

Gauging Systems Inc.

“Innovation in Liquid Level / Mass Tank Gauging”

“MTG – Question of accuracy”

The MTG “Multi-function Tank Gauge” is the most accurate tank gauge for volume measurement.

Why focus on Volume and Not Level

In the petrochemical industry, Shareholders, CEO's, CFO's, management, etc. are all concerned with net liquid assets, i.e., volume. The net worth of any company is in part based upon the inventory and the protection of company assets. In the oil and petrochemical industry this means accurate liquid measurement and loss control procedures.

Within the petrochemical industry there are standards for determining volume of petroleum products by automatic tank gauging. The two organizations most common referred too for volume standards are the American Petroleum Institute (API) and International Standards Organization (ISO).

Both API and ISO organizations agree in principle with two methods for volume by automatic tank gauging:

1. Hybrid method; consists of the measurement of Level, Temperature, Density, and Water. Both API and ISO standards recognize the need and effect of temperature, density, and water on volume; API standard 3.6 and ISO standard 15169.
2. Hydrostatic method; consists of the measurement of mass and density. API standard 16.2 and ISO standard 11223-1.

Common Myth: API 3.1B is NOT a volumetric standard. It is a standard for measuring level accuracy and can be used within the Hybrid method for calculation of Volume, provided all other measurements (Temperature, Density, and Water) meet the same accuracy within their own standards.

API 3.6 is a method of using multiple measurements to achieve volume measurement. It is of course a broader and more systematic standard, but it DOES NOT replace the 3.1B level standard. A common mistake is that people associate 3.1B standard with volume, or think that if they measure level to custody transfer accuracy referred to within API 3.1B they have a good volume, which is not necessarily true.

What is MTG technology?

MTG “Multi-function Tank Gauge” is both a hybrid and hydrostatic tank gauge. MTG meets API custody transfer accuracy for both Hybrid and Hydrostatic measurement.

The MTG provides mass, level, multi-point spot temperature, multi-strata density, free water, entrained water, vapor pressure, atmospheric pressure, vapor temperature, atmospheric temperature, and optional leak detection / tank tightness testing from a single instrument.

Accuracy and loss control are based on Volume and not a Level mindset.

MTG meets API, ISO, GOST, and OIML standards for metrology certifications for volume (Hydrostatic) measurement. MTG also provides API custody transfer accuracy for Level, Temperature, and Density for operational needs.

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However, other manufacturers (Radar, Servo, Magnetostrictive, and even Hydrostatic) sell tank gauging equipment based upon claims of 1mm or 0.5mm level accuracy.

First, Level alone doesn't meet API or ISO standards for volume measurement.

Second, how do these manufacturers meet the stated accuracy for level; in a laboratory within a stagnant water tank or within an active petroleum storage tank?

In metrology, you compare an instrument to a known measurement that is usually 3 to 5 times as accurate as the instrument being tested. In the case of level measurement within petroleum storage tanks; what test instrument is capable of level measurement to between 0.33mm to 0.20mm accuracy within an active petroleum storage tank?

Is the equipment purchased the same equipment that was tested and certified (displacer size and weight, gauge mounting, etc.)? If not, is this clearly stated to the purchaser?

Third, even if the level accuracy matches the manufactures claims, do the temperature, density, and water measurement meet API / ISO standards for custody transfer accuracy? Have these instruments been tested and certified individually, and as a system?

Changes in volume can be more greatly influenced by temperature, density, or water measurement than a slight difference in level measurement. However, the use of level instruments with a temperature measurement device utilizing class B, three wire RTDs, or Thermistors; density measurement from a displacer or from one or two DP cells mounted on the side of the tank; water measurement from a float, displacer, or capacitance device; doesn't achieve accurate volume measurement or loss control.

Forth, Reference Point of Measurement (calibration and verification)

API (3.1A) and ISO use manual hand lines and sampling as a comparative method for troubleshooting or verifying the accuracy of the automatic tank gauge. The main question for hybrid accuracy and loss control is how do you correct (or calibrate) for level, temperature, density, and water readings from different locations within the tank (or secondary stand pipes) versus manual readings and samples from the gauge well.

One Hydrostatic gauge makes the claim of a magnetic coupling to the datum plate. Since the manual hand line can no longer use the datum plate, how do you test the automatic tank gauge accuracy against a manual hand line & sample for accuracy or repeatability?

The MTG can be installed within the gauge well with enough room for manual hand lines and sampling, thus, providing a direct comparison between the MTG (automatic tank gauge) and manual measurement of level, temperature, density, and water from the same reference point. Regardless of slotted or non slotted gauge pipes and well surface covers.

MTG is the only automatic tank gauge when used within the gauge well that provides a direct comparison (of all Hybrid and Hydrostatic data variables) for volume accuracy, i.e., Inventory & Loss Control.

Fifth, a limited amount of data also affects volumetric measurement accuracy and loss control. Most Hybrid level systems supply only average density, free water, with no measurement of atmospheric pressure and temperature, etc. Accurate measurement of multi-strata density, free water, entrained water, atmospheric pressure, and atmospheric temperature increases the accuracy of the volume measurement.

White Paper
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Sixth, we can discuss the pros and cons of hybrid vs. hydrostatic measurement accuracy; the number of measured variables, assigned error, etc.

However, to ease this discussion, we will make a comparison on the cost of ownership of MTG vs. other hybrid or hydrostatic methods of measuring volume.

Cost Comparison

The cost of ownership should include: cost of equipment, tank infrastructure modifications, electrical & conduit costs, installation, integration, training, and maintenance. In the equipment can be installed in service or if it requires the tank to be emptied, gas freed, and cleaned to install additional infrastructure or the tank gauging equipment. If the tank is taken out of service, the loss of storage capacity for how long, and at what cost?

Cost of equipment:

Includes all instruments required for volume calculation by either Hybrid or Hydrostatic method. In most cases this means multiple instruments, however, with MTG in means only one instrument.

Cost of tank infrastructure:

MTG requires only one top entry flange (3” or larger) for all measurements. No hot taps or structural tank modifications.

Note: The MTG can be installed in service within the existing gauge well (preferred) or without a gauge well, stilling well, or stand pipe.

Note: Measurement errors can occur when using two separate gauge wells, one for manual and one for automatic tank gauging (Errors that can occur include: a different measurement /sampling reference points between automatic tank gauge and manual measurement; Differences between gauge wells, slotted or non slotted construction, size and flow through; Differences in bottom reference point because of the physical mounting of gauge well to the tank, thickness of floor plating in each gauge well location; etc.)

For custody transfer accuracy, level instruments need a gauge well or stilling well to eliminate reference point movement of the tank roof and shell. They also reduce agitation or product movement that can effect level measurement. Note: If a level instrument is mounted on the gauge well, additional structural hardware is usually required to allow the use of the gauge well for both automatic and manual measurements.

Volume measurement in accordance with API or ISO standards for Hybrid method, would require a flange for the Level instrument, with additional flanges (and possible hot work) for a temperature sensor, pressure sensors (average density), and capacitance device (water).

Cost of Electrical & Conduit:

The MTG is I.S. certified and requires only one electrical connection for both signal and power. Most Radar’s require separate wire and conduit for power and signal and are not I.S. certified. Note: Additional wire and conduit runs are needed for each instrument for

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Hybrid (volume) measurement, i.e., temperature probe, pressure transducers, water measurement, and integration device (in some manufacturer’s topologies).

Cost of Integration:

MTG uses industry standards - IEEE RS 485 Electrical and MODBUS RTU protocol. All data variables are accessible from the MTG, i.e., one protocol, one electrical standard.

Dependent upon manufacturer, multiple devices are needed to collect all data from instruments. Each device may or may not communicate using the same electrical standard or communications protocol. If not, then some sort of communications device will be needed to translate.

Cost of Installation:

MTG is one instrument, taking two men approximately four hours to install, add a half hour for terminations, and one hour for initial calibration by trained personnel.

The installation time required for other Hybrid Systems include: the physical installation time, time for terminations, time for calibration, and time for integration of a Level, Temperature, Density, and Water instruments.

Cost of Training:

MTG is a self calibrating and self diagnostic instrument. The training of personnel to do calibration and trouble shooting of multiple instruments with various levels of measurement accuracy and self sufficiency is more costly and time consuming.

Cost of Maintenance:

MTG has No Moving Parts. It consists of only one instrument, one electrical connection, and point of maintenance, making it a very reliable tank gauge technology. MTG has a longer mean time to failure after initial installation and calibration than most other automatic tank gauge technologies.

Hybrid measurement when using a level (Servo, Radar, etc.), device consists of multiple instruments, multiple electrical connections, multiple instruments to learn, multiple instruments to calibrate, and multiple points of failure.

Additional MTG features; Does your tank gauge provide the following benefits?

Overfill protection –

Since the MTG is composed of multiple sensors, by mounting the vapor sensor just above the maximum fill for the tank, you create a third overfill alarm. This is in addition to the primary gauge reading and independent secondary high level alarm.

How many gauges will indicate over pressure or under pressure (vacuum) within a tank? The MTG provides measurement of the vapor space, thus protecting against product loss, structural damage of the tank, and further endangerment.

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Leak detection –

MTG is a high accuracy mass based instrument, as such; it can sense the slightest minute change in pressure. The MTG is the most sensitive tank gauge instrument on the market for product movement, well beyond any claims by Radar, Servo, or Magnetostrictive manufacturers.

Hydrocarbon emissions –

The MTG measures both vapor pressure and vapor temperature. These two variables combined with the tank turn over (empty to fill) and other data (seal type, etc.) comprise the calculation of hydrocarbon emissions from a tank. The MTG provides real data vs. other means of calculating emissions, possibly earning PAD credits.

Entrained water and free water –

The MTG is the only tank gauge on the market that measures both free and entrained water. The measurement of free water by float, displacer, or capacitance is only relatively accurate in clean product and is of no use in emulsified product.

However, the MTG can provide both free water and entrained water (percentage of water) in the emulsion layer. On crude settling tanks this information can be used to detect suspended water and even evaluate when de-emulsifiers are required.

Quality control –

The MTG provides multi-strata density throughout the tank, thus, the ability to monitor if product is mixed and meeting specifications for packaging or shipment. MTG can be used for electrical savings, i.e., density stratification to determine when to mix and when not too.

The MTG provides multi-point spot temperature, thus, the ability to monitor for over heating and possible discoloration of product. MTG can be used for electrical savings, i.e., temperature stratification to determine when to heat tanks and when not too.

The MTG provides accurate density measurement and water (free & entrained) to determine product quality. This is useful in determining if the quality of product is the quality that you are paying for, i.e., power plants, railroads, etc.

The MTG has many operational uses beyond that of a normal tank gauging system. These all equate to economic benefits.

Is there any reason why you wouldn't use MTG Multi-function Tank Gauge?