



White Paper

November 6, 2009

Radar Tank Gauging for Asphalt Inventory Measurement

This document describes the correct selection of a radar tank gauge for inventory measurement and maintainability on an asphalt bulk storage tank.

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Executive Summary

Asphalt can be considered the most difficult level application in a refinery due to its viscous properties and the nature of its production. The composition of asphalt is a mix of solids (aggregates) with a liquid additive, producing a sticky and highly viscous substance. To manage the product as a liquid, the tank must be maintained at high temperatures (350 to 400°F). This means the atmosphere inside an asphalt tank is composed of product vapor, air and water vapor, which condensates and solidifies around the tank, adhering to any instrumentation that penetrates the tank.

Traditionally, three types of technology are used to measure asphalt - mechanical float and tape, hydrostatic pressure and ultrasonic devices. Each has its own specific problems that must be considered for the application. The primary concern, regardless of the chosen technology, is the loss of measurement signal that may cause the tank to overflow. Radar technology addresses the problems associated with asphalt tank gauging if the correct antenna and options, such as tank seal material are selected.

Influencing Factors and Ambient Conditions

Temperature

Product temperature of asphalt can reach over 350°F, which causes the ambient temperatures in the tank to approach 150°F. The use of a high temperature seal (graphite seal suitable to 536°F) in conjunction with a specialized heat dissipating antenna eliminates any effect high temperatures could have on the electronics of the radar gauge. The physics of the radar signal are not affected in any appreciable amount by temperatures in this range.

Viscosity, Adhesion and Coating

As the radar is a "non-contact" technology installed on the tank roof, the antenna is not in direct contact with the product. However, asphalt vapors tend to solidify on everything within the tank (see above), including gauging devices. Although coating of the antenna is a problem, it does not affect the transmitted or received signal of a radar gauge if the operating frequency is in the lower ranges. For example, devices operating at frequencies over 20 GHz are more susceptible than devices operating at 10 GHz or lower. Therefore, the ideal Varec radar gauge is a 7230 RTG with a horn shaped antenna that operates at 6 Ghz.

Condensation

The humidity level in a typical asphalt tank is very high and, as the vapor comes in contact with the cooler antenna, condensate forms, producing water droplets along the rim of the antenna. These droplets can cause severe reflections in the signals of both ultrasonic devices and radar gauges, which would give misleading measurements.

One of the key factors in any radar gauge application is the selection of the correct antenna and asphalt measurement is no different. The problems of condensation can be overcome by using a large antenna with a circumference to surface area ratio that produces a stronger signal with less noise. The 7230 RTG is available with the largest horn possible – 10" in diameter.

Air Purging

Air purging an area in a tank is a known solution for reducing build-up and condensation in viscous applications. The Varec 7230 RTG offers a specific option that allows the gauge to be connected to high pressure air source. A ¼" NPT air purge connection that is suitable for high temperatures allows air to be fed through the body of the radar and mounting flange into the horn itself.

Retrofit Installation

Varec recently replaced existing radar gauges with Varec 7230 RTGs with the options described above at a refinery in the Pacific Northwest. Previously, each antenna required to be cleaned a few of times a week to maintain the operation of the tank gauges. With the new air purge option, the maintenance staff only sees the need to clean the antenna a couple of times a year.



7230 Radar Tank Gauge with large horn, low frequency, high temperature and air purge options

Summary

Repeatability with Accuracy

The Varec 7230 Radar Tank Gauge offers a unique solution to gauging asphalt tank level due to the large antenna, 6 GHz operating frequency, air purge and high temperature options. The two-wire intrinsically safe design allows for simple installation with inventory accuracy. It meets the relevant inventory management requirements according to OIML R85 and API 3.1B.

Example Varec Radar Gauge Product Configuration: **N7230- T6LA3JAC4Y**

T – Factory Mutual Explosion Proof Approval

6 – 10” Horn Antenna

L – Extended Temp Graphite Seal to 536°F

A3J – 8” 150 lb 316 SS Flange Process Connection

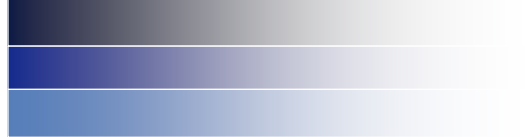
A – 4...20 mA Output with VU331 Display

C – T12 Alum Housing

4 – ½” NPT cable entry

Y – Option: ¼” NPT Air Purge Connection w/ Plug – For Extended or High Temp Range

Note – replace options not bolded that are specific to your installation requirements.



Credits

About Varec

Varec, Inc. delivers measurement, control and automation solutions and professional services for most major oil companies, defense organizations and airlines worldwide. Varec's FuelsManager® software applications and hardware products provide local level management and enterprise visibility of liquid petroleum assets at bulk storage facilities, marketing terminals, refineries, petrochemical plants and military fuel facilities.

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