Measuring Ammonia with Radar

KEY POINTS

- Any of the radar products can be used with aqueous ammonia
- For anhydrous ammonia, the Rosemount 5301, 3301 and 5601 are the preferred choices
- Measurement range will decrease with higher storage pressure

APPLICATION

Radar is a suitable method for measuring liquid ammonia. Since all Rosemount radar products have transmitter heads that can be serviced without breaching the tank atmosphere, radar is perfect for applications where tank openings must be minimized.

Emerson Process management offers four different radar solutions: the Rosemount 5301 high performance Guided Wave Radar, the Rosemount 3301 guided wave-radar, the Rosemount 5601 non-contacting radar with 10 GHz frequency and the Rosemount 5400 non-contacting radar with 6 and 26 GHz frequencies.

This technical note offers guidelines for choosing the most suitable Rosemount radar depending on the liquid ammonia application.

Aqueous ammonia (NH_4OH)

Liquid aqueous ammonia (ammonium hydroxide or ammonium hydrate) is a suitable application for both Guided Wave Radar and non-contacting radar. Any Rosemount radar is suitable for these application.

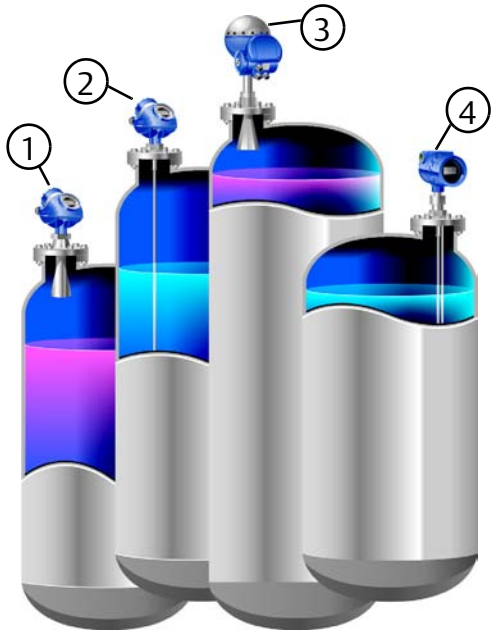
However, these tanks sometimes require isolation valves. It is not possible to use Guided Wave Radar with valves unless a bypass pipe is used. If a valve is required, it must be a full port valve so the inside of the nozzle is smooth. The Rosemount 5402 with a process seal antenna is preferred with valves because its higher frequency allows better signal propagation down the nozzle.

Other liquid ammonia solutions such as ammonia chloride will work with radar technology similarly to liquid aqueous ammonia.

Anhydrous Ammonia (NH_3)

Liquid anhydrous ammonia is difficult to measure because it produces heavy vapors that attenuate radar signals. As the storage pressure increases, the density of vapors will increase. With heavier vapors, signal attenuation is increased. Lower frequency radar signals are less attenuated than higher frequencies. Since Guided Wave Radar operates with a low frequency pulse, it will have minimal signal attenuation in heavy vapors. Therefore, Guided Wave Radar works better than non-contacting radar in high-pressure applications.

The low frequency of the Guided Wave Radar products ensures reliable level measurements in vessels with vapors such as anhydrous ammonia.



1. Rosemount 5400 Non-Contacting Radar 6 GHz and 24 GHz
2. Rosemount 5301 High Performance Guided Wave Radar
3. Rosemount 5601 Non-Contacting Radar 10 GHz
4. Rosemount 3301 Guided Wave Radar

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Process Management

During operation, product boiling may affect the radar reflection. If Guided Wave Radar or a 5601 in a still pipe is used, the effect will be minimized.

There are two main types of anhydrous ammonia applications:

1. Larger chilled tanks, 33-75 feet (10-23 m) high, with temperatures approximately -40 °F (40 °C) and with pressure up to 29 psig (2 bar). In these applications, the 3301, 5301 or the 5601 can be used (see measuring range graph).
2. Smaller pressurized tanks, 3 - 33 feet (1-10 M) high, with pressure to 145 psig (10 bar). Here, Guided Wave Radar has an advantage as compared to non-contacting.

The 5400 radar transmitter is not recommended in anhydrous ammonia applications.

If there is a nozzle with full port valves, the 5601 may be used. Since valves give uncontrolled microwave performance, a test installation is required.

Probe/antenna selection

For the 3301, the coaxial probe (up to 19.7 feet/6 m) is preferred but the flexible twin lead probe will work as well. Any of the probe types may be used with the 5300.

The preferred mounting location for the 5601 is on a still pipe. A 4-in. pipe with a 4-in. cone antenna is recommended. Eight-inch pipes should be avoided. If the gauge is to be mounted on a nozzle, a larger cone antenna (6- or 8-in.) is recommended.

In aqueous ammonia vessels with taller nozzles, the 5402 with a PTFE seal may be used. This helps to reduce signal attenuation in taller vessels.

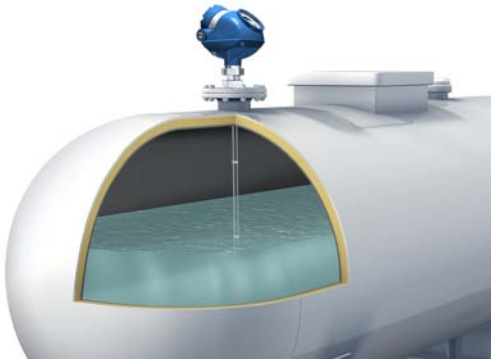
Measuring range

For aqueous ammonia, the measuring range is not limited by signal attenuation from the vapors. (See the appropriate Product Data Sheet.)

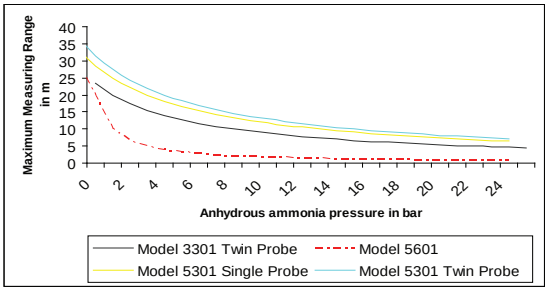
The graphs give guidelines for the maximum possible measuring range in anhydrous ammonia depending on the maximum pressure. If a still pipe is used for the 5601, the maximum measuring range can be improved.

Material compatibility

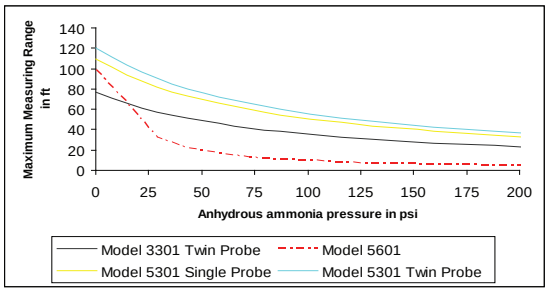
Material compatibility is ultimately the user's decision. Compatibility may vary with material concentration, temperature and if in a liquid or gas form. In the case of the radar products, the process seal of the standard units is a combination of PTFE and o-rings. The optional high pressure probe of the Guided Wave Radar products contains a ceramic process seal and no o-rings. It should be considered if unsure of o-ring compatibility.



Guided wave radar is a suitable method in anhydrous ammonia applications. Since it operates with a low frequency pulse, the signal attenuation will be minimal in heavy vapors



Measuring range in bar versus meters



Measuring range in psi versus feet

Emerson Process Management
Rosemount Division
8200 Market Boulevard
Chanhassen, MN 55317 USA
T (U.S.) 1-800-999-9307
T (International) (952) 906-8888
F (952) 949-7001
www.rosemount.com

Emerson Process Management
Emerson Process Management GmbH & Co.
Argelsreider Feld 3
82234 Wessling
Germany
T 49 (8153) 9390
F 49 (8153) 939172

Emerson Process Management
Emerson Process Management Asia Pacific
Private Limited
1 Pandan Crescent
Singapore 128461
T (65) 6777 8211
F (65) 6777 0947
Enquiries@AP.EmersonProcess.com

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For more information:
www.rosemount.com

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