Understanding Meter Calibration for Retail Fuel Dispensers

By: Patrick Jeitler, Product Manager, Wayne Fueling Systems

Over the last century, typical fuel dispensing equipment – more commonly referred to as a gas pump – has undergone tremendous evolution, turning this once simple device into a high-tech machine. Today’s dispenser can not only blend many different grades of fuels from two feedstock grades and securely process credit and debit transactions, but also interface with a variety of point-of-sale systems, connect to the internet, and play media.

Yet at its core, the fuel dispenser is a precision measuring device. It is required to accurately measure fuel to at least .005 ml/Liter dispensed while operating at flow rates up to 38 liters per minute. While there are a few ways to measure the fuel to this level of accuracy, the most common type is the piston meter. With this type of meter, measurement of flow is determined by the displacement of each cylinder, representing a known quantity. As fuel pumps through the meter the piston moves back and forth, which rotates the output shaft. The fuel flow has a direct and substantially constant relationship to the rotation of the output shaft. By connecting the output shaft to the pulser assembly, the rotary movement of the meter can be converted into electrical pulses which are counted by the dispenser’s computer.

Just like the piston rings in a car, the internal piston seals wear, and the meter loses accuracy over time. This depreciation is what is known in the industry as “meter drift”. In most cases, meter drift causes more fuel to be dispensed than is calculated – resulting in revenue loss to the retailer. While the loss per meter is relatively small, in sum and over time it may result in several thousands of dollars lost. Websites like www.stopfuelloss.com help calculate lost revenue based on several parameters.

Luckily, the meters in a fuel dispenser can be readjusted, or calibrated, to compensate for the wear and tear of the internal piston seals. Measurement Canada, the governing body responsible for developing and administering measurement standards and certifying measuring devices, currently requires a fuel dispenser to have accuracy within +/- 100 ml for every 20 liters of fuel dispensed.
Measurement Canada and its Authorized Service Providers inspect all measuring devices intended for use in trade. Inspections are performed before a device is first used in trade, and periodically during its lifetime, to ensure consumer and business confidence in the fairness and accuracy of measurement-based transactions. Inspections are part of a thorough process of measuring device evaluation, approval, and monitoring. (Measurement Canada website, February 6, 2013)

So how does meter calibration work? A certified test measure is used to validate the accuracy of the dispenser during the verification check. A test measure is essentially a rigid steel container with a graduated glass tube in which a zero mark on the tube indicates exactly 20 liters. Before calibration may begin, the technician performing the calibration must ensure the test measure is on level ground, or the reading of the graduated glass tube will be incorrect. In addition, he or she must take care not to pump too fast once the can fills, or one risks spilling a few drops of fuel requiring the procedure to be started over.

To initiate the test, the steel container has to be wet, which is accomplished by filling it with fuel and then draining the can for 20 seconds. This process ensures that the first reading is the same as all subsequent readings. Next, the service provider fills the container with fuel watching the gross and net volumes displayed on the fuel dispenser. Then he or she stops fuel flow at exactly 20 liters gross volume. The net volume displays the temperature compensated value. During the calibration test, the technician uses a calibrated temperature probe and manually calculates the net volume comparing it to the indicated net volume; thereby verifying functionality of the temperature sensor built into the dispenser.

If the test measure reads within 100 ml, the dispenser is within the acceptable standard range as determined by Measurement Canada and no further action is required. Outside of this range, recalibration is required. Each dispenser manufacturer has different procedures to adjust meter accuracy. Some companies compensate electronically while others require mechanical adjustments. During calibration, the meter must be calibrated to zero, meaning exactly 20 liters. Setting it slightly higher or lower is not allowed under Measurement Canada’s regulations. Once the meter is calibrated, the authorized service provider seals the calibration port with a lead seal.

Typically, the meter is tested at both slow- and fast-flow rates. A large disparity in accuracy between the two speeds indicates a meter that is worn beyond calibration capabilities and requires replacement.
The ideal temperature to calibrate meters is around 15 degrees Celsius. Temperature compensation calculation becomes difficult as the fuel changes temperatures while it flows from the underground storage tank into the calibration can. Extreme cold or heat can cause the metal test container to expand or contract. This causes inaccuracies, which have to be compensated mathematically. Also during the calibration test, fuel evaporation, which varies by temperature, can contribute to less than perfect measurements.

The frequency of calibrating fuel meters depends largely on the volume of fuel dispensed through the meters. Piston meters wear down and drift continuously. Measurement Canada prescribes a two-year test cycle, but many retailers choose to verify their calibration more frequently in order to curb fuel loss, and consequently revenue loss.

Newer meter designs, such as the axial flow meter, eliminate the pistons altogether. Instead, the fuel is pushed through a set of interconnected spindles with very tight clearances between the spindles and cylinder walls. Without the friction found in piston meters, the internal components are not subjected to abrasion allowing the meter to maintain its accuracy for years instead of months. Furthermore, this new axial flow technology requires 30 percent less pressure, which may yield up to a 20 percent increase in flow rate. The meter helps to reduce the time it takes for customers to fuel their cars, which means they spend less time at the pump. When turnover at the pump is faster, retailers have the ability to serve more customers. And what retailer doesn’t like to have more customers?