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Installed Costs of Automatic Tank Gauges

Technical Article

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Model MG Rigid Sensor

Model MG Flex sensor

By Lee Aiken, Product Marketing Manager of MTS Sensors

INSTALLED COSTS OF AUTOMATIC TANK GAUGES

A typical complaint of automatic tank gauge users is that they did not understand up front all of the additional costs associated with installing a specific level transmitter. The complaint centers on the lack of understanding of how the different technologies behind level transmitters work and their requirements for correct installation. Often, a correctly installed level transmitter on an existing tank or tank farm can cost more than the level transmitter itself. The installed costs of an automatic tank gauging system consist of the instrumentation costs as well as the costs of tank modifications, cabling and conduit, and auxiliary equipment. Before specifying a specific level transmitter, one should determine the installed costs of the main automatic tank gauges and weigh not only the cost and performance of the level transmitter but also the installed costs to allow the level transmitter to reach peak performance.

DIFFERENT MEASUREMENT TECHNOLOGIES

Before one can understand how selecting an automatic tank gauge affects the installed costs of the automatic tank gauging system, one should understand how the technologies behind automatic tank gauging work and the inherent features of these technologies. An automatic tank gauging system typically consists of the measurement of the product level, interface level, and temperature to allow for temperature compensated inventory monitoring. The three main level technologies for automatic tank gauging (ATG) in aboveground storage tanks are magnetostriction (Figure 1), radar (Figure 2), and servo (Figure 3). There are several manufacturers of these technologies but some are designed for automatic tank gauging and some are designed for smaller general process tanks. Examples of each technologies' manufacturers are MTS Sensors, Rosemount, and Enraf, respectively.

Magnetostriction is probably the least recognized out of the three technologies due to the fact that there are fewer manufacturers in the marketplace. Despite the lack of recognition, magnetostriction has several distinct features that allow it to be competitive.

A magnetostrictive level transmitter consists of electronics, a housing unit, a flexible hose that extends from the top of the tank to the bottom, a sensing element inside of the hose, and a float. The simplest explanation of how magnetostriction works is that the electronics are able to detect the interactions of two magnetic fields. One magnetic field is generated by the permanent magnet in the float and the other is generated by the sensing element. Two distinct features of magnetostriction are the ability to detect an interface level and also to measure the temperature stratification of the tank from a single instrument. The interface level is measured by adding a specially weighted float to sink through the product and float on the interface. The temperature measurement is accomplished by adding multiple digital thermometers inside of the flexible hose. The electronics take the temperature from each thermometer and combine it with the level in the tank to determine the average temperature of only those thermometers below the product level.

Figure 1. Magnetostrictive ATG System

The feature of combining the measurement of multiple variables, such as the product and interface levels and temperature, is commonly referred to as 3-IN-1 measurement as a result of the measurement of three process variables from one instrument and tank opening.

DIFFERENT MEASUREMENT TECHNOLOGIES (Continued)

In contrast to the lack of awareness of magnetostriction, radar is the most widely known technology for automatic tank gauging. A radar level transmitter determines the liquid level in the tank by taking a time of flight measurement by sending a microwave signal and waiting for the return reflection from the liquid. Radar is available as either 'through the air' radar or guided wave radar. The difference between the two types of radar is the 'through the air' radar sends the microwaves focused by an antenna through the air to determine the liquid level whereas the guided wave radar sends the microwaves through a pipe or metal braid to help guide the path of the microwaves.

Figure 1. Radar ATG System

For large above ground storage tanks, the vast majority of technologies used is the 'through the air' radar and this technology will be referred to from henceforth as radar. The radar level transmitter is a non-contact level transmitter which has the advantage of not being in contact with the product. This has allowed radar to develop an installed base in applications with highly viscous liquids. The disadvantage of non-contact level transmitters is that additional process instruments are needed to measure the interface level and temperature.

The third level technology is the servo level transmitter. The servo level transmitter consists of a motor, spool, cable, weighted float, and electronics. The liquid level is determined by raising and lowering the float via the spooled cable. The electronics of the servo level transmitter measure the amount of cable that is being released while monitoring for change in the tension of the cable. The tension of the float on the cable will change as the float contacts and is immersed in the liquid. Once the tension changes, the electronics determine the tank level by subtracting the length of the cable from the tank height. An interface level can also be determined by the servo level transmitter through monitoring another change in tension. The servo level transmitter can also be configured with the ability to measure the density of the product in the tank. One drawback to the interface and density level measurement is that these are not continuous measurements and the measurements take between 30 to 60 minutes to perform. For applications that require interface and density measurements, the measurements are often executed during an off-peak time, such as midnight. The servo level transmitter requires an additional temperature instrument in order to achieve a temperature measurement.

TANK MODIFICATION COSTS

Tank modification costs should also be considered when installing an automatic tank gauge on an existing tank. Most existing tanks are not designed to accommodate all of the necessary equipment used for automatic tank gauging and thus need to be modified. The mounting requirements for the different level technologies are dependent on the structure of an existing tank and can require no or several tank modifications. Selecting the level technology that best fits the tank can save thousands of dollars in installed costs. The costs of tank modifications can be broken down into the costs for tank openings and the cost for stilling wells. The costs of tank modifications increase with every additional opening requirement for the tank.

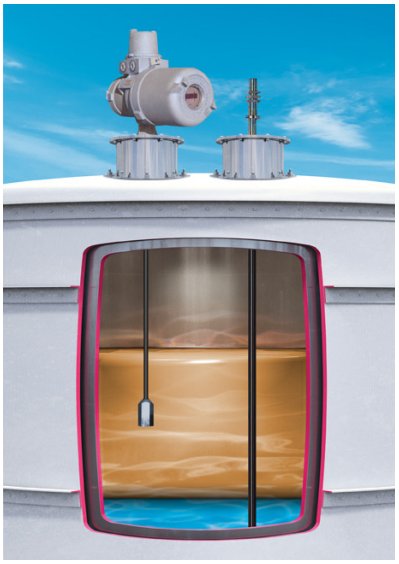

Figure 2. Servo ATG System

Additional openings are required when the automatic tank gauge does not provide all of the necessary process variable measurements and for manual gauging/sampling. Magnetostriction level transmitters do not require any additional tank openings due to the 3-IN-1 measurement capabilities. Radar level transmitters require two additional tank openings for the interface measurement and temperature measurement. Servo level transmitters require one additional tank opening for the temperature measurement. As a result, magnetostrictive level transmitters have an inherent advantage due to only requiring a single tank opening.

The second part of tank modification is the requirement for stilling wells. All three level technologies should be installed in a slotted stilling well for the most accurate level measurement. However, depending on the details of the application, some level technologies can be installed without the need for a stilling well, allowing for lower installed costs. In addition, stilling wells are typically required to allow the additional interface and temperature measurement instrumentation to perform correctly. The best course of action is to consult the specific manufacturer about the details of the application and if a stilling well is required for their automatic tank gauge. Once all of the information is gathered, an informed decision can be made about which level technology will have a lower installed cost.

CABLE AND CONDUIT

Cable and conduit choices are often mistakenly considered to be the same for all level technologies and not included in the estimated installed cost of automatic tank gauges. Cabling costs are composed of the actual costs of the cable and the amount of cable needed. To determine the costs of the cable simply access the installation manual for the manufacturer's cable specification. Some level transmitters require separate power and communication cables or very specific requirements. Even if the level transmitters are specified with the same output protocol that does not equate to having the same cable requirements or cost. A slight change in cable requirements can cause a significant change in price.

The wiring topology will also affect the overall cost of the cable and conduit. For analog outputs, the wiring needs to be a direct connection between the level transmitter and the host system. For bus networks, the wiring can share cabling and reduce the amount of cable needed, although using the same bus network will not necessarily have the same topology requirements. Some level technologies require individual power cables but will share the communication cable. All of these differences should be examined and determined if there are any significant cost differences in the level technologies.

AUXILIARY EQUIPMENT

Auxiliary equipment is the most overlooked installed cost of an automatic tank gauging system because the end user does not always know it is needed and the costs can be lost in the quote. The best way to determine the additional costs of auxiliary equipment is to have a site survey performed and an official quote from the manufacturer with line item detail. The manufacturer can go over the quote in detail to explain what the equipment is used for and why it is necessary. A few examples of auxiliary equipment are heaters for cold weather applications, protocol converters for proprietary protocols, specialty tools for service or installation, and licensed software. These are just a few examples of auxiliary equipment that is not always clearly defined as needed but increases the installed costs of the automatic tank gauge system.

TOTAL INSTALLED COSTS

Without understanding the impact of installed costs, projects often run the risk of exceeding their budget. Tank modifications, cables and conduits, and auxiliary equipment have been identified as key areas where installed costs can be hidden. Studying these areas of installed costs will help with determining which level technology best suits an existing tank. In most situations that require fitting existing tanks, magnetostrictive level transmitters have the lowest installed cost followed by radar and lastly by servo. The main difference is the ability of magnetostrictive level transmitters to measure the product level, interface level, and temperature from a single tank opening. When specifying a level transmitter for automatic tank gauging, talk to the manufacturer to determine the installed costs of the automatic tank gauge on a specific tank or tank farm and make an informed decision on the installed costs of the system and not just the specifications of the level transmitter.

ABOUT MTS SENSORS:

MTS Sensors, a division of MTS Systems Corp., is the global leader in the development and production of magnetostrictive linear-position and liquid-level sensors.

MTS Sensors Division is continually developing new ways to apply Temposonics® magnetostrictive sensing technology to solve critical applications in a variety of markets worldwide. With facilities in the U.S., Germany, Japan, and China, MTS Sensors Division is an ISO 9001-2008 certified supplier committed to providing customers with innovative sensing products that deliver reliable position sensing solutions.

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MTS® SENSORS

MTS Systems Corporation
Sensors Division

3001 Sheldon Drive
Cary, North Carolina
27513, USA
Tel.: +1-800-633-7609
Fax: +1-919-677-2343
+1-800-498-4442
e-mail: sensorsinfo@mts.com
http://www.mtssensors.com

MTS Sensor Technologie
GmbH & Co. KG

Auf dem Schüffel 9
D - 58513 Lüdenscheid, Germany
Tel.: +49-2351-9587-0
Fax: +49-2351-56491
e-mail: info@mtssensor.de
http://www.mtssensor.de

MTS Sensors Technology
Corporation

737 Aihara-cho, Machida-shi
Tokyo 194-0211, Japan
Tel.: +81-42-775-3838
Fax: +81-42-775-5516
e-mail: info@mtssensor.co.jp
http://www.mtssensor.co.jp