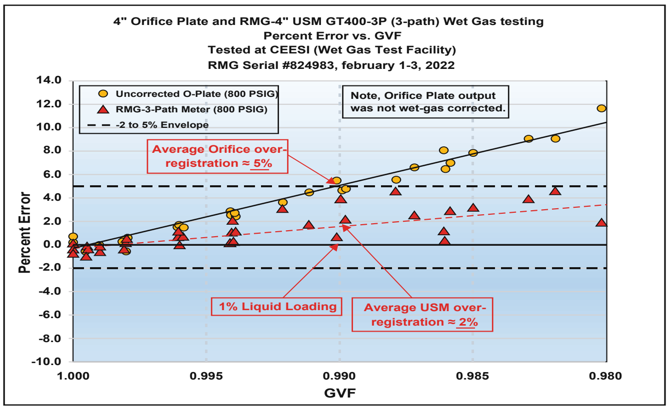
Testing Parameters

Gas pressure was approximately 800 PSIG, and the four velocities were approximately 71, 40, 20 and 10 FPS. Liquid loading went from 0% to 2% (0.980 GVF). Figure 1 (below) shows the effect on each meter's accuracy, from 0% liquid loading (1.000 GVF) to the maximum of 2% (0.980 GVF).

Results

The black solid line in Figure 1 represents a linear interpolation of the orifice meter over-registration results, and the red dotted line represents the USM's results. With a GVF of 0.99 (1% liquids), this graph shows **the orifice was over-registering by about 5%** while the **GT400-3P** only over-registered **about 2%**. At a GFV of 0.980 (2% liquids), the orifice is **over-reading by about 10%** where the **GT400-3P is less than 5%**. The GT400-3P USM diagnostics indicated the presence of liquid when the liquid loading exceeded 0.6%. Of course, the orifice meter provided no such diagnostic information.



RMG went a step further and conducted additional dry gas installation-effects testing at the TransCanada Calibrations facility.

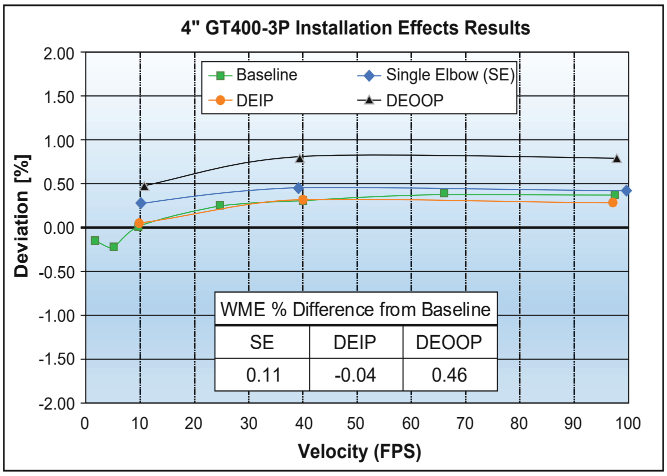
RMG's purpose with this set of tests was to demonstrate how the GT400-3P can be used in applications which dictate no flow conditioning (thus no pressure loss). RMG hired TransCanada Calibrations (TCC) to perform a series of installation effects tests to simulate a variety of "real-world" upstream piping conditions. Tests were conducted with 10 ND of SCH 80 straight piping upstream of the meter **with no flow conditioner** (two 5 ND spools).

Baseline testing was performed to obtain meter "out of the box" (as-found) data over the normal full flow-rate range of operation. Baseline velocities included 100, 70, 40, 25, 10, 5 and 1.5 FPS. Perturbation installation effects included a Single Elbow (SE), Double Elbows in-plane (DEIP) and Double Elbow out-of-plane (DEOOP) for velocities of 100, 40 and 10 PFS. Since most clients would not use a tee upstream for these applications, it was not included in the test protocol. Figures 2 thru 5 show the **RMG GT400-3P** during these four TCC tests.

Installation effects testing and calculations followed the OIML R137-1 & 2 guidelines. A Weighted Mean Error (WME) for baseline testing (Figure 2) was determined by TCC using all gas velocities. TCC also computed the WME for each of the three installation effects tests. Figure 6 (below) summarizes the WME for each of these installation effects and includes the gas velocities and corresponding errors.

Baseline		Single Elbow (SE)		DEIP		DEOOP	
Velocity	Error	Velocity	Error	Velocity	Error	Velocity	Error
97.66	0.38	99.62	0.42	97.21	0.28	97.92	0.80
40.12	0.32	39.21	0.46	40.07	0.32	39.47	0.81
9.67	0.01	10.14	0.28	9.80	0.05	10.77	0.48
WME	0.309	WME	0.422	WME	0.270	WME	0.77

Figure 6 shows the "as-found" WME to be +0.309%. Figure 7 summarizes baseline data, shown by the green line, and includes all test velocities. Also graphed are the results for each of the three perturbation tests. The table in Figure 7 indicates the difference for each perturbation test relative to baseline. The Single Elbow (SE) and DEIP WME results were within ±0.11%. The most severe DEOOP test, due to the high level of swirl from the close-coupled elbows, shows +0.46% shift relative to baseline.



RMG's GT400-3P gas ultrasonic meter was specifically designed with upstream/midstream applications in mind where liquids are often present. All tests were performed **without a flow conditioner**. Liquid-loading results showed the effect on accuracy to be less than half that of the orifice. All WME perturbation errors were less than 0.5% relative to baseline. Performance of the uncalibrated GT400-3P meter, even during the high-level (DEOOP) perturbation test, showed the total uncertainty to be less than 1%, and less than 0.5% for the Single Elbow (SE) and Double Elbow in-plane (DEIP) tests. The addition of a CPA 55E would substantially reduce these effects.

RMG, providing solutions, always evolving, to remain... One Step Ahead.