LPG Dispenser Calibration

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Abstract : One coin has two sides. The three Test methods have their advantages and disadvantages. In ours more than 2 years testing LPG dispenser experience, Comparing the two test methods. Master meter Test Method fit in with the gas station and producer LPG dispenser. Gravimetric Test Method fit in with lab. The reasons and the truth. Compare to the methods.

Keywords: LPG dispenser, Master meter Test Method, Gravimetric Test Method

1. Introduction

L.P.G. is Liquefied Petroleum Gas. It is gas produced by the Petroleum Industry which can be liquefied at normal tempatures by the application of moderate pressure.It is hydrocarbon which may be a pure component or a mixture of components. Generally it is considered to be Propane, Butane. L.P.Gas mixtures are heavier than air. Its advantages as a motor fuel are that is is a high calorific value fuel with good combustion characteristics and with low exhaust emissions. LP Gas (AutoGas) is already a well-proven automotive fuel. Today there are over 4 million vehicles in more than 50 countries around the world using LP Gas as automotive fuel. For just side, all commercial LPG dispensers need to be calibrated.

One coin has two sides. The three **LPG Dispenser Calibration** Test methods have their advantages and disadvantages.

a) Volumeter Master meter Test Method;
b) Massflow meter Test Method;
c) Gravimetric Test Method.

2. Volumeter Master meter Test Method

Ensue the LPG dispenser is the temperature uncompensated mode. Place oil or glycol in the thermowell of LPG dispenser and insert the thermometer. Attach the pressure gauge to the isolating valve and while cautiously opening the isolating valve, check that there is no leakage of gas. Circulate enough LPG product through the system and back to the supply tank until the temperature and pressure readings have stabilized. During this stabilizing run introduce a sample of LPG into the hydrometer pressure vessel and immediately record the pressure (Pe) of LPG in the vessel. This pressure can be used as the equilibrium vapour pressure (Pe) of LPG valid for the temperature of LPG flowing through the dispenser (T_{FD}). Check if the density displayed by the LPG dispenser is within the approved $\pm 10 kg/m^3$. Record the temperature and pressure of the product in the LPG dispenser (T_{FD} and P_{FD}) and at the master meter (Tm and Pmm). Record the indicated uncompensated volume from the master meter (Vmm) and the uncompensated volume from the LPG dispenser (V_{FD}). If the LPG dispenser allows the display of both compensated (V_{FD15}) and uncompensated volume (V_{FD}) then record both indications.Check out the conversion factors C_{tlFD} AND C_{tlMM} for the effect of temperature on LPG at the dispenser and at the master meter respectively. The SAME,

TO check out the conversion factors C_{pLFD} and C_{pLMM} for the effect of pressure on LPG at the dispenser and at the master meter respectively, too.

Calculate the converted and corrected master volume as follows:

$V_{REF}=V_{MM}\times C_{tLMM}\times C_{pLMM}\times MF_{MM}$

Calculate the converted and corrected LPG dispenser volume as follows:

$V_{FDC}=V_{FD}\times C_{tLGD}\times C_{pLFD}$

Calculate the relative error (EFD) BY comparing the converted LPG dispenser volume with the converted master meter volume as follows:

$$E_{FD}=100\times(V_{FDC}-V_{REF})/V_{REF}$$

All the above step , We may use single chip microprocessor or laptop computer to do it .

3. Massflow Master meter Test Method

The other master meter we may choice is Coriolist massflow meter. Note: universality LPG dispenser display volume (litres) ,the automobile drivers are custom with this unit. But the massflow meter result is mass (kg), when we do the test, we must ensure the massflow meter is level. we need to take a sample of LPG flowing through the meter by filling the hydrometer pressure vessel with sufficient quantity of LPG until the certified hydrometer is floating . Perform any correction and conversions to the hydrometer reading to obtain the density(kg/m^3) of LPG at 15℃; and then we may calculate the volume (litres) ,Convert the mass to volume at base conditions. Some massflow meter itself has density , temperature test. Of cause it will take more money.

4. Gravimetric Test Method

Ensure the LPG dispenser is the temperature uncompensated mode . If this is the case make the delivery in normal mode and use the appropriate switch to obtain the temperature uncompensated indication at the end of the delivery. Place oil or glycol in the thermowell of LPG dispenser and insert the thermometer. Attach the pressure gauge to the isolating valve and while cautiously opening the isolating valve, check that there is no leakage of gas. Ensure the weighing instrument is level. Check the weighing instrument using standard weights equivalent to the volume of LPG dispenser intended to be delivered. Fill and then empty the LPG test cylinder to purge the test equipment. During delivery shut the vapour return and check that pressure differential valve stops the delivery. Place the empty LPG cylinder on the weighing instrument , tare off the cylinder by using taring device or by recording the tare value. Introduce a sample of LPG into the hydrometer pressure vessel and immediately record the pressure (Pe) of LPG in the vessel. This pressure can be used as the equilibrium vapour pressure (Pe) of LPG valid for the temperature of LPG flowing through the dispenser (T_{FD}).

Note:The process should be repeated if the temperature of the LPG in the dispenser changes significantly.

Place the hydrometer pressure vessel in a cool safe place and allow it to stabilize before reading the density and temperature (t1) taking care to include the calibration correction factor for the hydrometer and the thermometer. Check if the density displayed by the LPG dispenser is within the approved ±10kg/m3 of D15. Reset the LPG dispenser to zero. Make one delivery at the maximum flowrate attainable with the nozzle fully open. Approximately half way through the delivery, record the temperature and pressure of the product in the LPG dispenser (T_{FD} and P_{FD}) and at the master meter (Tm and Pmm). If the LPG dispenser allows the display of both compensated(V_{FD15}) and uncompensated volume (V_{FD}) then record both indications.

Convert the mass (M) to volume at base conditions (V_{REF}) by dividing the mass by D15. Check out the conversion factors C_{tlFD} for the effect of temperature on LPG at the dispenser. The SAME, TO check out the conversion factors C_{plFD} for the effect of pressure on LPG at the dispenser .

Calculate the converted and corrected LPG dispenser volume to base conditions.

$V_{FDC}=V_{FD}\times C_{tlGD}\times C_{plFD}$

Calculate the meter relative error (E_{FD}) BY comparing the converted LPG dispenser volume with the converted test volume as follows:

$$E_{FD}=100\times(V_{FDC}-V_{REF})/V_{REF}$$

Note:

Ensure the LPG dispenser indicates temperature compensated volume V_{FD15} at 15 ℃;

5. Conclusion

In ours more than 2 years testing LPG dispenser experience, Comparing the two test methods. Master meter Test Method fit in with the gas station and producer LPG dispenser. Gravimetric Test Method fit in with lab.

LPG dispenser itself has vapour recycle inlet. The master meter may easy connect with it. Open the master meter nozzle and circulate product through the system and back to the supply tank until the temperature and pressure readings have stabilized.

Compare to the Master meter Test Method, the Gravimetric Test method, we need to circulate product LPG to the supply tank. It needs a pump to finish the job. The supply tank pressure is high (about 2MPa), the pump need more high pressure to let the LPG into tank. It is a hard and tough work, and it is very danger to do the job in the gas station. So Master meter Test Method fit in with the gas station and producer LPG dispenser. Gravimetric Test Method fit in with lab.