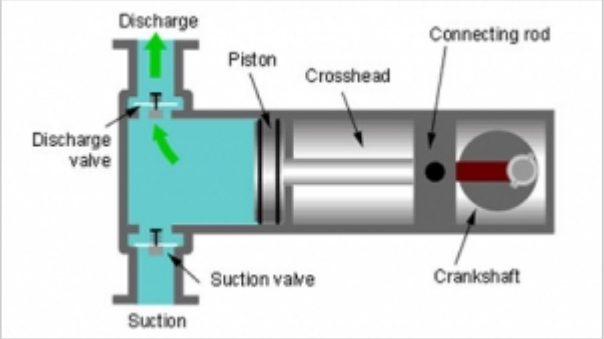
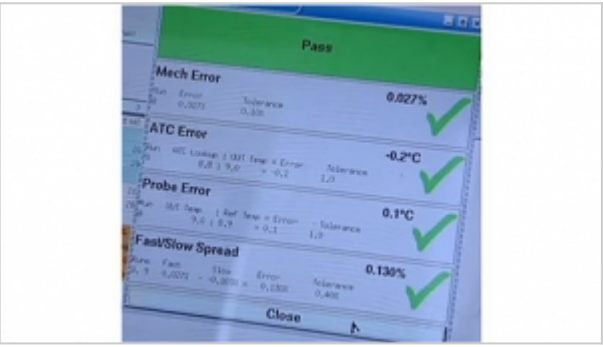
Closed Loop Electronic Calibration (CLEC) Technology eliminates cost associated to conventional fuel dispenser meter calibration

Originally storage tank integrity testing services were ordered due to inventory reconciliation problems but precision testing results would seldom provide the answers to the inventory reconciliation discrepancies.





In 1997, Cantest launched the Alarm Management Program (AMP); this service investigated inventory reconciliation problems by studying and correcting tank charts, inventory procedures, and compensating for tank deformation and tank tilt as well as evaluating product purchase vs. average fuel dispensing temperatures. The significant majority of the Alarm management report findings indicated poor meter calibration as the source of the problem resulting in meter calibration services being requested.

Often recalibration of the meters, using traditional calibration services, would not solve the problems

and further investigation was required.

This further investigation resulted in highlighting the following facts:

- Inventory reconciliation has a regulatory standard of 0.5% of fuel purchases. Fuel dispenser meter calibration standards are also at 0.5%. The problem is if you consider vapor loss associated to product storage and dispensing as well as the repeatability factor associated to fuel metering systems the actual meter calibration must be tighter than 0.25% (1/2 of the regulatory standard) just to balance fuel purchases to sales at a 0.5% standard (inventory reconciliation objective). Meter calibration at a more accurate standard is necessary.
- The North American Weights and Measures Regulatory Standard of 0.5% was originally deemed appropriate due to the perceived repeatability of fuel dispensers and the variables associated to using the open neck prover to calibrate meters in field conditions. Twenty years ago fuel dispenser manufacturers advertised the ability to repeat measurement to a 0.3% Standard. This perpetuated a belief that even with a good calibration you may still have problems reconciling to a 0.5% standard.
- Open neck provers (traditional calibration device) require significant effort, expertise and very strict procedures to detect meter wear, pulser inaccuracies, software programing errors and general meter failure. Finding meter failures responsible for inventory problems with traditional calibration services may require multiple trips to site in a trial and error scenario.

Recent Weights and Measures Studies have illustrated the following:

- Vapor loss during the open neck prover use may be as high as 0.3% (Measurement Canada Study – Product Loss During Retail Motor Fuel Dispenser Inspection – April 10, 2007)
- Open neck prover use without adequate fuel temperature stabilization may create an inaccuracy greater than the total allowable 0.5% standard. (Nebraska Weights and Measures Study - Nebraska RMFD Test Results –Variables That Effect the Accuracy of Tests – April 2006)
- Please see the following summary of measurable errors for further recognized variables associated to conventional prover use.

Summary of Measurable Errors	Volume (in mL)	Percentage
Adhesion differences due to drip time (at 15°C)	8	.04%
Initial calibration of Open Neck Prover	10	.05%
Vapor loss during Prover filling	20-60	0.1 to 0.3 %
Non-stabilized temperature effects	100	0.5 %
Human error including meniscus reading	20	.1%
Open Neck Prover shell expansion and contraction (per 1°C)	1	.005%

Table 1*: All of these errors take place each time an Open Neck Prover is used. Due to differing temperature effects some of these errors may be either a plus or minus to the final calibration. Vapor loss is always in favor of the consumer and at the cost of the dealer. (Source-http://tokheim.com/dispenser/automatic-temperature-compensation/)*

Why Meters Require Calibration

The diagram in Figure 1 illustrates the setup of a positive displacement meter, with all of its

components included. The chambers each have a piston that moves in and out, while the cam rotates along the piston rollers. This action forces the piston to release the fuel. When the dispenser level is activated, the submersible pump pressurizes the product line with gasoline which then loads the pistons with fuel that allow the camshaft to rotate. Above the meters, pulsers are mounted in the dispenser cabinet. At the camshaft, the meter rotates the pulser and counts the number of rotations. Next, a computer program can be utilized to calculate the volume of fuel dispensed in this process.

See figure 1: Positive Displacement Pump Meter

When the electronic dispensers are calibrated, the pulse count is being compared to a measured volume.

Meter cylinder walls and other components wear over time, the meter accuracy drifts from the initial calibration resulting in the dispenser giving away product until the meters are recalibrated again to correct the volume of the meter output.

Meter Drift is not consistent and will vary from site to site and even from dispenser to dispenser on the same site. The following factors affect the rate of Meter Drift:

- Volume Dispensed
- Type of Product (Viscosity and Lubricity features)
- Ethanol and Bio diesel content
- Range of Operating Temperatures
- Consistency of use.
- Operating pressures.

THE METER CALIBRATION PROBLEM

The Objective of high quality inventory reconciliation is to provide the following:

- Storage system integrity evaluations – Insuring early warning of system leaks or failures.
- Theft recognition
- Consistent operational profit evaluations.
- Insuring all product dispensed has been paid for.

For these objectives to be met, high quality, consistent meter performance and calibration is mandatory.

In today's retail fuel market place, with constantly increasing costs, the need to eliminate costs associated to the following is an absolute must:

- Product loss investigations including storage tank and dispensing integrity testing.
- Repeat meter calibration services
- Dispensing free product due to meter drift
- Lost product associated to meter component failure.

- Employee wages associated to poor inventory control results.

THE SOLUTION: Closed Loop Electronic Calibration (CLEC) SYSTEM

In 1998, Cantest Solutions Inc, and Measurement Technologies Incorporated started a joint venture to develop meter evaluation technology to eliminate the problems identified with the open neck test measure (open neck proving can). The Closed Loop Electronic Calibration (CLEC) Prover is a purpose built unit designed to eliminate all of the variables associated to traditional meter calibration. This technology has been in use for over 15 years, calibrating tens of thousands of meters every year. Cantest is the first company in the world to use a completely electronic fuel meter calibration process.

The following advantages are due to the design and procedural use of the CLEC Technology:

- The repeatability of Measurement for the CLEC system, as certified by Measurement Canada is .03%, allowing Cantest to consistently calibrate meters to a guaranteed standard of 0.1% or better. This allows The CLEC system to provide lab quality measurement in the field under all conditions. The system accuracy proves that current fuel dispensing systems actually repeat measurement on a very consistent basis to less then 0.1%.
- Elimination of Vapor loss during the Calibration Process. This may be a cost savings of up to 0.3% of all fuel sold.
- Temperature stabilization of fuel before the Calibration Process. As illustrated by the Nebraska study, this error can be greater than the total calibration standard of 0.5%.
- Continuous flow of the CLEC Technology enables temperature stabilization to a level not feasible with any other technology, enhancing the accuracy of the CLEC results.
- Elimination of human error associated to a traditional prover use including:
    - Reading of the Meniscus
    - Prover Leveling
    - Drip Time Variances
    - Consistency in run frequency. Insuring consistency in prover wetting.
    - Manual data recording errors.
- Elimination of Human Intervention as all processes are computer and sensor controlled.
- Density sensors ensure product consistency, detect phase separation, water and entrapped air (suction systems).
- Pressure and temperature sensors provide a meter leak down test, facilitating a precision meter condition evaluation illustrating meter degradation significantly before total meter failure.
- Extremely precise fast to slow flow meter volume differentials provide another source of accurate meter condition reporting.
- Automated Computer generated reporting eliminates the human error associated to manual data entry
- The CLEC system eliminates the operator strain associated to manually carrying and lifting traditional provers and the consistent exposure to harmful vapors including benzene. This

ensures that this service is an appropriate long term career choice helping provide stability to both employer and customer.
- The standard fuel meter cycles through a range of measurement referred to as its repeatability range. To mitigate effects on the meter calibration procedure the CLEC samples the range and averages the result for a more accurate calibration evaluation.

By accounting for and/or eliminating the sources of error that negatively affect traditional calibration the CLEC system provides lab quality calibration in field conditions. This high quality calibration service eliminates the unnecessary costs associated to poor traditional calibration while ensuring the retail site operator is paid for all the fuel dispensed.

The steps below describe exactly how it is done.

- Isolate the testing area, and park service truck next to pump meter to ensure easiest access to equipment.
- Use grounding hose to contain static charges.
- Use runners to protect the line from being stepped over during inspection.
- Return product to storage tank.
- Connect pump line to Cantest equipment with an inlet line.
- Start the system and wait for real time measurements to be delivered. (density, pressure, volume, temperature & flow rate)
- All results from calibration runs are sent to an onboard computer system
- System takes into account the flow rate and inserts info into the computer to evaluate the results of the meter calibration.
- All information is then revealed in a summary report, including how much product is being given away based on current condition.
- Conduct a 40 Litre run to confirm accuracy of calibration and ensure meter software is untampered at extended pulsar counts to promote consumer confidence.

See figure 2: Reading from CLEC technology after calibration test

All of the steps taken by the CLEC technology to reduce errors experienced in previous systems contribute to a monumental change in the world of meter calibration. Cantest has proven to deliver a savings amount of $0.0018 per litre and $.0068 per gallon – a minimum improvement of 0.154%. This translates into large savings for participating networks of the technology. In fact, some networks have experienced substantial Annual Volume Savings of 0.392% to 0.778% after switching to Cantest Solutions Inc. and the CLEC Prover Technology. This proves that meter calibration can help improve inventory shortages where meters are basically giving away fuel. What is imperative to understand is that without the CLEC system, proving can calibration and other methods of calibrating pump meters are causing errors and expenses that are almost impossible to avoid.

Not only does the CLEC system provide financial benefits, but this system has provided major improvements in safety, minimizing the risk of spill or injury on site. Additional corporate wide reports

are generated quarterly, providing clients with a professional, independent assessment of their site equipment with network wide trends identified. Environmental costs are reduced, safety is improved, company image can be maintained, and clients can have more control over their inventory.

Until recently dispenser manufacturers advertised that their meters were capable of repeating to a .3% standard. With today's Closed Loop Electronic Prover (CLEC) it can be shown that the same meters actually repeat to a .1% standard and that the .3% evaluation was due to the inaccuracies associated to the open neck prover being used to evaluate dispenser meters in the field. The majority of meters in Canada are now calibrated using this system.

2010 CANADA REGULATION

In 2010, the Canadian government passed a law called the 'Fairness at the Pump Act'. This act requires all fuel pumps in Canadian service stations to be calibrated at least every two years. Cantest Solutions Inc. is the only Measurement Canada Accredited service provider to offer in field recertification services to all of Canada. Accreditation is based on the ISO 9001 standard with Measurement Canada conducting annual audits to ensure compliance.

As of August 1st, 2014 the 'Fairness at the Pump Act' is in full force with fines as high as $50,000 for serious offenses. Cantest technicians are authorized to perform inspections under this new law as non-government inspectors to ensure compliance with Measurement Canada standards.

Cantest has been a registered service provider since 2010 performing thousands of inspections and re-certifications every year. With the law in full effect, Cantest requested a full Accreditation audit from Measurement Canada and was concluded to be in full conformance with Measurement Canada Accreditation standards.

Lee Krause is a managing director of Cantest Solutions Inc. and was key individual responsible for conducting all field trials of the CLEC technology during prototyping and initial deployment across Canada. He is an expert in all meter calibration technologies available in the world today and maintains involvement with the CLEC technology as well as new product development for Cantest Solutions Inc.

