

# Custody Transfer Accuracy Tank Gauging

**You don't buy and sell petroleum by level;  
You buy and sell petroleum by volume.**

The American Petroleum Institute, Manual of Petroleum Measurement Standards Chapter 3.1B, Second Edition June 2001 is for level (not volume). Chapter 3.6, First Edition, February 2001 – "Measurement of Liquid Hydrocarbons by Hybrid Tank Measurement Systems" is for Volume. So, why are companies still buying Tank Gauges based upon Level?

Tank Gauging technology has advanced beyond level (Servo, Radar, or Magnetostrictive) with the development of a Hybrid gauge that provides accurate volumetric inventory, as well as level, mass, temperature, density, and other parameters to custody transfer accuracy.

## **MTG provides operational benefits and Payback from a tank gauge!**

The MTG "Multi-function Tank Gauge" was designed to measure all parameters needed (Level, Mass, Multi-point spot temperature, Multi-strata density, Free and entrained water) to calculate volume to "Custody Transfer" or "Inventory" accuracy under API Standard 3.6. In fact MTG provides Custody Transfer accuracy on all measured parameters. No other single tank gauge device (Level, Mass, or Hybrid) on the market provides the data or accuracy of MTG.

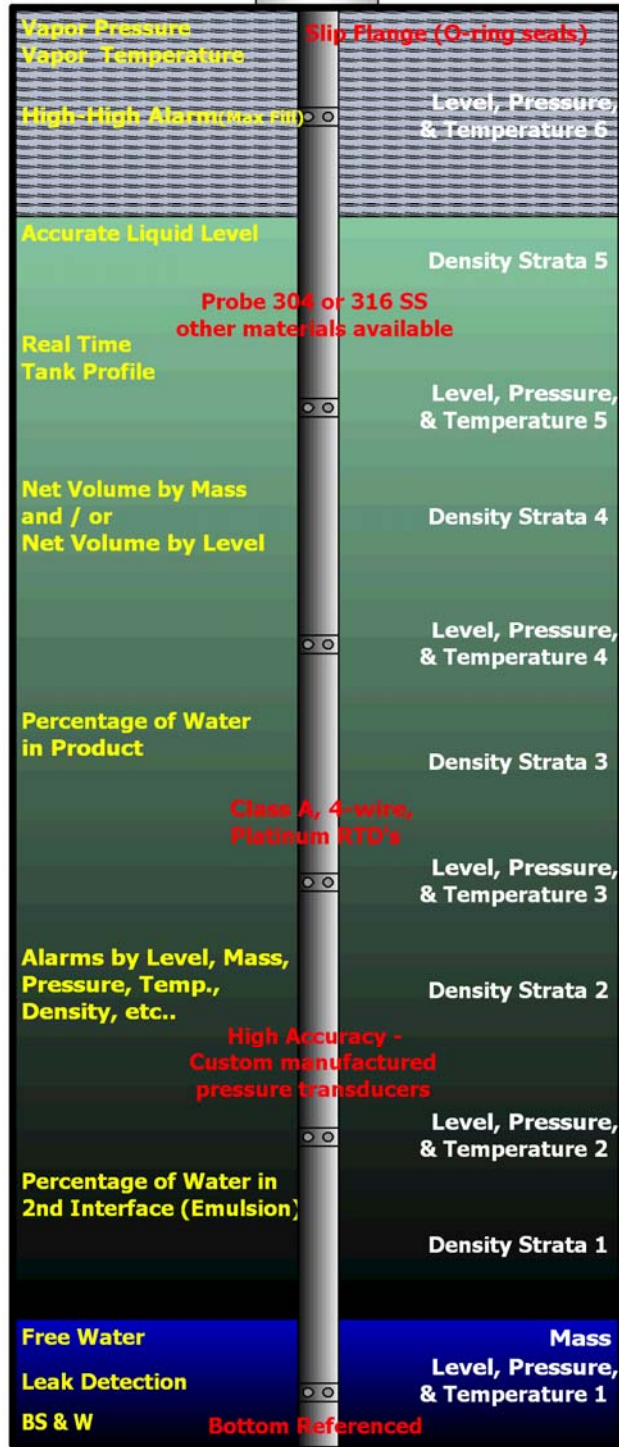
Think outside of the box for a moment. How many tank gauges can you think of that supply the following cost benefits?

- Full volume calculation (level or mass) from a single instrument. **LOSS CONTROL, INSTALLATION COST**
- Innage measurement - Bottom Referenced **LOSS CONTROL**
- Atmospheric pressure **LOSS CONTROL**
- Primary, third, and fourth alarms for overfill protection (all based on separate sensors) **ENVIRONMENTAL, LOSS CONTROL**
- Monitoring of Vapor Space
  - Pressure relief valve monitoring (Iced over or stuck relief valve? Check settings on relief valves) **ENVIRONMENTAL, LOSS CONTROL, ASSET PROTECTION**
  - Gas blanket monitoring (Leaking blanket or regulator) **ENVIRONMENTAL**
  - Hydrocarbon emission reporting (Actual vapor pressure and temperature data) **ENVIRONMENTAL, LOSS CONTROL, OPERATING COST**

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**MTG**

**Multi-Function  
Tank Gauge**



## Does your current gauge provide:

Alarm for over pressure or vacuum caused by a stuck pressure relief vent.

Monitoring of gas blanket.

Actual -  
Hydrocarbon emissions reporting.  
Loss Control.

Multiple sensors providing redundant level alarms.

Density stratification -  
When to mix product.  
Blend to specific gravity in tank.  
Quality Assurance of product (density and water content).  
Crude tanks, when to use demulsifiers.  
Prevention of slugs of water from reaching process units.

Measures both free and entrained water.  
Alarm for high water or % water above pull out pipe.

Temperature stratification -  
When to mix product.  
Alarm for overheating, discoloration of product.

All measured data for calculation of volume by either level or mass.

Custody Transfer Accuracy.

No Moving Parts. Bottom Referenced.

Self calibrating / Self diagnostic

Installs in service. Stilling well not required.

One 4" flange opening. One electrical connection for power and signal.

- o Leak detection capability (Mass sensitivity and optional hardware) **ENVIRONMENTAL, LOSS CONTROL**
  - o Temperature stratification (When to heat product or not, i.e., electric cost) **OPERATING COST**
  - o Individual spot temperature (Alarm for over or under temperature, i.e., overheating or discoloration of product) **OPERATING COST, LOSS CONTROL, PRODUCT QUALITY**
  - o Density stratification
  - o When to mix product or not, i.e., electric cost **OPERATING COST**
  - o Blend by density, i.e., lubricants, benchmark crude, etc. **OPERATING COST, PRODUCT QUALITY**
  - o Qualitative measurement of product, i.e., product deliveries to railroads, electric utilities, etc.) **PRODUCT QUALITY, OPERATING COST**
  - o Measurement of both Free and entrained (suspended) water
  - o Qualitative measurement of product, i.e., product deliveries to railroads, electric utilities, etc.) **PRODUCT QUALITY, OPERATING COST**
  - o In crude oil, when or when not to use demulsifiers. **OPERATING COST, LOSS CONTROL, PRODUCT QUALITY**
- Suspended water entering process units **ASSET PROTECTION**
- How many of these benefits could be operationally useful or save your company money?

**NOTE:**

MTG is a patented technology with I.S. approvals from UL, UL/CSA, DEMKO, PTB, and CENELEC (Gosstandard pending). Other approvals (leak detection) and metrological certifications (weights and measures) pending.





## Equipment Cost

The MTG "Multi-function Tank Gauge" is price competitive with other Custody Transfer Level Gauges and a Multi-point temperature averaging bulb & Switch. However, the MTG provides Level, Mass, Multi-point Spot temperatures or average, Multi-strata density, Free and entrained water needed for volume.

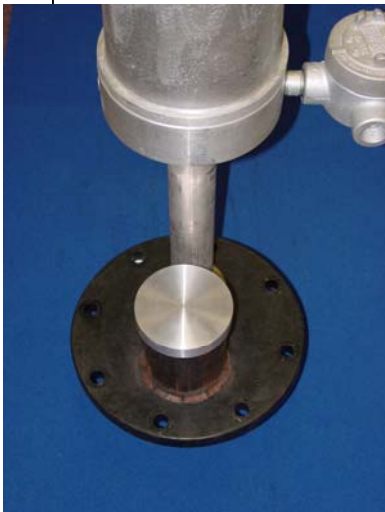
## Installation Cost

Physically, the MTG is a 2" pipe (assembled by sections) that is lowered into the tank to the bottom, through a 3" or larger flange opening. The MTG does not require a stilling well or stand pipe, it can be installed free standing in a cone roof tank. It is a single instrument, thus it requires only one electrical connection (Not multiple tank openings and electrical connections as with other level or level hybrid systems).

Installation of the MTG takes roughly 3-4 hours by a two man crew for a tank height of 50 feet. That includes the time involved in manually carrying the MTG and MTG Installation Kit (seen below) to the top of the tank. If a cherry picker or hoist is used for moving the equipment to the top of the tank, the installation time can be cut in half.

The MTG can be installed in tanks with internal floating roofs most easily through the gauge well. GSI manufactures a split flange assemble with a manual gauge/sampling hatch on one side and a spool section for mounting the MTG on the other half of a 6" or 8" flange face. You do not need to pivot the gauge or lift it out of the gauge pipe temporarily to take a manual gauge or sample.

The benefit of installing the MTG within the gauge well; you can directly compare it to manual and laboratory sample measurements (Level, Temperature, Density, and Water content) taken side by side from within the gauge well. This is unusual; most hybrid systems measure different volume parameters from different locations within the tank. Discrepancies can arise over the temperature within the gauge well vs. the temperature within the general tank structure; density sample from the gauge well vs. the measured density of the product from a pressure transducer mounted on the tank shell; Free and entrained water measured within the gauge well vs. Water bottom measured by a float or capacitance device mounted from a roof opening or tank shell opening. The MTG provides a direct comparison to reference samples and measurements. No other gauge on the market can provide a direct comparison of all manually measured parameters



at the same referenced point (Gauge well).

## Maintenance Cost

The MTG has NO MOVING PARTS, it is Intrinsically Safe, Self calibrating (after initial calibration), and Self diagnostic. The transmitter card consists of two PC boards that are tied together by polarized ribbon cable connector. One PC board contains all sensor connections, while the other PC

board contains dual CPU's, precision calibration resistors, and all other electrical circuits.

During standard operation, the first MTG register sent to the host system contains the diagnostic message. It will pinpoint the location of any bad sensor, any failure by the MTG to provide raw or calculated measurements, and any communication errors. The MTG gauge provides optional registers that can be polled by the host system to monitor all sensors to the millivolt. The communications from the MTG to the E/TGI (local display) uses industry standard MODBUS RTU (GSI does not use dedicated manufacturer protocols, with the exception of integration to other manufacturers' equipment or systems). There are a number of generic MODBUS RTU diagnostic software packages, including **GSI TEST Software**, for trouble shooting communication issues.

From the E/TGI (local display) the most common topology used with MTG or integrated MTG systems is Fiber Ethernet (MODBUS TCP/IP). This topology provides electrical isolation from lightning and noise, reduces the number of tanks from a trouble shooting perspective, increases data throughput speed, allows multiple user/system access to tank gauging information (locally or remote via Intranet), and can provide remote access by Gauging Systems Inc. to do remote system maintenance (historical trending of sensors, preventative maintenance scheduling, backup of system and MTG parameters, etc.). NOTE: The GSI Win TG Pro Software can be configured for C2 security compliance.

## Summary

The **MTG** provides "Custody Transfer" accuracy for volumetric measurement and "Custody Transfer" accuracy for Level, Temperature, and Density measurement. The MTG is the only gauge on the market that is designed to measure density stratification, temperature stratification, and both free & entrained water.

The capabilities of the MTG do have a direct payback when utilized beyond just the tank gauging functions it provides. The MTG is equally priced with other "Custody Transfer" technologies, but supplies more data and benefits. The MTG has a lower installation and maintenance cost when compared with other "Custody Transfer" technologies. MTG has a low integration cost and is already designed for multiple communication topologies using the E/TGI, including Ethernet.

## MTG “Multi-function Tank Gauge” Product Family™

**MTG “Multi-function Tank Gauge” (GSI-3000)** – Provides Mass, Level, Multi-point spot temperature (Temperature stratification), Multi-Strata density (Density stratification), Free & Entrained Water, Vapor Pressure, Vapor Temperature, Leak Detection, etc. from four (4) to six (6) sensor sections. One tank entry, Top or Bottom referenced a single electrical connection, self calibrating and self diagnostic. Tank Heights: 8’ to 60’ (2.4m to 18.2m). Level accuracy is affected by the span between sensor sections; Mass and Volume accuracy is not affected by the span between sensor sections. MTG configurations are available for both Custody Transfer Accuracy and Inventory “Level Accuracy” (less expensive). Option: Leak detection measurement; etc.

**NEW MTG “Multi-function Tank Gauge” (GSI-3012)** – Provides Mass, Level, Multi-point spot temperature (Temperature stratification), Multi-Strata density (Density stratification), Free & Entrained Water, Vapor Pressure and Temperature, Leak Detection, etc. from four (4) to Twelve (12) sensor sections. One tank entry, Top or Bottom referenced a single electrical connection, self calibrating and has advanced self diagnostic features. Tank Heights: 8’ to 120’ (2.4m to 36.6m). Level accuracy is affected by the span between sensor sections; Mass and Volume accuracy is not affected by the span between sensor sections. MTG configurations are available for both Custody Transfer Accuracy and Inventory “Level Accuracy” (less expensive). Options: Leak detection measurement; Product in water measurement; etc.

**MTG-L “Multi-function Tank Gauge - Long”** - Provides Mass, Level, Multi-point spot temperature, Multi-Strata density, Free & Entrained Water, Vapor Pressure and Temperature, Leak Detection, etc. from twelve to thirty-six (or more) sensor sections. One tank entry, multiple transmitter cards within the transmitter enclosure, self calibrating and self diagnostic through integrated CPU solution. Tank Heights: 120’ to 265’ (36.6m to 80.8m)

**NEW MTG-H “Multi-function Tank Gauge - High Pressure”** – Provides Mass, Level, Multi-point spot temperature, Multi-Strata density, Vapor Pressure and Temperature for spherical tank applications requiring Inventory Accuracy. Tank Heights: 8’ to 120’ (2.4m to 36.6m), Pressure ranges: 50 psi to 300 psi.

**NEW MTG-S “Multi-function Tank Gauge - Sanitary”** – with or without optional wash system for food and pharmaceutical applications.

**NEW HTG/P “Hydrostatic Tank Gauge Probe” (GSI-3050)** – Provides Mass, Spot temperature, and Density. A three or four pressure transducer HTG system in a top mounted probe, using one tank opening and no hot taps.

**NEW MTP “Multi-function Tank Probe” (GSI-3025)** - MTP provides Multi-point spot temperature, Mass, Vapor and Atmospheric pressure. Designed for use with level gauges (Radar or Servo technology) to provide Temperature, Density, etc. for Volumetric Measurement Custody Transfer Accuracy (API 3.6).