

# Measuring Solids with a Rosemount 5600 Non-Contacting Radar

## KEY POINTS

- Special antennas suitable to solids
- Location on vessel
- Tank connections
- Software settings



The level measurement of solid materials has been a frustrating experience for many users. The number of available technologies suitable for solids measurements is limited. Radar, ultrasonic, nuclear capacitance, phase shift, weigh cells, and mechanical devices are the most common technologies found in these applications. Of the technologies available, all have varying results and many restrictions.

## Why are solids so difficult to measure?

- The surface of solid materials is rarely flat or horizontal. 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. While radar can handle this dust fairly well, ultrasonic devices cannot.
- Heavier materials can create a pull force that can break cables. While this is more likely to be an issue in vessels taller than about 50 ft. (15 m), care must be taken to guard against this possibility.
- The weight of the material may push cables towards other structures in the tank, causing false targets.

Radar technology does offer distinct advantages over other technologies. Radar signals can penetrate vapor spaces containing dust or steam which is problematic for ultrasonic devices. Non-contacting radar eliminates the breaking and pushing issues associated with technologies that use probes or other mechanical structures. In addition, it is not susceptible to mass changes or ambient temperature changes as are load cells. Unlike nuclear technologies, no special licenses or training are needed for radar devices. There are no empty tank requirements during installation for the non-contacting radar.



Figure 1: Rosemount 5600 with PTFE bag.

**Good Installation is the key to success:**

As solids generally provide a difficult measuring environment and the signal levels are often very low, installation is of utmost importance. Antenna selection and its location in the tank are the keys to success.

**STEP 1: ANTENNA SELECTION**



**Parabolic Antenna with PTFE Bag**

- Dusty applications
- Best choice for long distances
- Can handle weak surface reflection
- Positionable towards surface
- Teflon bag prevents dust build up at the antenna



**Parabolic Antenna**

- Best choice for long distances
- Can handle weak surface reflection
- Positionable towards surface



**8-in. Cone Antenna**

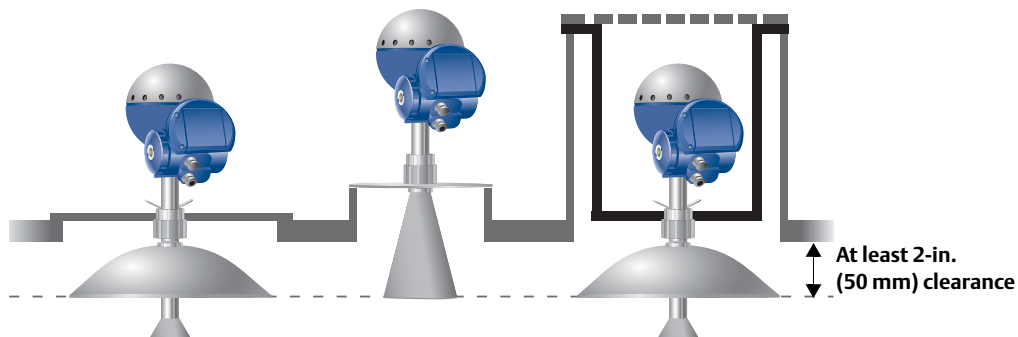
- Suitable for short distance
- Stronger surface reflection than smaller cones



**8-in. Cone Antenna with Flushing Adapter**

- Dusty applications
- Suitable for short distances
- Stronger surface reflection than smaller cones

**STEP 2: TANK CONNECTION**

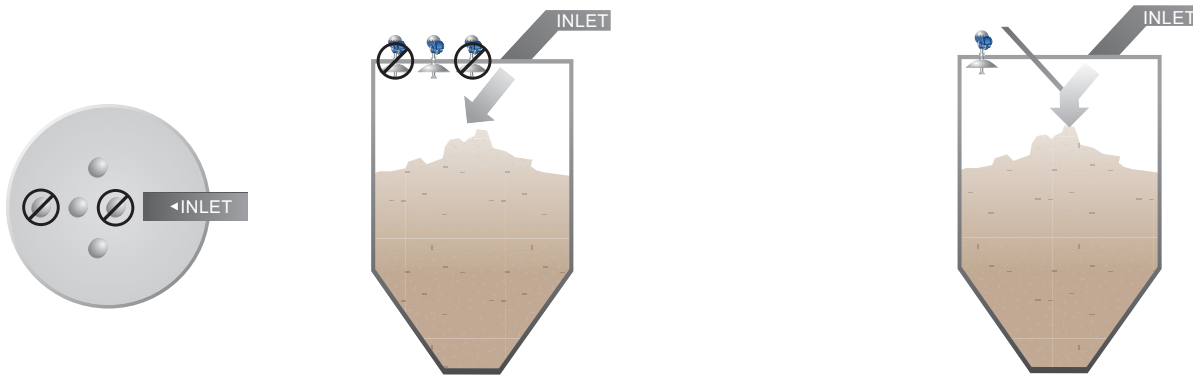


Make sure the radar antenna has at least 2-in. (50mm) clearance into the silo.

**Hint**

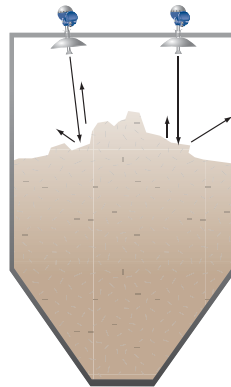
If the signal is dampened by heavy condensation at the antenna, it often helps to insulate the nozzle. This is in order to minimize the temperature disparity between the internal and the ambient temperature.

STEP 3: RADAR LOCATION



- The radar signal must never be shaded by the inlet nor the injected product.
- The radar should not be mounted in the center of the silo. It should always be mounted as close to the silo center as possible. A general practice is to mount the radar at  $\frac{2}{3}$  tank radius from tank wall.
- A deflection plate might need to be installed at the inlet point in order to deflect the product stream away from the antenna.

STEP 4: INCLINATION OF ANTENNA



If the surface echo is weak, the antenna can be inclined 0.5° to 2° towards the surface slope in order to increase the reflected signal.

**Note**  
 Too great of an angle can create problems in detecting surface echo at the bottom region.  
 The angle of the slope differs during filling and emptying. Therefore, monitor the entire cycle in order to verify and to determine an optimum antenna inclination.

TABLE 1. Sample Solid Applications

Applications	Common Characteristics					Antenna Recommendation	Recommended Teflon Bag	Degree of Difficulty Compared to Liquids <sup>(1)</sup>
	Particle Size			Vapor Space				
	• Dust • Powder	• Small (<1")	• Larger (>1")	• Dust	• Steam • Condensation			
Wood chip bins <sup>(2)</sup>	Yes	Yes	Yes	Yes	Possible	Parabolic antenna <sup>(3)</sup>	Yes	Medium
Grain silo - small kernel grains <sup>(2)</sup>	Yes	Yes	No	Yes	No	Parabolic antenna <sup>(3)</sup>	Yes	High
Grain silo - large kernel grains	No	Yes	No	No	No	Parabolic antenna <sup>(3)</sup>	No	Medium
Lime stone silo	No	Yes	Yes	Possible	No	Parabolic antenna <sup>(3)</sup>	No	Medium
Cement - raw mill silo <sup>(4)</sup>	Yes	Yes	No	Yes	No	Parabolic antenna <sup>(3)</sup>	Yes	Medium
Cement - Finish product silo <sup>(4)</sup>	Yes	Yes	No	Yes	No	Parabolic antenna <sup>(3)</sup>	Yes	Medium
Granule	Possible	Yes	No	Possible	No	Parabolic antenna	Yes	Medium
Flour silo	Yes	Yes	No	Yes	No	Parabolic antenna <sup>(3)</sup>	Yes	Medium
Fly ash	Yes	Yes	No	Yes	No	Parabolic antenna	Yes	Medium
Coal bin <sup>(5)</sup>	Yes	Yes	Yes	Yes	Yes	Parabolic antenna <sup>(3)</sup>	No	Medium
Saw dust	Yes	Yes	No	Yes	No	Parabolic antenna <sup>(3)</sup>	Yes	High
High consistency pulp stock	No	No	No	No	Yes	Parabolic antenna	No	Medium
Alumina	Yes	Yes	No	Yes	No	Parabolic antenna <sup>(3)</sup>	No	Medium
Salt	No	Yes	Yes	No	No	8-in. Cone antenna	No	Low

(1) If the degree of difficulty is "low", the application is similar to a standard application on liquid and hence is easy to apply while "high" means that the application is very difficult. The more difficult an application is, the more important it is to carefully follow every part of the installation instructions and guidelines. Note that the ratings are based on "typical" applications which can vary from case to case and from market to market.

(2) For interstice silos the antenna can be inclined 0.5-in. to 2-in. towards the surface slope.

(3) These tend to be taller applications and thus require the parabolic antenna. The 8-in. cone can be used on shorter applications.

(4) For interstice silos: The radar must be installed so that the radar signal clearly passes internal support structures without interferences

(5) Antenna to be cleaned on regular basis. Teflon bag is NOT approved for use in hazardous area!

## STEP 5: SOFTWARE SETTINGS

- Note that solids applications generally are difficult and thus Emerson Process Management has developed a special solids mode in the radar database. This means that the radar database configuration is optimized for solids measurements when the "solids" check box in the Radar Master setup (tank environment window) is checked. Additional adjustments of the database might in some cases become necessary and in such cases, contact the factory for further details how to proceed.
- Some solids build up electrostatic discharges, which might result in explosion risks. Therefore the 5600 series has been approved for use in such environments. See the Rosemount 5600 Radar Transmitter Product Data Sheet (00813-0100-4024) for detailed information about approvals. Also note that the PTFE (Teflon) bag is NOT approved for use in hazardous area.

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