GT400 6-Path Gas Ultrasonic & Orifice Meter Wet Gas Test Results

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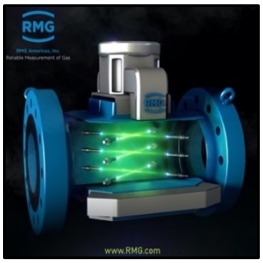
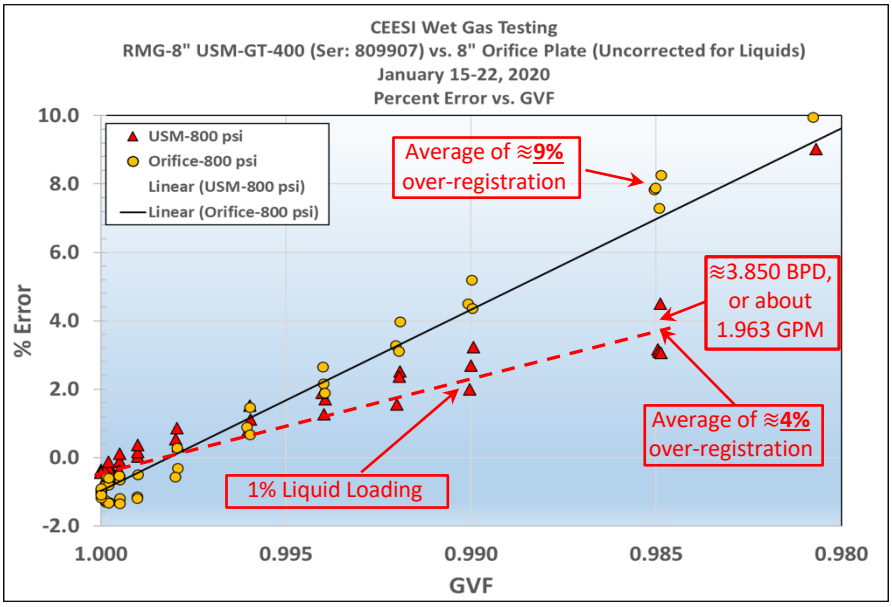


Introduction

The use of custody quality gas ultrasonic meters (USMs) in pipeline applications, where liquids may be present, has often been considered a bad application for this technology. Since there are many different USM path configurations in use today, *one should not assume poor performance by one brand translates into the same performance for all others*. To better understand how the RMG GT400 6-path USM responds to liquids, several tests were conducted in January 2020 at the CEESI Wet Gas Multiphase Test Facility in Colorado. Data included in this document was collected and processed by the CEESI staff. **During the GT400 testing, CEESI also collected data on an 8" orifice meter located downstream of the USM.** This document compares the results of the RMG GT400 6-path USM with the orifice meter.

Test Details

The purpose of these tests was three-fold. **First**, identify how much liquid the GT400 could tolerate before a path failed. **Second**, quantify the meter error at various liquid loadings the client expects to see in the "real world." **Third**, identify / verify which diagnostics changed, when they begin changing, and the extent of these changes. Test pressure was 800 PSIG. Liquid loading varied from 1.000 GVF (Gas Volume Fraction) (100% gas) to 0.990 GVF (99.0% gas) which was the client's request. Data was also collected to 0.980 GVF (98.0% gas). The liquid was Exxsol D80, which is commonly used to replicate field hydrocarbon condensates. The following graph shows the effect on each meter's accuracy, from no liquid loading (1.000 GVF) to the maximum of 0.980 GVF. The red dotted line shows the USM linearity up to 0.985 GVF. Transducer performance was 100% for all liquid loading data points in this graph. Pictures show the 8" orifice and GT400 meters. A GVF of 0.985 is similar to the



maximum liquid loading found in many shale play areas like Haynesville and Eagle Ford. This equates to about 3,850 BPD (barrels/day) at 51 FPS (81.5 MMSCFD). A GVF of 0.985 also equals 1.963 GPM (Gallons per MSCF) for all 3 velocities.

Data Analysis

Velocities for the wet as testing included 20, 40 and 51 FPS for each GVF. The previously published Tech Note 2 provides additional details. For the above graph, the red triangles represent the over-registration for the GT400, and the orange circles represent the orifice meter over-registration. The graph shows an average of about 8% over-registration for the orifice at a GVF of 0.985, but the baseline was about 1% slow which translates to about a 9% change. The GT400's over-registration was about 4% for the same GVF liquid load. Also, the USM's diagnostics were indicating the presence of liquid once the GVF was about 0.9995 (0.05% liquid content, or 0.0654 GPM). Of course, the orifice meter provided no indication that liquids were present.

Summary

The CEESI Wet Gas results above shows that, throughout the various liquid loading conditions up to 1.5% (GVF of 0.985 is about 3,850 BPD, or 1.963 GPM), the GT400 was relatively linear in over-registration. It shifted about +4% at a liquid loading of 1.5% with **all 6 paths still operating at 100% performance**. This over-registration was **significantly less than the orifice meter's approximate +9% shift in accuracy**. Several GT400 diagnostics were also reporting changes that relate to the presence of liquids. Thus, when liquids are present, **the GT400 is an excellent choice that not only measures more accurately than the orifice meter, but also clearly indicates when liquids are present.**