

# Replacing Displacers with Guided Wave Radar

## KEY POINTS

- Mounting flanges vary by displacer supplier
- Probe must extend the length of the displacer chamber
- Single rigid probes are the preferred probe style for chamber installations
- Guided Wave Radar measurements are reliable even with vibrations, high turbulence, or density changes

## INTRODUCTION

### Rosemount Guided Wave vs. Displacers

Displacers are used for level, interface, and density applications, where the buoyancy of the displacer in the fluids is the primary measurement principle. Density of the fluid is a key factor in determining the sizing of the displacer and stability of the applications, and any deviation from the initial density will impact the measurement accuracy.

Displacers have moving parts that require frequent cleaning and replacement. They are affected by mechanical vibration and turbulence, the mechanical parts can give false readings, and maintenance costs can be expensive.

Guided Wave Radar (GWR) technology has no moving parts, which means a reduction in maintenance costs as well as improved measurement. GWR is not density dependent and provides reliable measurement even with mechanical vibration of high turbulence. Since existing chambers can often be used, replacement is simplified.

There are many displacer flanges and styles, so it is important to correctly match the 3300/5300 flange choice and probe length to the chamber. Both standard ANSI and DIN, are used, as well as proprietary chamber flanges with a non-standard diameter and gasket surface.

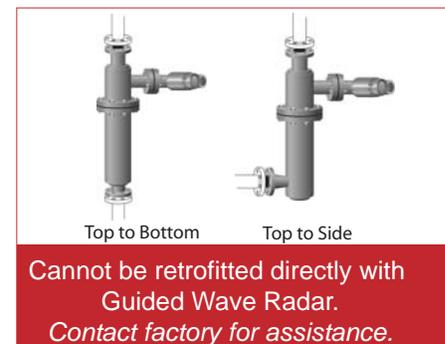
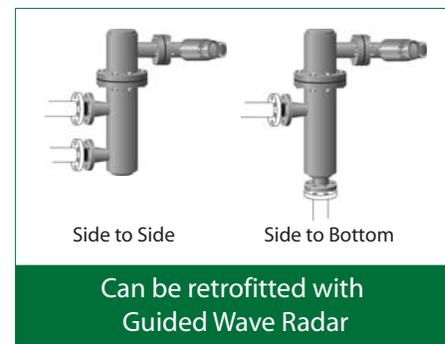
## STEPS TO DETERMINING REPLACEMENT WITH THE 3300 OR THE 5300 SERIES

1. *Determine which measurement is needed: level, interface, or density?*  
GWR is an easy, direct replacement for level measurements. For interface measurements, the upper fluid must have a lower dielectric value than the lower fluid. See interface guidelines below for more details. For interfaces with thick emulsion layers, GWR can be unpredictable. Consider Emerson's high performance displacer transmitters instead. If density is the desired measurement, then GWR is not a solution; consider a differential pressure transmitter instead.
2. *Check Displacer chamber mounting style with the diagrams shown in Figure 1*



**Guided Wave Radar is immune to density changes and provides a low maintenance alternative to displacers.**

Figure 1: Displacer Chamber Mounting Styles



- Determine manufacturer and type of displacer chamber flange (proprietary, ANSI or DIN). The Outside Diameter (OD) of the chamber flange on top of the chamber can help determine if a proprietary flange is used:  
 Major torque tube chambers  
 249B and 259B OD: 9.0 in. (229 mm)  
 249C OD: 5.8 in. (148 mm)  
 249K: 10 in. (254 mm)  
 249N: 10 in. (254 mm)  
 Masoneilan OD: 7.5 in. (190 mm)  
 All others: per ANSI or DIN specifications
- Determine from Figure 2 if it is a torque tube or spring loaded displacer chamber.
- Determine probe length. The probe length is measured from the flange face to the bottom of the chamber (internally) as shown in Figure 2 or listed in Table 1. While the probe needs to extend the full height of the chamber, it should not touch the bottom of the chamber. There should be a small gap (about 1/2 to 1 in. [12 – 25 mm]) between the end of the probe and the bottom of the chamber.

TABLE 1. Chamber Manufacturer with Probe Length Correction

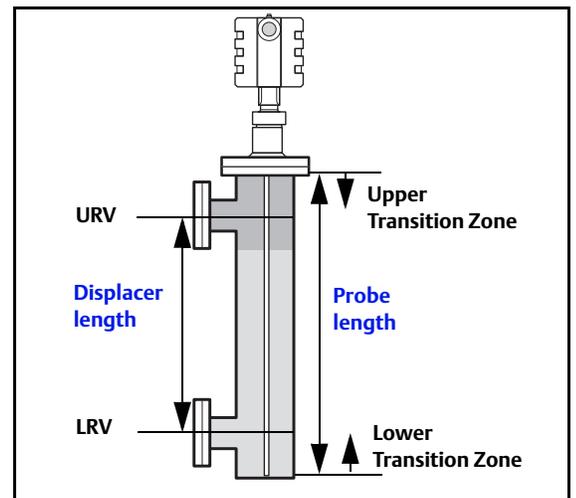
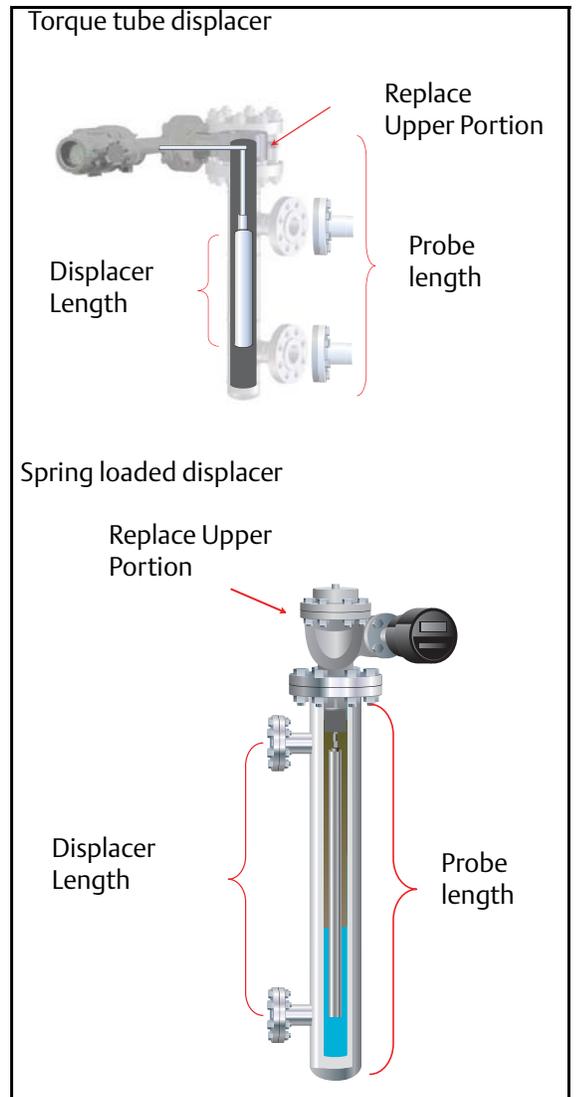
Chamber Manufacturer	Probe Length*
Major torque-tube manufacture (249B, 249C, 2449K, 249N, 259B)	Displacer +9 in. (229 mm)
Masoneilan (Torque tube operated), proprietary flange	Displacer +8 in. (203 mm)
Other - torque tube**	Displacer+8 in. (203 mm)
Magnetrol (spring operated)***	Displacer+ between 7.8 in.(195mm) to 15in (383mm)
Others - spring operated**	Displacer +19.7 in. (500mm)

\*If flushing ring is used, add 1 in. (25 cm)

\*\*For other manufacturers, there are small variations. This is an approximate value, actual length should be verified.

\*\*\* Lengths vary depending on model, SG and rating, and should be verified.

Figure 2: Probe Length is longer than displacer length



## INTERFACE APPLICATION

### Rosemount 3301/5301 Interface with a Submerged Probe

Many displacers are located on the vessel where they will only measure interface. In these applications, the upper part of the probe will be submerged in the upper fluid and only the interface of the two fluids is measured. The same interface guidelines about dielectric properties of the fluid apply for both submerged probe interface applications and where level and interface measurements are desired.

#### Interface Application Guidelines

- Lower dielectric fluid must be on the top
- The two liquids must have a dielectric difference of at least 6
- The upper layer dielectric must be known (in-field determination is possible)
- The upper fluid layer thickness must be at least 4 in. (10 cm) for 3300 rigid probes and 5.1 in. (13 cm) for 5300
- Target applications; low upper layer dielectric (<3), high lower layer dielectric (>20)
- Dielectrics of oil and gasoline range from 1.8 to 4. Water and water-based acids have high dielectrics (>50)

#### Rosemount 3300 and 5300 Series

- Rosemount 3301/5301 can be used for level or interface measurements. Only interface is measured in the submerged probe mode. Flushing option should be used to eliminate air pocket
- Rosemount 3302 or 5302 can be used to measure both level and interface. These products are recommended if there is a large air pocket at the top of the chamber

## RECOMMENDED PROBE STYLES

Single rigid probes are recommended mostly for chamber installations. Exception is for high pressure (over 580psi / 40 bar) liquified gases where the coaxial probe is preferred. Single lead probes are the easiest to clean and are the best choice for dirty or viscous fluids. Since the chamber walls help to amplify the signal, single probes can be used for interface measurement and measurements on low dielectric materials. Centering disks are recommended.

#### Chamberless Displacers

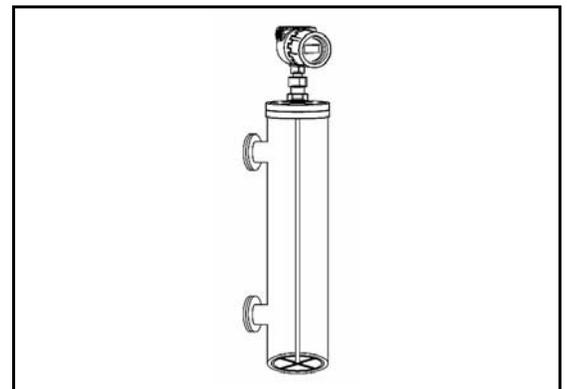
Displacers can be mounted directly in the vessel, usually suspended down a stilling well. In these cases, sizing is based on the overall height. Rigid probes are recommended, but if a flexible probe must be used, make sure to center the cable to prevent it from touching the sides of the well. If a flexible cable is used, a 4 in. (10 cm) stilling well is the recommended minimum size.



*Submerged probe interface applications*



*Probe Styles - single probes are available in standard and high pressure/high temperature versions*



*Rigid single probe style with centering disk*

**Flushing Connections and Vents**

It is often desirable to vent the chamber near the top. This will ensure there is no trapped air or gas for submerged probe applications. Venting is also needed if the level in the chamber will be manipulated in order to verify the output of the 3300/5300 or to drain the chamber. The following options will accomplish this task:

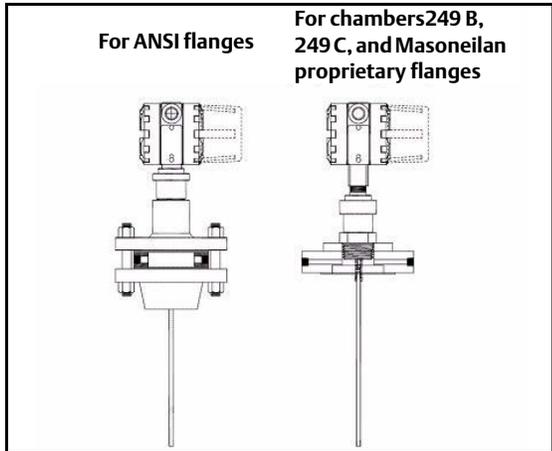
- A separate flushing ring may be inserted between the 3300/5300 flange and the chambers that use ANSI or DIN flanges
- Proprietary flanges are available with an integrated vent option. They are used with 1 1/2 NPT threaded probes.

**Pressure and Temperature**

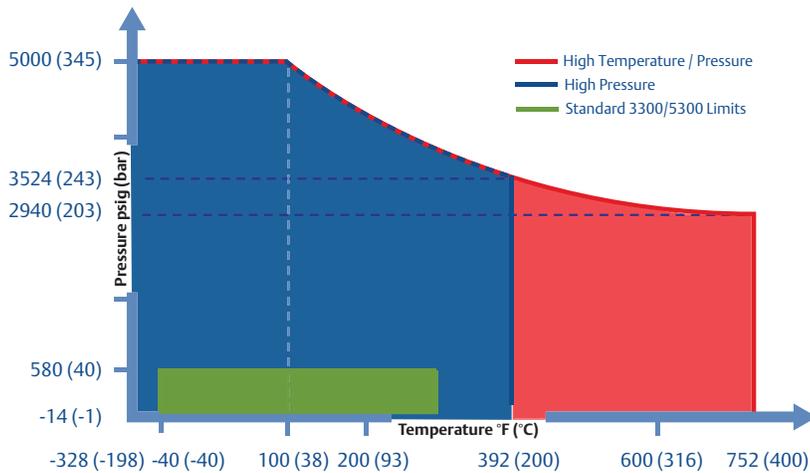
The standard Guided Wave Radar products may be used in applications up to 302 °F (150 °C) and 580 psi (40 bar). For higher pressures and temperatures, the high pressure/high temperature or high pressure probe is available. See Figure 3 for details.

The 5300 has a higher sensitivity and is recommended for all liquified gas applications above 580 psi (40 bar) that need the High Pressure or High Temperature / Pressure probe, with the exception of fully submerged interface applications.

Figure 3: Pressure and temperature limits for standard, high pressure, high temperature/high pressure probes.



3300/5300 flushing ring/vent options



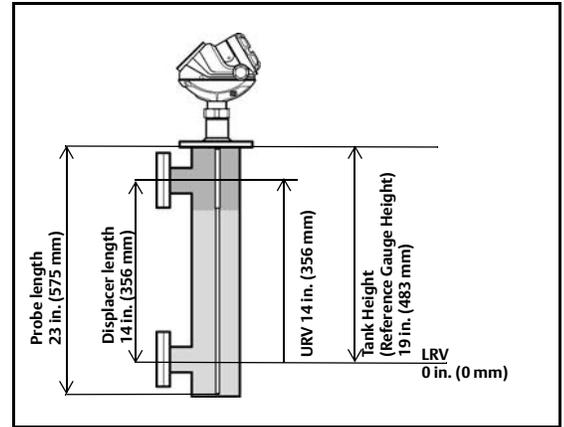
**SETTING RANGE VALUES - THREE OPTIONS**

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

With displacers, the output span corresponds to the displacer length. The lower (LRV) and upper range values (URV) represent the bottom and top of the displacer. In the 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**

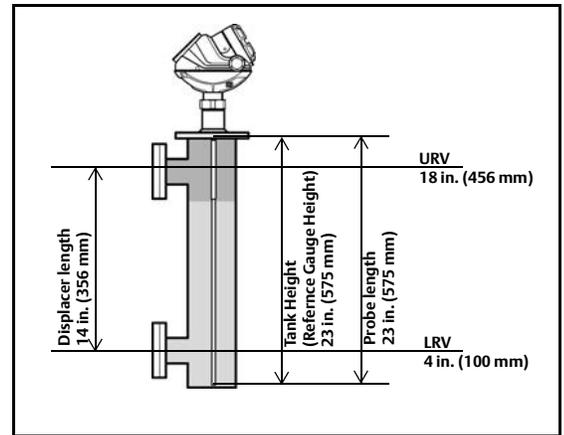
Set the Tank Height to the distance to the zero level point. In this example, it is the lower side-pipe which is located 19 in. (483 mm) below the reference point. Output range values will equal the pipe connection heights relative to the zero level point. LRV should be set at 0 in. (0 mm) and the URV should be set at 14 in. (365 mm). The probe should be set to the correct probe length.



**Setting range values, Option 1**

**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).

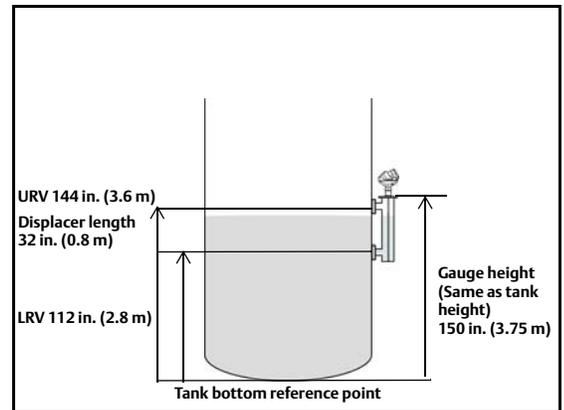


**Setting range values, Option 2**

**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, simply add the tank connection distance. The actual probe length needs to be entered.

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 correspond to height of the lower tank connection relative to the tank bottom.



**Setting range values, Option 3**

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