Storage Tanks - Liquid Measurement and Leak Detection Using Reed Switch Technology

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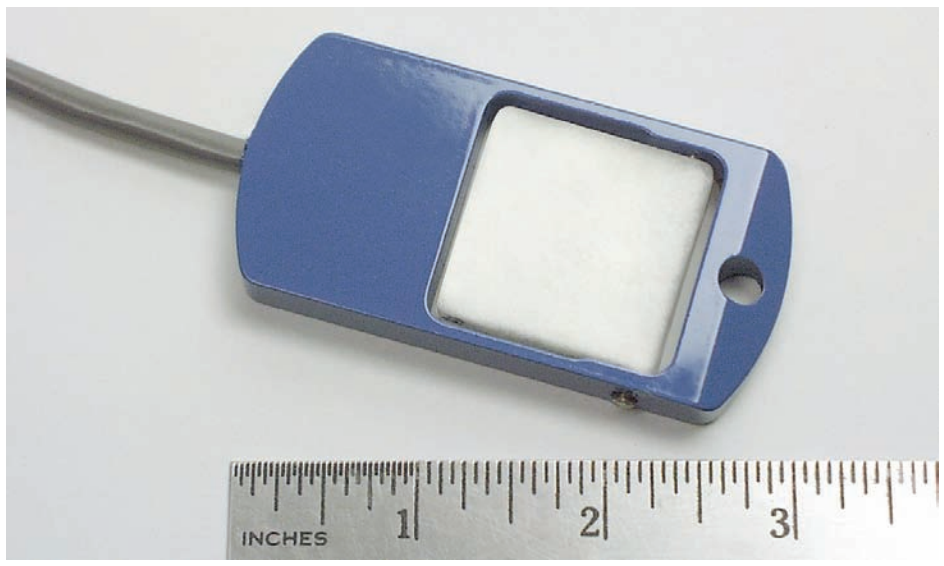
The use of aboveground storage tanks presents several concerns for both level measurement and leak detection. In the US, aboveground storage tanks are subject to both Federal regulations and state and local regulations. Such aboveground storage tanks need to meet the U.S. EPA's Spill, Prevention, and Countermeasure (SPCC) requirements (40 CFR, Part 112). This particular regulation applies to any single storage tank with a capacity greater than 660 gallons or a multiple-tank site with a combined capacity greater than 1,320 gallons. In 1984 the U.S. EPA was authorized to develop regulations for underground storage tank systems as well. The EPA formed the Office of Underground Storage Tanks to carry out the mandate from Congress. Their federal regulations went into effect in December 1988. These regulations provide for the Office of Underground Storage Tanks to approve state programs. States with approved programs operate in lieu of the federal regulations. Currently 29 states (plus the District of Columbia and Puerto Rico) have approved underground storage tank programs. As of March 31, 2002, 422,573 releases had been reported from underground storage tank systems. These reported releases resulted in cleanup costs and, in some cases, required emergency responses. Such releases can be caused by leaks, spills, and overfills of the underground storage tank. One technology that has been used to accomplish both leak detection and overfill protection is float switches that use reed switch technology. With this technology having longstanding service reliability, the old adage of "an ounce of prevention being worth a pound of cure" is particularly relevant.

There is no one leak detection system that best suits all tank sites, or a particular sensor technology that is the most appropriate for all tank installations and their unique characteristics. Identifying the best leak detection choice for your storage tank depends on a number of factors including cost (both initial installation cost and long-term operation and maintenance cost); facility requirements for piping runs and an interior or exterior tank site; temperature ranges; and availability of experienced installers, to name a few.

The basic liquid level indication can be accomplished with a float switch design, usually mounted on the tank top, extending down into the tank to the lowest point where the empty indication is desired. This would be the simplest configuration for obtaining a low-level signal. This could also be accomplished by mounting a single-point float switch horizontally into the side of the tank. Such single-point devices are 2-wire electrical hook ups, and it is easy to select the proper position on the tank for installation. The only consideration that needs to be made about the tank construction is that the wall or top must not be constructed of carbon steel, since this material would cause interference with the magnet and reed switch within the float switch. Float switches have been successfully used for both overfill and leak detection with petroleum products, gasoline, jet fuel, motor oil, kerosene, diesel fuel, and ethanol and/or methanol blends. Other successful installations have included the sensing of liquids

A suspendible/submersible float switch.

Continuous level sensors with a self-contained, compact alarm display. User can program set points.



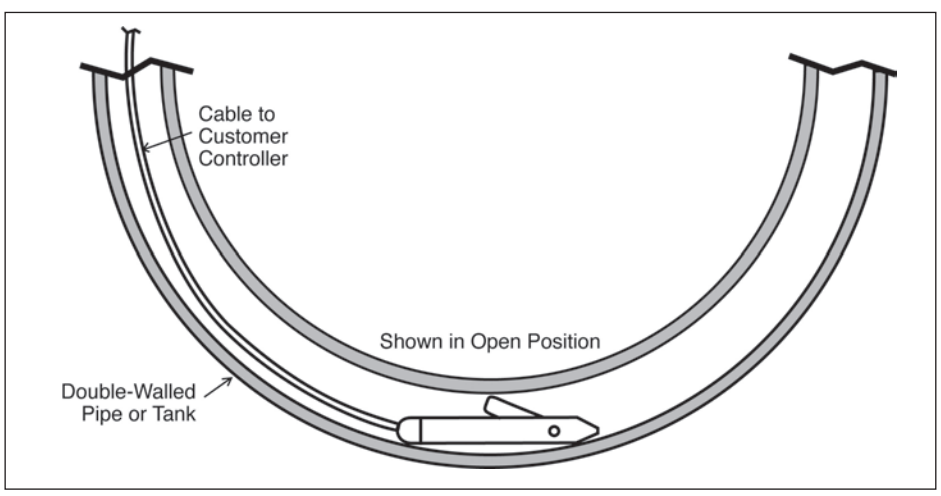
The low profile and small size of the Interstitial Switch makes it ideal for leak detection in double-walled tanks.

stored in tanks constructed of various steels that do not affect the magnetic functioning of the switches. Additional indication, such as high level and overflow level, can be achieved by the use of a vertically mounted float switch. With a multi-point signal, we can then interface to relays and pump controls to maintain the desired liquid level in the tank. The level indication for HIGH HIGH level limit (overfill alarm – stop filling), HIGH level limit (tank full), LOW level limit (reorder delivery), and LOW LOW level limit (stop dispensing) are all typical liquid level switch configurations.

Continuous level indication, at a higher cost, can also be provided with reed switch devices. If this type of level indication is required, specify a 5mm resolution. (Although grosser resolutions are available at lower cost, leak detection regulations may not allow their use.) This specification should take into consideration tank capacity, tank configuration (linear or non-linear) and the cost benefit of the material being monitored. With this type of device, logging of the tank's inventory may help in detecting leakage if the operator begins to record inventory loss between refills. This would not be considered a highly reliable method of early tank leak detection, however. A float switch can also be used to monitor the interface level between two different liquids, such as water and gasoline. This type of application requires the use of different float configurations on the switch. For example, a low signal can be obtained when the float designed for a water specific gravity (SG) is at the desired level. With the float that travels the majority of the float switch span having its SG set for gasoline, the desired level indication for the fuel will also be sent. This type of float switch is also used in oil/water separator systems.

Any tank storage system that can allow water to accumulate in the tank through loose fittings or condensation should have a water detection method installed, if the water would have a negative impact on the system or its process, A float switch installation that takes into consideration the liquid being stored and water is a low-cost way to monitor for undesirable water.

Each of these types of liquid level switch configuration can also be designed to have an integrated temperature sensor such as a thermocouple or Resistance Temperature Detector (RTD) embedded inside. This provides both liquid and temperature indication with only a single installation hole required in the tank.



Leak detection in tanks is another obvious use for reed switch technology. An interstitial float switch having a very low profile can actually be placed between the walls of double-walled tanks, at the tank bottom. Furthermore, liquid leakage between the tank walls would activate the interstitial switch's float, thereby causing a signal to indicate a leak. With this use of the float switch, an early warning can be given prior to leakage through the exterior tank wall. Such an early leak indication would help eliminate the costs associated with site cleanup and regulatory compliance.

Indication of leakage from a tank that is installed above a sump can be accomplished by suspending in the sump a liquid level switch designed for this submersible application. Leakage into the sump would activate the float switch, which would send its signal. This style of level switch can also be used in dispenser pans, double-wall tanks or other locations where the presence of liquid would indicate that a leak has occurred.

Aluminum Bottle Switch

Not as common, but also used in aboveground tank installations, are bottle switches, which are reed switch indicators housed in a metal "bottle" that is plumbed to piping that leads in and out of the tank. The liquid passing through the pipe and bottle switch provides a level indication based on the relation of the liquid in the pipe egress from the tank to the liquid passing through the bottle switch, activating the float switch housed inside.

The use of reed switch technology in each of these applications provides a highly reliable, low-cost method to send an input signal to a tank control console. With the use of a liquid level switch, both accidental spills and leaks can be indicated at an early stage, with an inexpensive remotely monitored system having a simple alarm in the wiring circuit. With its low cost compared to the more expensive continuous monitoring systems or the delayed detection of manual methods such as sticking, a redundant indication can be considered.

Retrofit projects are easy to deal with, since a float switch is adaptable to a wide variety of mounting configurations. With only minor wiring modifications and slight additional costs for an indicator and/or alarm device, such configurations can include field-replaceable designs with integrated indication and alarm points. These points can be set by the user without the need for skilled technicians. By adding a basic indicator to the level switch, a visual indication can be given when the fill point is reached, and another setting can be used as the alarm for an overfill condition. For leak detection, the same type of alarm can be set so that the first low level of liquid creating the float activation will trigger the visual (or audible) alarm, providing early warning for possible system shutdown or planned maintenance for a tank leak.

In summary, float switch technology represents a field-proven method for both tank overflow protection and leak detection. These versatile sensors, off-the-shelf or with minor modifications, provide the reliability required by government programs for virtually any aboveground or underground tank.

New Innovative Diagnostics for Early Warning of Abnormal Process or Equipment Conditions

Emerson Process Management (USA) has announced the availability of advanced diagnostics on its industry leading Rosemount 3051S Series of Instrumentation for pressure, flow and level solutions using the HART communications protocol. The ASP™ Diagnostics Suite, embedded in Emerson's scaleable, highest performing, and most reliable pressure transmitter, provides users with new tools for troubleshooting, detecting, and preventing abnormal situations.

Patented statistical process monitoring technology, integral to the transmitter, provides users with an early warning of abnormal process or equipment conditions such as plugged impulse lines, changes in fluid composition, or other events signalled by a change in the noise characteristics of the pressure signal. Early notification of these abnormal conditions will allow operators to respond immediately, reducing maintenance costs and increasing plant productivity.

The ASP Diagnostics Suite also includes time stamped variable logging and advanced process alert capabilities to detect and record transient events or conditions outside specified limits of the transmitter, key information when troubleshooting process or installation issues. All diagnostic information can be viewed on the new Enhanced EDDL-based graphical user interface, which provides an intuitive view into the process so that operators and maintenance personnel can quickly detect and respond to abnormal situations.

The Rosemount 3051S Series of Instrumentation is part of a broad range of intelligent, digital field devices from Emerson that power the PlantWeb® digital plant architecture to improve plant efficiency by 2% and more through delivering asset optimisation, process automation, and management execution.

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Pressure and Temperature Sensors in Harsh and Hazardous Areas

Georgin's (France) pressure or temperature sensors have been designed to withstand the most severe conditions such as vibration, corrosion, heavy and aggressive atmospheres. In addition, these instruments are ATEX certified with two main protection modes: flameproof EEx d or Intrinsic Safety EEx ia.

From basic 4/20 ma signal to HART® protocol instruments, Georgin offers a complete range of reliable and high performance products, giving users in the oil related industries the idealsolution for pressure and temperature products packages.

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Award for Advanced Coriolis Flow and Density Measurement Technologies

Emerson Process Management (UK), as the recipient of a 2006 Technology Leadership Award for the company's introduction and continuing development of Micro Motion® Coriolis advanced flow and density measurement technology.

Coriolis technology, ideal for a large number of gas and liquid applications, offers high accuracy measurement for a range of operating environments. While other measurement technologies may require additional pressure and temperature devices, a single Coriolis meter measures mass and density directly for improved efficiency and reliability in the process.

"Emerson's Micro Motion division has made extensive contributions in Coriolis technology development and has been awarded over 150 US patents that cover a wide range of product, technology and applications for their technology," says Frost & Sullivan Research Analyst Miriam Nagel. Since introducing the first practical Coriolis metering devices in 1977, Emerson has further developed the technology and installed over 500,000 Micro Motion Coriolis devices in a vast array of applications around the world, establishing itself as the leader in this area. Due to its accuracy and ability to measure flow and density with a single device, the impact of Coriolis technology is also great across diverse sectors where measurement accuracy is critical, such as the custody transfer of LNG, and compressed natural gas (CNG), as well as in other oil and gas industries.

"Significantly, Coriolis flow measurement technology is also being used for ethanol production and quality control due to the ability to measure alcohol concentration and flow with a single device," added Nagel. "In recognition of the company's pioneering efforts and long-standing leadership in the development of Coriolis measurement technology, Frost & Sullivan presents this Award for Technology Leadership to Emerson Process Management."

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Clamp-on Flowmeter, Approved by UK Environment Agency

UK based, **GE Sensing** (Panametrics) are pleased to announce that they are the first and only manufacturer to be awarded MCERTS Accreditation for Flow Measurement in a Closed Conduit. The Panametrics DF868 Ultrasonic Liquid Flowmeter has been independently assessed by SIRA Certification Service on behalf of the Environment Agency, and was found to fully comply with Part 3 of the MCERTS performance Standards for Continuous Water Monitoring Equipment.

MCERT approval is an Environment Agency Initiative that recognizes GE Sensing's Panametrics DF868 as fully compliant, showing GE's ongoing commitment to its ecomagination initiative. The DF868 uses non-invasive ultrasonic transducers that clamp-on to the outside of existing pipes, avoiding costly process disruption and installation downtime.

This Award further demonstrates GE Sensing's commitment to both the regulator and the Industry. Any end user who has to comply with MCERTS can be reassured that the DF868 will help ensure that they fulfill their regulatory requirements.

MCERT approval helps water authorities and other businesses comply with the EU's Integrated Pollution Prevention Control (IPPC) regulations, many of which already use the DF868, on pipes going from 50 mm to 1200 mm in diameter.

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Radar Level Transmitter gets 'Dynamic'

Vega (Switzerland) have introduced enhanced electronics versions to their standard radar level transmitters by utilising components of the high dynamic range solids level device. This is especially useful for really challenging liquids applications with ultra low reflectivity and for more difficult foaming, agitated processes. To measure solids level reliably, major technological advances have been achieved in signal processing to handle the weak return signals from low reflectivity products (e.g. plastics), uneven product surfaces and heavy dust, both of which can scatter and attenuate return signals. This is achieved with enhancements to the electronics design.

The solids radar was 1000 times more sensitive than standard radar when it came to the market. Now some of these benefits have been passed on to the standard liquids radar ensuring even more reliable measurement.

But what does increased 'dynamic range' really mean? It is the ability of the device to receive and differentiate the smallest echoes from background noise, the equivalent of literally being able to distinguish a 'pin drop from the roar of a football crowd', important for applications with weak level reflections.

As a result of these developments, the full range of market leading Vegapuls process radar transmitters has been enhanced with increases in dynamic range. However, power is nothing without control, Vega's unique 'Echofox' software ensures the correct echo is chosen and tracked securely. 2-wire loop powered radar devices are now available with ranges up to 70m, SIL conformance and ATEX approvals.

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