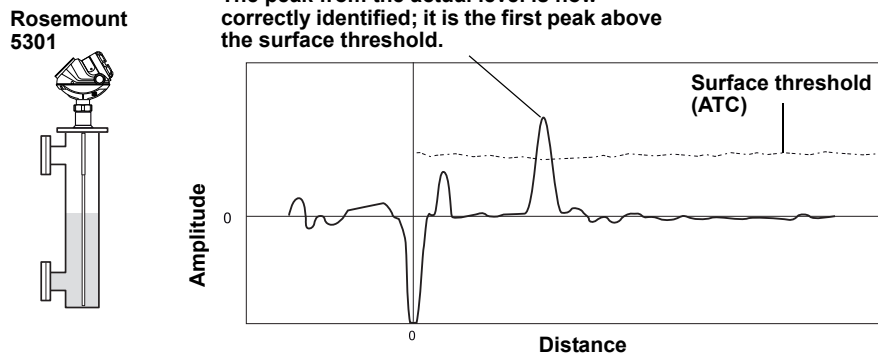


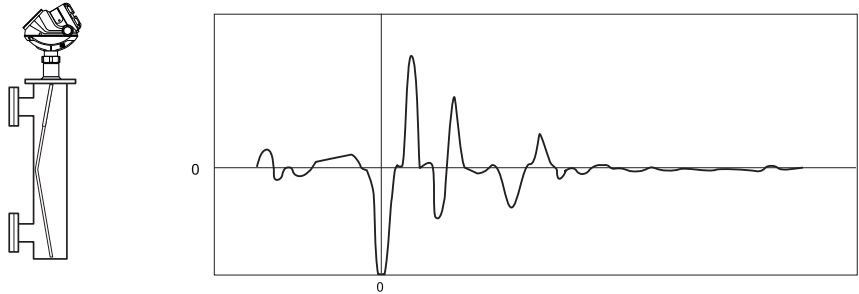
Figure 6-9. Surface peak identified correctly



## Incorrect reading due to bent probe

If the probe has been bent, twisted, or similar in chamber installations, peaks will appear randomly in the echo curve (Figure 6-10). If this is the case, the mechanical installation will need to be redone ensuring that the recommendations in Section 2 "Installation Considerations" are followed. The problem can often be resolved by adding a centering disk at the bottom of the probe, but it may also require a replacement of the complete probe assembly.

Figure 6-10. Measurement data using a bent probe



## Sources of Measurement Error

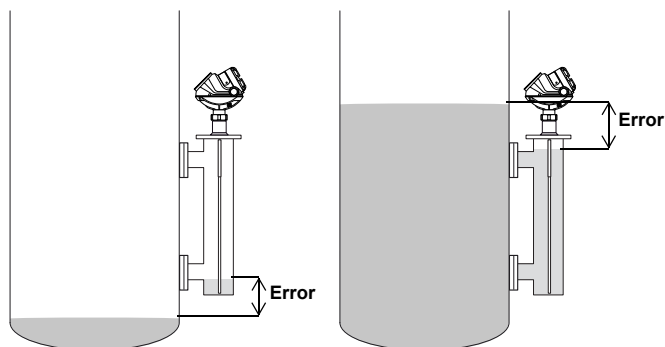
This section applies to radar level transmitters that track the surface, but have poor accuracy or a fixed offset. There are many possible error sources for this, such as incorrect settings or incorrect interpretation of the analog output signal. These errors almost exclusively depend on the external environment since radar is extremely accurate and does not drift.

### Installation and Location Errors

Review the installation to determine what the transmitter is measuring and what the expected output is.

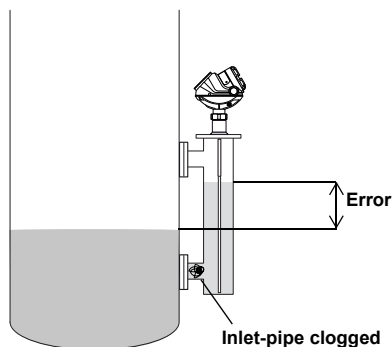
In a chamber installation, check that the level/interface corresponds to the value inside the tank. Ensure that the chamber has been installed where the level/interface range can be adequately covered.

Figure 6-11. Installation error - level/interface range is not covered adequately



The connections between the vessel and the chamber must allow for flow of the product. Clogging should be avoided.

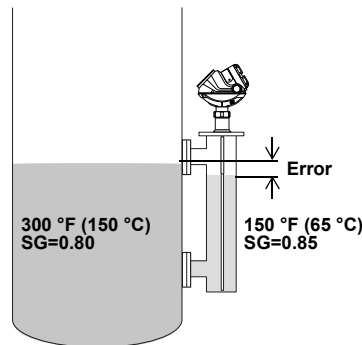
Figure 6-12. Inlet-pipe clogged



# Rosemount Radar Level Transmitters

The radar transmitter is not temperature dependent. However, the fluid is, and it expands and contracts with increased and decreased temperatures. With certain fluids, the effect on level/interface level is noticeable in hot applications with large differences in temperature between the chamber and the tank. Insulating the chamber minimizes the temperature changes.

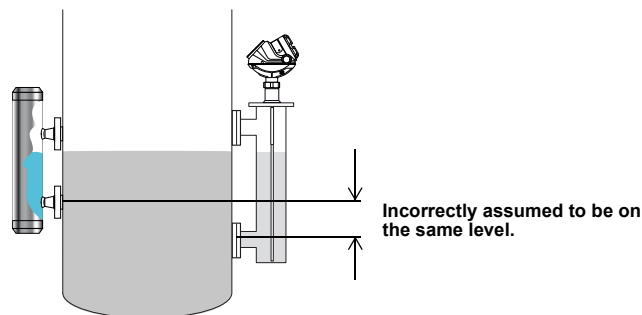
Figure 6-13. Temperature drop in the chamber without insulation



## Geometries

Review the tank geometry and check if any assumptions have been made that caused the inaccuracies. For example, the location of a sight-glass or secondary chamber may have been assumed to be at the same location as the radar measurement, but in reality they are not.

Figure 6-14. The sight-glass and chamber are not on the same level where they are supposed to be



## Analog Output Settings

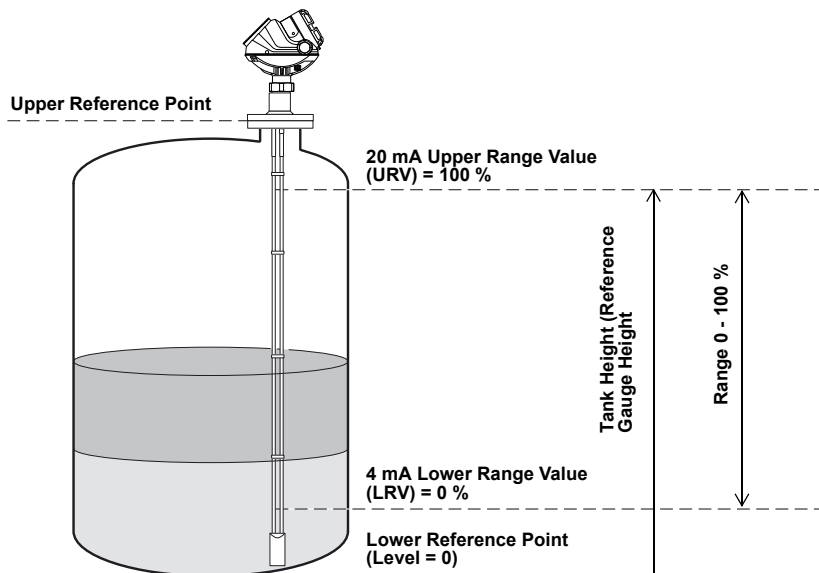
Review the analog output settings. The primary variable determines the output, and is often set to Level. The definition is:

$$\text{Level} = \text{Tank Height (Reference Gauge Height)} - \text{Measured Distance}$$

Consequently, the zero level point is at "Tank Height (Reference Gauge Height)" below the transmitter's flange. The LRV (4 mA setpoint) and URV (20 mA setpoint) should be set with this zero point as reference.

Probe Length and Tank Height (Reference Gauge Height) do not need to match.

Figure 6-15. Analog output settings - range values and reference points



## Incorrect Dielectric Constant of the Upper Product

The Interface Level and Upper Product Thickness in interface applications are calculated values. If an incorrect dielectric constant of the upper product is used, it will result in inaccurate measurement (Product Level is not affected). If this is the problem, the following tools can be used:

*Rosemount Radar Master > Tank/Environment > Dielectric Constant Calculator*

Figure 6-16. Dielectric Constant Calculator - [LT-01]

The screenshot shows a software window titled 'Dielectric Constant Calculator - [LT-01]'. It contains the following fields and buttons:

- Enter actual upper product thickness**: A text box with the value '0.195' and the unit 'm'.
- Upper product thickness reported by device**: A text box with the value '0.220' and the unit 'm'.
- Current dielectric constant stored in device**: A text box with the value '2.500'.
- New calculated dielectric constant**: A text box with the value '3.170'.
- Buttons: 'OK', 'Cancel', and 'Help'.

# Rosemount Radar Level Transmitters

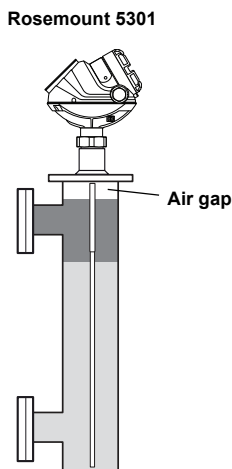
Rosemount Radar Master > Tank/Environment > Dielectric Constant Chart

Figure 6-17. Dielectric Constant Chart

Dielectric Constant Chart			
Product name			Dielectric constant
Product name	State	Temperature	Dielectric constant
ABS (PLASTIC)	Solid	22.22°C	1.90
ABS GRANULATE, BLACK	Solid	RT	1.70
ABS resin, lump	Solid	23.89°C	2.4-4.1
ABS resin, pellets	Solid	23.89°C	1.5-2.5
Acenaphthene	Liquid	21.11°C	3.00
Acetal	Liquid	21.00°C	3.60
ACETAL (1, 1-DIETHOXYETHANE)	Liquid	25.00°C	3.80
Acetal Bromide	-	5.00°C	16.50
ACETALDEHYDE	Liquid	5.00°C	21.80
ACETALDEHYDE	Liquid	20.00°C	14.80
Acetaldehyde oxime	Liquid	23.00°C	3.00
ACETALDOXIM	Liquid	23.00°C	3.00
Acetaldoxime	Liquid	21.00°C	3.40
ACETAMIDE	Liquid	20.00°C	41.00
ACETAMIDE	Liquid	77.00°C	59.20

## Submerged Probes with Air gap

Figure 6-18. Submerged probe with air gap



Where the Rosemount 5301 has an air gap in an application for interface measurement with a submerged probe, an offset in the interface level measurement will be generated according to:

Figure 6-19. Formula for the calculation of Interface Level Offset

$$\text{Interface Level offset} = \text{Air gap distance} \times \left( 1 - \frac{1}{\sqrt{\text{dielectric constant of upper product}}} \right)$$

For example, an air gap of 4 in. (100 mm) with oil as the upper product ( $dc=2$ ) generates a 1 in. (25 mm) positive level offset. If the air gap is constant and cannot be removed, the interface level output can be compensated by reducing the reference height with the offset. Alternatively, using the Rosemount 5302 automatically compensates for the air gap, including changing air gaps.

## **Incorrect Vapor Compensation**

A few specific high-temperature and high-pressure applications, like saturated water steam, requires a compensated value be entered for the vapor dielectric constant. This compensation is fixed and will only adjust the level reading at a specific condition. Normally, this means that the transmitter will show a correct level reading during operation, but not during startup and shutdown. Alternatively, if no correction is entered, the level reading will be correct during shutdown but not during startup and operation. See Table 3-1 on page 3-4 and Table 3-2 on page 3-6.

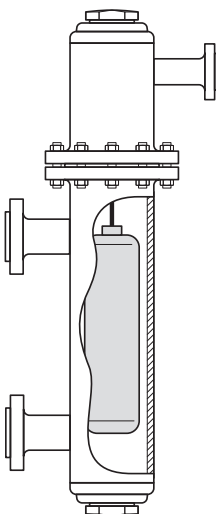
## **Reconciling Radar with other Level Measurements**

When comparing level measurements to each other, they often do not match up as expected. There are numerous reasons for this with the most prominent one being related to what is actually being measured. Few instruments measure the level directly as radar does. Instead an indirect measurement of, for example, pressure, pull-force, or capacitance is done, and then the level is calculated from this measurement. Inaccuracies in the level measurement may occur during the calculation process, or from the fact that what is thought the measurement is for is not what is actually being measured.

### *Displacer*

Displacers are one of the most common methods to measure level. The Archimedes' principle is used, and by measuring the apparent weight of the immersed displacer, a level measurement can be indirectly measured. Besides the possibility of the displacer getting stuck, it also requires precise calibration. Any change in density, such as a different product in the tank or changed temperature, will result in inaccuracies.

Figure 6-20. Displacer used for measurement



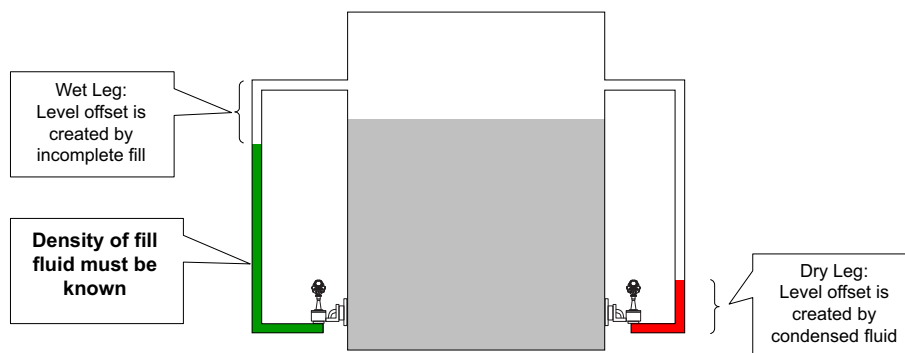
Example: A 50 in. displacer calibrated to SG 0.9 will only show a 44 in. level reading at full range with a product that has a SG 0.8, resulting in a systematic error of  $50 - 44 = 6$  in.

## Differential Pressure (DP)

Another common method for measuring level is using Pressure or Differential Pressure transmitters. These are examples of indirect level measurement methods, where incorrect conversion or installation can result in inaccuracies. Potential problems include:

- **Fluid density changes:** source, grade, product and temperature affect the density of the fluid, and thereby the level output
- In case of a **wet leg**, is it completely filled? Or, if a **dry leg** is used, is it really dry? Loss of fluid and condensed fluid respectively create an offset in the level reading. Consider using either an electronic or capillary remote seal
- If a **fill fluid** is used, is its density known? Has the transmitter been scaled correctly?
- If a single pressure transmitter is used, process pressure will create an offset in the level reading. Consider using a differential pressure transmitter.

Figure 6-21. Differential pressure transmitter



## Appendix

## Checklists

<b>Safety Messages</b> .....	<b>page 7-1</b>
<b>Checklists</b> .....	<b>page 7-2</b>
<b>Commissioning Procedure Checklist</b> .....	<b>page 7-2</b>
<b>Measurement Validation at Operating Conditions Procedure Checklist</b>	<b>page 7-3</b>

## SAFETY MESSAGES

Procedures and instructions in this section may require special precautions to ensure the safety of the personnel performing the operations. Information that raises potential safety issues is indicated by a warning symbol (⚠). Please 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 environment of the gauge is consistent with the appropriate hazardous locations certifications.

Before connecting a HART®-based communicator in an explosive atmosphere, make sure the instruments in the loop are installed in accordance with intrinsically safe or non-incendive field wiring practices.

Do not remove the gauge cover in explosive atmospheres when the circuit is alive.

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

Make sure only qualified personnel perform the installation.

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

Do not perform any service other than those contained in this manual unless you are qualified.

#### **High voltage that may be present on leads could cause electrical shock.**

Avoid contact with leads and terminals.

Make sure the main power to the transmitter is off and the lines to any other external power source are disconnected or not powered while wiring the gauge.

Probes covered with plastic and/or with plastic discs may generate an ignition-capable level of electrostatic charge under certain extreme conditions. Therefore, when the probe is used in a potentially explosive atmosphere, appropriate measures must be taken to prevent electrostatic discharge.

# Rosemount Radar Level Transmitters

## CHECKLISTS

### Commissioning Procedure Checklist

The commissioning procedure has been carried out according to the Quick Installation Guide enclosed to the transmitter.

Instrument Identification	
Tag	
Model-code	
Serial Number	
Service	

Step	Task	Result	Completed
1	Shorten the Probe	New Probe Length: _____	Yes / No / NA <sup>(1)</sup>
2	Mount Centering disk	Disk diameter: _____ Cage diameter: _____	Yes / No / NA
3	Mechanical Installation	Probe - mechanical integrity: _____ - wetted material process compliance: _____ - P/T process compliance: _____ Gasket: _____	Yes / No
4	Anchor Flexible Probe	Method: _____	Yes / No / NA
5	Electrical Installation	Power supply: _____ Communication: _____ I/O: _____ Hazardous Location Classification: _____	Yes / No / NA
6	Transmitter Configuration	Configuration Tool: _____ Tag: _____ Tank Height (Reference Gauge Height: _____ Product Dielectric: _____ LRV (4 mA): _____ URV (20 mA): _____	Yes / No
7	Trim Near Zone	Command Executed: _____	Yes / No / NA
8	Store Backup and Verification Files	File paths: - Echo-Curve: _____ - Settings: _____	Yes / No
9	On the Bench Test	Method: _____	Yes / No
10	Measurement Validation at Operating Conditions	See separate check-list	Yes / No

(1)NA = Not Applicable

Comments: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

## Measurement Validation at Operating Conditions Procedure Checklist

The validation procedure has been carried out according to Section 6 in the document Rosemount Process Radars in Refining Applications - Best Practices Supplement to Reference Manual (00809-0100-xxxx, Rev AA).

Instrument Identification	
Tag	
Model-code	
Serial Number	
Service	

Step	Completed	Task	Result	Passed
1	Yes / No	Verify correctness of Level Reading	Radar Level Reading: _____ Second Level device: _____ Second Level Reading: _____	Yes / No
2	Yes / No	Analog Output Signal Validation (4-20mA/HART units only)	Radar Output (Level): _____ Radar Output (mA): _____ DCS Reading(%): _____ DCS Reading (mA): _____	Yes / No
3	Yes / No	Echo-Curve verification at operating conditions	Reference peak: _____ Surface threshold: _____ Interface threshold: _____ Echo Curve File Location: _____	Yes / No
4	Yes / No	Transmitter Diagnostics Review	Active Warnings: _____ Active Errors: _____	Yes / No
5	Yes / No	Monitor Level while emptying	Transmitter output: _____	Yes / No
6	Yes / No	Echo-Curve verification with empty tank or chamber	Reference peak: _____ Noise level: _____ Bottom/Probe-end peak: _____ Echo Curve File Location: _____	Yes / No
7	Yes / No	Monitor level while filling	Transmitter output: _____	Yes / No

**Comments:** \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Result:**

- ☐ Transmitter failed  
☐ Transmitter passed

# Rosemount Radar Level Transmitters

---



## Reference Manual

00809-0200-4530, Rev AB

September 2009

# Rosemount Radar Level Transmitters

---

*The Emerson logo is a trademark and service mark of Emerson Electric Co.  
Rosemount and the Rosemount logotype are registered trademarks of Rosemount Inc.  
HART is a registered trademark of the HART Communication Foundation.  
Modbus is a registered trademark of Modicon.  
PlantWeb is a registered trademark of one of the Emerson Process Management group of companies.  
Teflon, VITON, and Kalrez are registered trademarks of DuPont Performance Elastomers.  
Asset Management Solutions is a trademark of Emerson Process Management.  
All other marks are the property of their respective owners.*

*Standard Terms and Conditions of Sale can be found at [www.rosemount.com/terms\\_of\\_sale](http://www.rosemount.com/terms_of_sale).*

© 2009 Rosemount Inc. All rights reserved.

**Emerson Process Management  
Rosemount Measurement**  
8200 Market Boulevard  
Chanhassen MN 55317 USA  
T (USA) 1 800 999 9307  
T (International) +1 952 906 8888  
F +1 952 949 7001

**Emerson Process Management**  
Blegistrasse 23  
P.O. Box 1046  
CH 6341 Baar  
Switzerland  
Tel +41 (0) 41 768 6111  
Fax +41 (0) 41 768 6300

**Emerson FZE**  
P.O. Box 17033  
Jebel Ali Free Zone  
Dubai UAE  
Tel +971 4 811 8100  
Fax +971 4 886 5465

**Emerson Process Management Asia  
Pacific Pte Ltd**  
1 Pandan Crescent  
Singapore 128461  
Tel +65 6777 8211  
Fax +65 6777 0947  
Service Support Hotline: +65 6770 8711  
Email: [Enquiries@AP.EmersonProcess.com](mailto:Enquiries@AP.EmersonProcess.com)