CRUDE OIL GATHERING BY TRUCK METERING VERSUS MANUAL GAUGING

Class 2080

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Introduction

Normal procedures for custody transfer of oil from lease tanks requires the driver/gauger to manually gauge the producer's storage tank to determine the volume of oil in the tank and the S&W content of the oil. This procedure requires the driver to climb to the top of the tank where exposure to H2S or injury from falling from the tank is a risk.

This paper will compare the manual method of tank gauging as described in API Chapter 18, Section 1 to the use of a measurement system that is mounted on the transport truck. The truck mounted measurement system relates to a system and a method for measuring crude oil, and more particularly to a system for accurately measuring oil as it is transferred from a lease storage tank to a transport vessel.

Manual Gauging

On first arrival at the lease site, the driver must utilize precaution and monitor the area for unsafe conditions for loading. Typically the driver has a personal monitor, which will alarm if there is a high concentration of H_2S in the area. Certain leases are IDLH (Immediate Danger to Life and Health) leases where the H_2S normally is above 300 PPM and OSHA requires there to be two individuals at the lease when loading oil.

Manual samples and measurements necessary at the lease site are made from the top of the storage tank. The driver/gauger must carry the required instruments, a gauging tray, up the ladder on the side of the tank to a small platform at the thief hatch or access to the tank.

The first necessary measurement is to suspend a thermometer into the oil from the top of the tank. The thermometer should reach the midpoint of the oil and be 12 inches from the tank wall. Temperature is read at a minimum of 10 minutes for crude greater than 50API and as long as 45 minutes on crude 20-29API. This temperature reading will represent the average temperature of the entire tank, however, location of the thief hatch relative to the sun or wind may adversely affect the recorded temperature.

Two samples are taken from the tank of oil to determine the S&W content of the oil. The first sample is taken from the upper one third of the column of oil and the second should be taken at or slightly above the pipeline connection near the bottom of the tank. The greatest potential for finding high S&W is in the sample taken from near the bottom of the tank. These individual samples are later taken to a centrifuge on the truck where the average S&W content for the two samples is determined before loading the oil. Contract agreements differ on the allowable water content of the oil, but the results of this test determine if the oil is merchantable or if the oil is rejected. If rejected, the carrier normally assumes the cost associated with the time spent at the lease.

The observed gravity and the observed temperature of the oil are read with a thermo-hydrometer from the sample taken from the middle of the tank. This sample location does not address tank stratification where free water or varying temperature may affect the recorded measurements. Rain, wind or snow can make it difficult to visually read the hydrometer. Samples open to the atmosphere allow light ends to escape and may produce error in the reading. High pour point crude oils are also difficult to read with a hydrometer.

The gross volume of oil loaded is determined by calculating the difference between the opening and closing tank levels. These levels are later used with the tank strappings, or measurement of the tank dimensions, to determine the total gross volume taken from the tank. Incrustation, adhesion, and non-uniform tank bottoms are factors that need to be addressed when using level measurements to determine tank volume.

API covers these procedures in the Manual of Petroleum Measurement Standards, Chapter 18, Section 1, Measurement Procedures for Crude Oil Gathered from Small Tanks by Truck.

Truck Mounted Measurement System – Components

The purpose of a truck mounted Coriolis system is to more accurately measure a tank's contents, while minimizing the operator's exposure to the existing hazards associated with hand gauging.

The truck-mounted system is comprised of the following components:

- Coriolis flow meter and transmitter
- Air actuated 3-way 2-position divert valve
- Air eliminator
- S&W system with 12VDC solenoid, volume regulator and sample container
- 100 ohm RTD with thermo-well
- Junction box with input from overfill and outputs for emergency shutdown, sample system, and divert valve
- Cab-mounted ticket printer for customized bill of lading
- Cab-mounted flow computer with keypad for data entry and display

These components can be mounted either on the tractor or on the trailer dependent on the location of the transfer pump.

Truck Mounted Measurement System – Capabilities

The Coriolis meter measures mass (lbs.) and density. From this the gross barrels, gross standard barrels, and observed gravity can be calculated. Average temperature, average observed gravity, and average gravity at 60°F is also calculated for each load. A 10K-pulse/barrel prover output and prover connection is provided in order that the Coriolis meter can be proven by acceptable industry standards. The system can provide a shut down on weight, volume and over fill (optional input provided for over fill system). Alarms automatically stop delivery on meter malfunction. The metering system controls a sample system with a one pulse per barrel output signal to gather a 2cc sample per barrel during the load. The system monitors for air before loading and automatically stops delivery on detection of air. A low-density alarm, set at 10 degrees API for water detection, will shut down the loading process. The system provides a signal for reducing engine idle/pump speed on user-selectable percent of total weight/volume to minimize system pressure. Once the load is complete, all measurement related information will then be printed on an 8½ x11 ticket.

Truck Mounted Measurement System –Benefits

A truck mounted measurement system reduces the risk of personal injury/accidents by lowering activity around the lease area. By eliminating manual sampling, the driver does not have to climb the tank. His risk of exposure to poisonous H_2S gas is reduced. The system also protects against overfill by monitoring gross volume and diverting flow at a selectable maximum truck capacity.

There is an improvement in efficiency when using a truck mounted measurement system. The time at the lease site is reduced by approximately 30 minutes. The automated measuring system saves the time associated with climbing the tank the two times required before and after loading, the time to write the ticket, and the time to gather the samples and make the manual measurements. Flow weighted sampling has been shown to greatly reduce the number of turn downs for high water content saving the carrier the costs associated with returning to the lease and saving the producer the costs associated with chemical treatment. The load capacity can be optimized to DOT regulations by measuring and knowing the total weight allowable, thus loading the maximum possible by law and eliminating the possibility of a fine.

With the truck-mounted system, the net volume of oil is calculated from measurements of temperature and gravity, which are updated and averaged 10 times per second throughout the load. This produces a true flow weighted average and eliminates the errors known to exist when pulling samples and determining these measurements at one or two points over a typical 180 barrel load. The ability to accurately determine S&W content for the load is increased by providing a sample that is representative of the entire load and again not obtained from a limited number of points below the thief hatch. Any measurement error caused by the need to correct the gauge readings for tank incrustation or errors associated with old or inaccurate tank strappings are also eliminated. The system provides a means of proving the measurement system with industry standard field provers thus maintaining and documenting its accuracy. Load tickets are electronically printed and measurements are computer calculated reducing the errors created by visually read gauges and hand writing measurements.

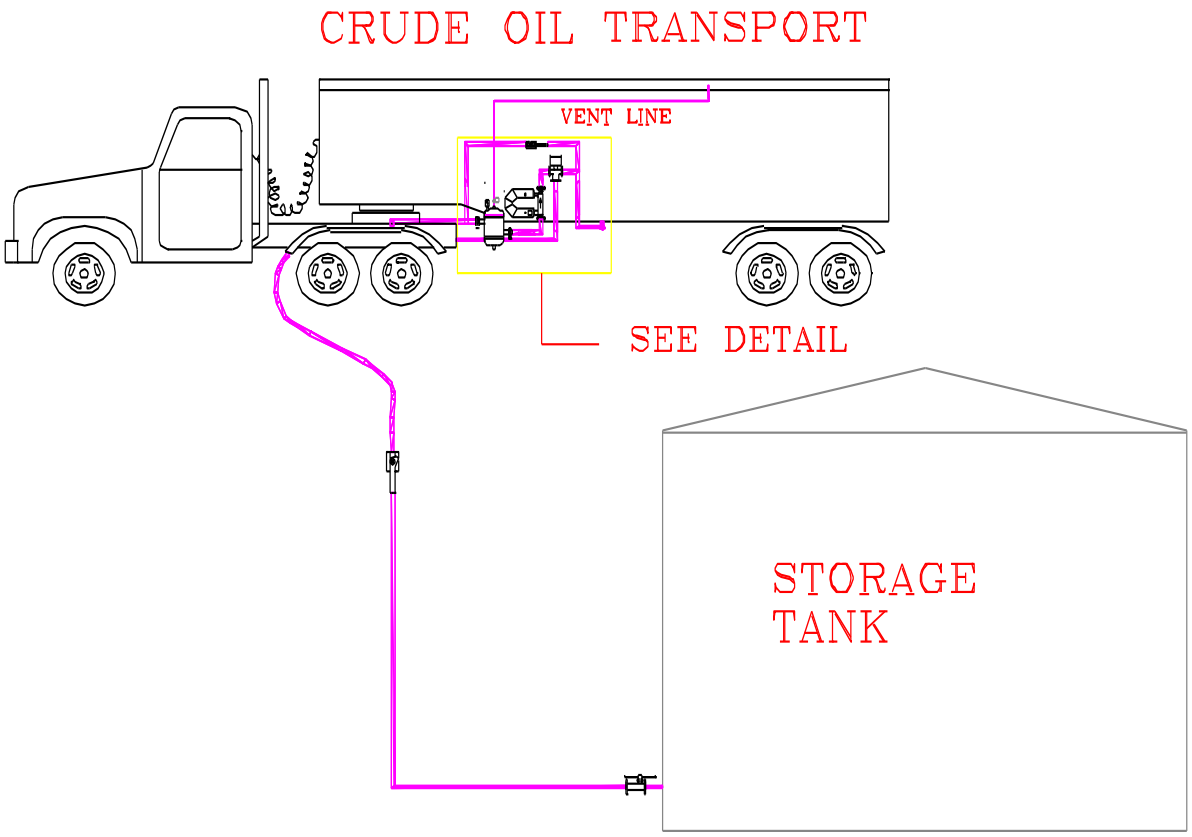

Figure 1 – Crude Oil Transport and Storage Tank

Preliminary Conclusion

Field testing indicates the system can satisfactorily replace manual hand gauging to determine the volume from a crude oil tank, virtually eliminating most measurement variables associated with manual gauging. The vision of automated measurement from crude oil tanks onto transport trucks is becoming a reality.

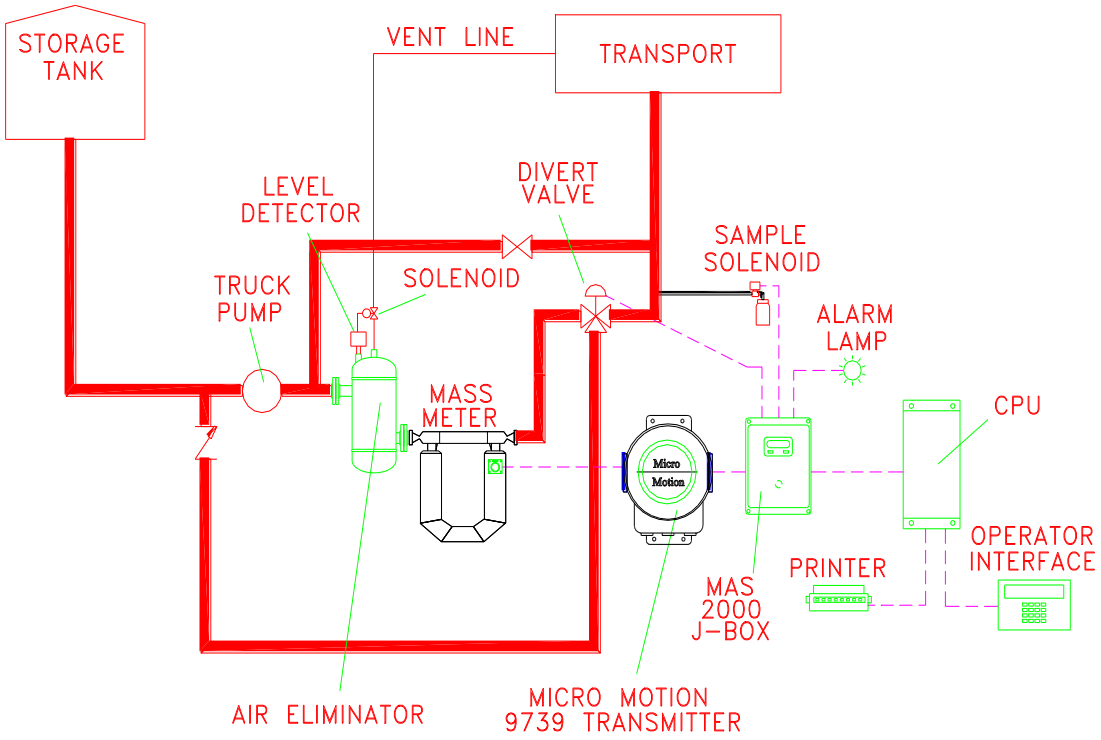

Figure 2 – Detail of Crude Oil Transport

Personal Observations and Conclusions

Previous authors of papers on this subject have done an excellent job. There are only a few remarks and conclusions that can be added, and these are derived from years of field experience.

- To add to the paragraph that addresses the benefits of the truck-mounted measurement system, measurement accuracy is not compromised while loading a truck from a tank that is still being produced into, commonly known as “buying on the fly”. This is a particular advantage to a producer who, through circumstances beyond his control, has only one tank to produce into. The truck-mounted measurement system will allow him to sell his production volumes, and have accurate measurement, without shutting in.
- To add to the paragraph that addresses meter proving, it can be stated that, in all reality, the truck-mounted measurement system is proved at every load. Modern crude transport trucks have on-board factory installed volume indication systems that are remarkably accurate, and since a driver/gauger is present at the calculation of each run ticket, the producer has the added assurance that the measurement system is indeed accurate. Years of meter provings and meticulous volume comparisons between the hand measurement method and the truck-mounted measurement system have provided conclusive data that the system can be trusted without a doubt.

- A subject that has not been addressed in previous presentations has been disadvantages of the system. To the purchaser, initial cost at first glance seems to be unacceptable, however once installed, maintenance costs are minimal, and the life span of the system seems almost infinite. At first glance, additional training to properly operate the system is a concern; however it has been shown that it is far easier to train someone to operate the meter than it is to train someone to accurately measure tank volumes using the traditional hand method. It is difficult to point to anything in particular that would be a disadvantage to the producer, other than the fact that he or his representative simply does not understand the system. This could possibly be a cause for concern in measurement accuracy. Studying the system and the accumulated data attesting to its accuracy should alleviate these concerns.

- In conclusion, the time has come for all concerned parties to accept the automated truck-mounted measurement system. It is a good thing for all.

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