Measuring Level and Volume of Solid Materials
1.0 **Solids measurement characteristics**

Solids and liquids have different characteristics. This Technical Note outlines the most important areas for consideration when measuring solids.

1.1 **Uneven surface**

Most technologies for measuring level and/or volume of solid materials are top-down measurements and depend on a signal reflecting from the surface back to the device.

Guided wave radar is less affected by uneven surfaces since the microwave signal is more compact and guided by the probe.

Non-contacting radar is affected by uneven surfaces since much of the signal is not reflected directly back and instead may be re-directed away from the device. The device gathers several smaller echoes concentrated in an area and then merges them into a single echo that represents an average of the measured area.

The acoustic phased-array technology is not affected by uneven surfaces since it measures over wide surface areas and calculates an average level and volume.

![Figure 1. Signal Reflections from Uneven Surface](image)

Guided wave radar reflection  Non-contacting radar reflection  Acoustic phased-array reflection

1.2 **Dielectrics and bulk density**

The dielectric constant of many solids is fairly low. For the radar technology, this is a key indicator of the amount of signal that will be reflected back to the gauge and thereby the possible measuring range. Technologies based on radar devices are not affected by bulk density.

![Figure 2. The Dielectric Constant of Many Solids is Fairly Low](image)

The acoustic technology is not affected by dielectric properties but can be affected by bulk density (when smaller than 0.2 g/cm³), although most solids materials do not absorb enough of the acoustic signal to be an issue.
1.3 Filling

The mounting location in relation to the filling location is important for most measuring technologies. The closer the device is mounted to the filling point, the larger the risk the device will be affected.

Figure 3. Filling of Dusty Solids Material

There are also cases where the material is blown into a silo through a pneumatic process. Due to the nature of the acoustic technology, measurements can be affected during such filling but the effect decreases with increased silo size.

Dust and the actual stream from the filling can disturb the measurement to a large extent. It is recommended to locate the devices in accordance with best practices presented later in this technical note.

1.4 Dust

There is often a lot of dust created during the fill cycle. The amount of dust depends on the type of filling and the material.

Radar and acoustic technologies can handle dust in the vapor space fairly well. Other technologies, like ultrasonic and laser devices, are less suitable since their signal is significantly impacted by dust.

A heavy layer of dust on the antenna can block the signal. With non-contacting radar, an air purge system may be required. With guided wave radar, the natural flexing of the probe can knock off excessive dust build-up. With the acoustic phased-array technology, the natural vibrations created by the acoustic signal can prevent dry dust build-up from occurring.

In applications where the dust is especially sticky, other alternatives such as non-stick antenna materials may be helpful.

1.5 Condensation

In many solids applications, condensation is present. Since the vessel ceiling is normally the coldest spot, it is a common location for condensation. Unfortunately, this is typically the location of top-down measurement devices, so consideration needs to be made as to the effects of condensation on the technology. Condensation can also tie up dust and create a layer on the wetted parts, which may cause problems if no action is taken. Guided wave radar is not affected by condensation and is a good choice for extreme condensation, although buildup on the probe could affect readings. Signal Quality diagnostics can monitor this. Non-contacting radars may need air purging to cope with condensation related issues; see “Antenna requirements” on page 15 for more information. The acoustic phased-array antenna devices include self-cleaning functionality, which reduces the need for maintenance. Using a PTFE antenna reduces maintenance needs even further.
1.6 Open air applications

Open air applications include measurements on piles and distance control between conveyor belts and the pile. These types of applications have different properties compared to standard bin or silo applications. There are no walls or roof to install instruments onto so the biggest challenge in these types of applications is to find an installation point. Protection from external factors like wind and rain can also be a challenge. Non-contacting radar or acoustic phased-array is recommended in these types of applications. Non-contacting radar devices are not affected by outdoor conditions. The acoustic phased-array will not be affected if the wind speed is less than 18.5 mph (30 km/h).

![Figure 4. Open Air Application](image)

1.7 Noise

Many solids applications are in noisy environments. The noise can be generated by running engines, conveyor belts or by the filling and emptying process. Sound has no effect on radar based devices.

Acoustic devices use the following three frequencies: 2.7 kHz, 3.4 kHz, and 7 kHz. It is rare that all three frequencies are disturbed at the same time and an acoustic phased-array device can work even if two frequencies are compromised. The effect can often be mitigated with a different location of the device or possibly a different configuration.

1.8 Level or volume?

When selecting a measuring device, it is important to understand the purpose of the measurement. Whether volume or level is the desired primary measurement, this will impact the selection of the technology. Using products outside of its main function could result in less than satisfactory measurement.

**Solids level measurement**

The main benefit of a continuous level measurement is having continuous access to information, which allows for better materials tracking and control. Radars usually provide appropriate solutions for small to medium sized silos where the filling rate can be high and the environment can be rough. The Rosemount™ 5708L 3D Solids Scanner is a good alternative for applications with extremely low dielectric properties.
**Solids volume measurement**

Volume measurement is often related to a demand for inventory control, sometimes directly connected to an Enterprise Resource Planning (ERP) system. The demand for accurate volume readings is therefore high.

Material properties often challenge the ability to measure the volume of solids. There can be high peaks and deep holes and the surface is generally quite uneven. Multiple point measurement is therefore recommended and Rosemount 5708V is a good fit. The Rosemount 5708S is recommended where visualization of the material may be desired or where several Rosemount 5708S units are needed to cover the area. They are designed so they can be connected together and give one combined volume output.

On solids, using only a single device suitable for level measurement when your desire is volume can often mean less accurate results and an inferred volume reading, since the volume will be based on the level reading from only a small portion of the surface.

**Figure 5. Solids Volume Measurement**

A. True volume  
B. Inferred volume
## 2.0 Selection best practices

The following guide provides basic information on the different technologies and products in the Emerson™ product portfolio for solids measurement.

### Table 1. Technology Selection

<table>
<thead>
<tr>
<th>Technology</th>
<th>Measuring footprint</th>
<th>Minimum mounting requirements</th>
<th>Advantages</th>
<th>Limitations</th>
</tr>
</thead>
</table>
| Guided wave radar              | Rosemount 5303      | 1"                           | • Low DC, Probe End Projection  
• Small vessel intrusion  
• Internal obstructions  
• 2-wire                     | • Pull force dependent  
• Wear on probe  
• Inferred volume             |
| Non-contacting radar           | Rosemount 5408 cone antenna | 2", 3", 4"                     | • Narrow beam  
• Small vessel intrusion  
• Internal obstructions  
• 2-wire                      | • May need purging  
• Inferred volume             |
| Acoustic Phased-Array - level and volume | Rosemount 5708   | 8" (4" with neck extension) | • Self-cleaning antenna  
• Long range  
• DC independent  
• Inventory (Rosemount 5708V)  
• Multiple vessels management software available | • Not suitable for vessels narrower than 9 ft. (3 m)  
• No configuration via AMS, Field Communicator, DTM™, DD  
• Requires separate server for multi-scanner systems  
• 4-wire, 18 to 32 Vdc         |
| Acoustic Phased-Array - visualization | Rosemount 5708S     |                              | • Self-cleaning antenna  
• Long range  
• DC independent  
• Inventory applications  
• 3D visualization  
• Multiple Rosemount 5708S can be connected together for large silos  
• Multiple vessels management software available | • Not suitable for vessels narrower than 9 ft. (3 m)  
• No configuration via AMS, Field Communicator, DTM, DD  
• Requires separate server for multi-scanner systems  
• 4-wire, 18 to 32 Vdc         |
Table 2. Product Selection

<table>
<thead>
<tr>
<th>Model</th>
<th>Silo height</th>
<th>Silo width</th>
<th>Power</th>
<th>Material restrictions</th>
<th>Protocol</th>
<th>Primary output</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rosemount 5303</td>
<td>3-98 ft. (1-30 m)</td>
<td>Unlimited</td>
<td>2-wire DC &gt; 1.1 up to 39 ft. (12 m) with Probe End Projection activated DC &gt; 1.4</td>
<td>4-20 mA, HART®, FOUNDATION™ Fieldbus, Modbus®, WirelessHART®</td>
<td>Level</td>
<td>Probe End Projection, Signal Quality Metrics</td>
<td></td>
</tr>
<tr>
<td>Rosemount 5408</td>
<td>Maximum 131 ft. (40 m)</td>
<td>Unlimited</td>
<td>2-wire Up to 131 ft. (40 m) depending on antenna type and product category. See Table 5 on page 16 for further details.</td>
<td>4-20 mA, HART, WirelessHART</td>
<td>Level</td>
<td>Solids signal processing, air purging, FMCW technology, All-PTFE solutions, Signal Quality Metrics</td>
<td></td>
</tr>
<tr>
<td>Rosemount 5402</td>
<td>Parabolic: 3-105 ft. (1-32 m) Cone: 3-66 ft. (1-20 m)</td>
<td>Unlimited</td>
<td>2-wire Parabolic: DC &gt; 1.5 up to 52 ft. (16 m), DC &gt; 2.0 up to 105 ft. (32 m) Cone: DC &gt; 1.5 up to 33 ft. (10 m), DC &gt; 2.0 up to 66 ft. (20 m)</td>
<td>4-20 mA, HART, FOUNDATION Fieldbus, Modbus, WirelessHART</td>
<td>Level</td>
<td>Solids signal processing, air purging</td>
<td></td>
</tr>
<tr>
<td>Rosemount 5708L</td>
<td>19-229 ft. (6-70 m)</td>
<td>Min: 7 ft. (2 m) Max: Unlimited</td>
<td>4-wire Material density &gt; 12.5 lb/ft³ (200 kg/m³)</td>
<td>4-20 mA, Modbus(3), WirelessHART(1)</td>
<td>Average level</td>
<td>DC independent level measurement</td>
<td></td>
</tr>
<tr>
<td>Rosemount 5708V</td>
<td>19-229 ft. (6-70 m)</td>
<td>Min: 9 ft. (3 m) Max: 39 ft. (12 m)(2)</td>
<td>4-wire Material density &gt; 12.5 lb/ft³ (200 kg/m³)</td>
<td>4-20 mA, Modbus(3), WirelessHART(1)</td>
<td>Volume</td>
<td>True volume measurement, multiple point measurement</td>
<td></td>
</tr>
<tr>
<td>Rosemount 5708S</td>
<td>19-229 ft. (6-70 m)</td>
<td>Min: 9 ft. (3 m) Max: Unlimited</td>
<td>4-wire Material density &gt; 12.5 lb/ft³ (200 kg/m³)</td>
<td>4-20 mA, Modbus(3), WirelessHART(1)</td>
<td>Volume</td>
<td>3D Visualization, multiple devices can be connected together</td>
<td></td>
</tr>
</tbody>
</table>

1. The Rosemount 5708 with the Emerson Wireless THUM™ Adapter enables wireless access to the following parameters: 4-20mA current, Distance, Percentage, Temperature and SNR. Diagnostics and configuration are available through wired connection.
2. Use Rosemount 5708S if \( \frac{\text{silo height}}{\text{silo width}} < 3 \). For more information, see section “Determining number of Rosemount 5708s” on page 20.
3. Ethernet capable.
3.0 **Guided wave radar**

Guided wave radar is used in many different applications. It is especially well suited for smaller vessels with diameter <33 ft. (10 m) containing powders and small granular materials and where the installation area is restricted. As vessel height increases, wear on the probe becomes more of a factor in the suitability of its use.

3.1 **Mounting considerations**

Always install the probe in an empty silo and regularly inspect the probe for damage. For silos taller than 98 ft. (30 m), consult your Emerson representative.

**Position**

Mount the probe as far away as possible from filling and emptying ports. This will minimize load and wear and will help to avoid disturbances from the incoming product.

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**Figure 6. Position Recommendations**

![Diagram](image)

A. Recommended location  
B. Avoid inlets  
C. Avoid outlets

Installing the probe at about 1/3 to 1/2 of the silo radius is recommended to compensate for measurement errors caused by cone-shaped surface formation during centered filling. The minimum recommended probe distance to tank wall or disturbing objects is 20 in. (50 cm), unless the wall is comprised of smooth metal, then the distance is 4 in. (10 cm). In any case, the probe should not be able to touch the wall of the tank during operation.
Nozzle

A short nozzle is recommended. The maximum recommended nozzle height is nozzle diameter + 4 in. (100 mm). When nozzles are more than 4 in. (100 mm) in height, a long stud is recommended to prevent the probe from contacting the nozzle. Avoid 10 in. (250 mm)/DN250 or larger diameter nozzles, especially in applications with low dielectric constants.

Figure 7. Nozzle Recommendations

Special silos

In case of non-metallic silos, a guided wave radar should be mounted with a metal plate of at least 14 in. (350 mm) in diameter. Use metal shielding for the conduit connections.

In the case of bunkers with a concrete roof, a Rosemount 5303 should be installed flush with the inner roof surface or in a nozzle insert.

Figure 8. Installation in Concrete Silos with Metal Shielding
3.2  Probe anchoring

The best practice is to have a free-hanging probe but an anchored probe is sometimes needed for application reasons. The probe end should not be fixed for 98 ft. (30 m) or longer probes. The probe must be slack when anchoring the probe to reduce the risk of probe breakage. Select a probe longer than the required measuring range so there is a sag in the middle of the probe greater than or equal to 1.5 in. per 10 ft. (1 cm per m) of the probe length.

**Electrostatic discharges**

In some applications, such as plastic pellets, electrostatic charges can build up and eventually discharge. While the Rosemount 5300 electronics can tolerate some static charge, providing a good earth ground for the electronics by anchoring the end of the probe to the vessel will create ground paths for discharge away from the electronics. If the product can build up static electricity, the probe should be properly grounded (R < 1 Ohm).
3.3 Probe End Projection

Probe End Projection is a function in the Rosemount 5303 that allows for measurements when the surface pulse is too weak to be detected. This commonly occurs when the material dielectric constant is very low, especially in combination with a long distance to the surface, or electromagnetic interference. When the dielectric constant of the material being measured is low, only a portion of the electrical signal is reflected off the top of the material. The rest of the signal continues down the probe. When the signal reaches the end of the probe, there is a strong reflection. Since the microwave signal propagates more slowly in the material than it does in air, this echo is seen at a distance further than the actual probe end. The actual probe length, the probe end reflection echo location, and the dielectric of the material can be used to calculate the level of the material when the initial reflection from the top of the material is not strong enough to make a direct reading.

This function is recommended for solids with a dielectric constant less than or equal to two (e.g. perlite at 1.7, plastic pellets at 1.2).

The maximum product level (m) with Probe End Projection is calculated by dividing the difference of 50 - the air gap to the material surface with the square root of the material dielectric constant, as shown in Figure 11 on page 12.
**3.4 Pull force**

The flexible single lead probe is recommended for solids. It is available in two versions to handle different loads and lengths. Yield strength is the amount of force the probe can withstand before any deformation occurs.

Probe End Projection is easily configured by using the guided setup in either Rosemount Radar Master, AMS, or the Field Communicator. For best performance, complete the Guided Probe End Projection Setup with an empty tank and then, without overwriting the empty tank calibration, a second time with a filled tank.

\[
= (50 - A)/\sqrt{\text{material DC}}
\]

**Figure 11. Maximum Product Level with Probe End Projection**

- A. Air gap to the material surface
- B. Maximum product level (m) with Probe End Projection

**Figure 12. Pull Force**
It is important to keep the following in mind when planning for installation:

- The silo roof must be able to withstand maximum probe tensile load.
- The tensile load depends on the silo size, material density, and the friction coefficient. Forces increase with the buried length, the vessel width and probe diameter.
- Forces on probes are generally increased two to ten times when probes are anchored to the vessel.

### Table 3. Tensile Load for Unanchored 0.16 in. (4 mm) Flexible Single Lead Probe, lb (kN)

<table>
<thead>
<tr>
<th>Material</th>
<th>Probe length 49 ft. (15 m)</th>
<th>Probe length 115 ft. (35 m)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tank Ø = 10 ft. (3 m)</td>
<td>Tank Ø = 39 ft. (12 m)</td>
</tr>
<tr>
<td>Wheat</td>
<td>670 (3)</td>
<td>1120 (5)</td>
</tr>
<tr>
<td>Plastic pellets</td>
<td>340 (1.5)</td>
<td>670 (3)</td>
</tr>
<tr>
<td>Fly ash</td>
<td>770 (3.4)</td>
<td>1690 (7.5)</td>
</tr>
<tr>
<td>Coal dust</td>
<td>540 (2.4)</td>
<td>1190 (5.3)</td>
</tr>
<tr>
<td>Cement</td>
<td>900 (4)</td>
<td>2020 (9)</td>
</tr>
</tbody>
</table>

1. Exceeds the yield strength limit of 2698 lb (12kN).

### Table 4. Tensile Load for Unanchored 0.24 in. (6 mm) Flexible Single Lead Probe, lb (kN)

<table>
<thead>
<tr>
<th>Material</th>
<th>Probe length 49 ft. (15 m)</th>
<th>Probe length 115 ft. (35 m)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tank Ø = 10 ft. (3 m)</td>
<td>Tank Ø = 39 ft. (12 m)</td>
</tr>
<tr>
<td>Wheat</td>
<td>900 (4)</td>
<td>1690 (7.5)</td>
</tr>
<tr>
<td>Plastic pellets</td>
<td>450 (2)</td>
<td>920 (4.1)</td>
</tr>
<tr>
<td>Fly ash</td>
<td>1130 (5)</td>
<td>2520 (11.2)</td>
</tr>
<tr>
<td>Coal dust</td>
<td>790 (3.5)</td>
<td>1780 (7.9)</td>
</tr>
<tr>
<td>Cement</td>
<td>1350 (6)</td>
<td>2920 (13)</td>
</tr>
</tbody>
</table>

1. Exceeds the yield strength limit of 6519 lb (29 kN).
4.0 **Non-contacting radar**

Non-contacting radar is used on a large variety of applications. It has no restrictions with respect to the weight of the material so it can be used in applications where guided wave radar may not be appropriate because of pull forces or concerns about probe breakage.

Non-contacting radar can see more of the surface than guided wave radar, so it will be slightly more accurate. As a radar device, it reacts quickly to level changes so it is also appropriate for process applications and small vessels.

4.1 **Mounting considerations**

**Position**

A non-contacting radar should not be mounted in the center of the silo or very close to the tank wall. General best practice is to mount the non-contacting radar at \(\frac{2}{3}\) tank radius from tank wall. The inlet stream of the product will interfere with readings if it is in the path of the radar beam.

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![Figure 13. Position Recommendations](image-url)
Antenna requirements

The antenna types available for non-contacting radar are: Cone antenna, parabolic antenna, and process seal antenna. They require different tank connections as displayed in Figure 14.

Figure 14. Tank Connection Requirements for Rosemount 5408 Antenna Types

For solids applications, it is sufficient to minimize potential disturbances from the nozzle. A shorter nozzle typically results in a stronger surface reflection. This is applicable to all antenna types.

The cone antenna is fixed but should be installed perpendicular to the ground. The parabolic antenna inclination is adjustable. General best practice is to initially align the parabolic antenna perpendicular to the ground as well. Refer to the Rosemount 5408 Level Transmitter Reference Manual for further information.

If the signal is dampened by heavy condensation at the antenna, it often helps to insulate the nozzle. This minimizes the temperature disparity between the internal and ambient temperature. Installing the antenna so it is inside the vessel helps reduce the chance of condensation.
Measuring range

The recommended measuring range for Rosemount 5408 varies depending on antenna type and product dielectric constant. Table 5 provides detailed measuring range information.

Table 5. Recommended Measuring Range for Solids, ft. (m)

<table>
<thead>
<tr>
<th>Rosemount 5408 antenna</th>
<th>Light powder(1)</th>
<th>Light granulates and pellets(2)</th>
<th>Heavy powder(3)</th>
<th>Grains(4)</th>
<th>Larger particles(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-in. (DN50) cone/process seal(6)</td>
<td>16 (5)</td>
<td>33 (10)</td>
<td>82 (25)</td>
<td>82 (25)</td>
<td>98 (30)</td>
</tr>
<tr>
<td>3-in. (DN80) cone/process seal(6)</td>
<td>49 (15)</td>
<td>66 (20)</td>
<td>98 (30)</td>
<td>98 (30)</td>
<td>130 (40)</td>
</tr>
<tr>
<td>4-in. (DN100) process seal(6)</td>
<td>66 (20)</td>
<td>98 (30)</td>
<td>130 (40)</td>
<td>130 (40)</td>
<td>130 (40)</td>
</tr>
<tr>
<td>4-in. (DN100) cone(6)</td>
<td>115 (35)</td>
<td>130 (40)</td>
<td>130 (40)</td>
<td>130 (40)</td>
<td>130 (40)</td>
</tr>
</tbody>
</table>

1. Plastic powder, etc. (Dielectric constant: 1.2)
2. Plastic pellets, etc. (Dielectric constant: 1.35)
3. Lime powder, cement, sand, etc. (Dielectric constant: 1.5)
4. Kernels, brans, etc. (Dielectric constant: 1.5)
5. Wood chips/pellets, etc. (Dielectric constant: 1.7)
6. Cone and process seal antennas are the preferred choice for most solid applications. For specific recommendations in dusty applications, see "Dust management" on page 16.
7. Recommended for longer measuring ranges, typically > 66 ft (20 m).

The figures given in Table 5 should be considered as guidelines; the total measuring range may differ depending on other contributing application conditions such as product filling, how the product piles up, silo diameter vs. angle of repose, internal obstacles within the silo, dust, condensation, antenna buildup, etc.

Dust management

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

The easiest way to determine if air purging is needed is to open the manhole hatch and see if there is a thick layer of dust on it. If so, air purging is most likely needed.

In absence of air supply, the process seal antenna provides an all PTFE solution — ideal for aggressive media, and is resistant to dust and/or condensation.
4.2 Software setup

Follow a standard configuration and check the "solids" check box in the tank environment window to activate the special solids mode. Solids applications are generally difficult and thus Emerson has developed a special solids mode in the device database. While additional adjustments are generally not needed, they are in some cases. Consult your Emerson representative for further details on how to proceed if additional adjustments are needed.
5.0 Acoustic phased-array antenna

Acoustic phased-array devices can be used on a large variety of applications but are especially suitable for bulk storage materials. These applications tend to be very large vessels with slow changes in surface movement.

5.1 Mounting considerations

Acoustic phased-array antenna devices measure volume and level in bins, silos, warehouses, and domes. Correct location and mounting are key to achieving the most accurate volume measurements. Fill in the Application Evaluation Form (AEF) carefully with your Emerson representative to determine the optimal location. The AEF is used to evaluate the installation for suitability of use with the Rosemount 5708 and to determine optimal position(s) and quantity of devices needed.

**Position**

The Rosemount 5708 should always be mounted perpendicular to the ground, or using a product dedicated angle adapter, to ensure highest accuracy. It is also important to mount the device so at least 0.4 in. (10 mm) of the antenna protrudes below the standpipe or nozzle. Since the Rosemount 5708 measures in three dimensions, it is also important to set the antenna array with a correct orientation in relation to the center. The notch on the top of the thread must be directed toward the center of the vessel as shown in the illustration below.

**Distance to wall and inlet**

To get the highest accuracy from the Rosemount 5708, it is important to make sure the distance to walls and filling points is at least 24 in. (600 mm). This is to prevent false readings and ensure trouble-free operation.
Obstacle avoidance

It is important to know the location of any obstacles in the silo. Some obstacles may affect the measurement and this would impact the suitable device location. The following common obstacles are important to identify before deciding on Rosemount 5708 location:

- Inlets
- Internal structures
- Ladders
- Support beams
- Thick roofs (for example in concrete silos)

Figure 18. Tank Obstacles

If an obstacle can't be avoided by relocating the device, a neck extension can be used to extend the antenna past the obstacle.

Handling moving obstacles

Moving obstacles like augers and mixers must be taken into consideration when the Rosemount 5708 is installed.

The best practice to handle bottom mixers and augers is to exclude them from the measurement area. This is done during the commissioning phase where the silo dimensions are used as normal but “zero level” is set above the auger or mixer. The area under “zero level” will be the end of measurement.

Figure 19. Moving Obstacles Excluded from the Measurement Area
Nozzle proximity to wall

Sometimes the recommended installation location is not available for a silo or vessel. To handle a less optimal location of the device, a separate angle adapter can be used. This adapter should only be used if there are no other alternatives. Consult your Emerson representative for further details as needed.

Figure 20. Rosemount 5708 Angle Adapter

5.2 Determining number of Rosemount 5708s

For a large vessel or open bin, it may be necessary to install more than one Rosemount 5708 to cover the complete surface. Information from the AEF will determine how many devices are needed. The combination of vessel height and diameter are the primary factors along with the maximum fill height.

The Rosemount 5708s are daisy-chained with RS-485 linked to a Rosemount System Controller. Data from all devices is then synchronized and sent to the control room.

Figure 21. Rosemount 5708 Daisy-Chained Linked to a Rosemount System Controller

It is important to input the exact location of each Rosemount 5708 during configuration for the devices to cooperate in an optimal way. Accurate location information will ensure optimal measurement accuracy.
5.3 Center of Gravity

Center of Gravity is a feature in the Rosemount 5708 that allows the user to input an optimal vessel Center of Gravity (COG) area into the silo configuration. When implemented, the feature will automatically detect when the actual COG of the stored bulk material is outside the configured COG area, and generate an alert. The COG calculations are based on the volume measurement.

When the COG of stored material deviates from the configured COG area, there is a risk of the vessel collapsing or tilting. Using this function will allow maintenance teams to conduct preventative maintenance, fix operational issues, as well as increase the safety of employees and the plant, by preventing the vessel from collapsing or tilting.

The software displays X, Y, Z coordinates of the COG, accepted COG area, and provides a 3D image of the COG calculated areas when using MV/MVL models of the Rosemount 5708.

Figure 22. Center of Gravity Based on the Volume Measurement

A. Actual COG: Red color indicates the actual COG is outside the accepted COG area, and an alert is generated.
B. Accepted COG area
5.4 Virtual Sections

Virtual Sections is a feature in the Rosemount 5708 that allows for monitoring of different sections of the vessel. The vessel is divided into a maximum of 99 sections, minimal section size is 5 ft. (1.5 m) by 5 ft. (1.5 m). The feature will supply minimum, maximum and average level output for each section and is seamlessly integrated into the SCADA, using Modbus commands.

The larger the vessel, the more complicated it is to control the material allocation and optimize the filling and emptying processes. In many cases, there is today a need for a manual inspection, putting employees at risk. Using the Rosemount 5708 with this feature, allows for full control from a remote location, such as the control room.

Figure 23. Different Sections of the Vessel are Monitored with the Virtual Sections Feature
5.5 3D visualization

The 3D visualization constructed in the Rosemount 3DVision/Rosemount 3DMultiVision™ software is based on multiple points collected by the Rosemount 5708 and represents the material surface the device(s) can see. This allows the user to get the best representative surface measurement. It also provides information on material formations within the vessels.

Rosemount 3DVision/3DMultiVision software also provides sophisticated analysis of current conditions as well as historical data that allows you to improve your workflows while reducing operating costs. It allows for monitoring vessels across multiple sites and remote geographic areas with accurate information that is based on real-time conditions. It allows the user to receive online data from devices, view a 3D visualization of the material stored in the vessels (for Rosemount 5708S types only), add or remove sites, vessels, and devices and manage alerts and reports.

Figure 24. 3D Visualization of Material Surface Measurement