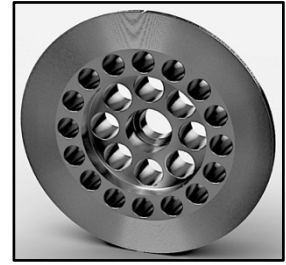


Shorter Upstream USM / CPA Piping Lengths Significantly Reduces Cost



Introduction

In North America Gas Ultrasonic Meters (USMs) have traditionally been installed with flow conditioning to reduce measurement uncertainty. Field upstream piping, that wasn't included with the flow calibration, can increase overall uncertainty. A calibrated metering package usually consists of 10D + CPA 50E + 10D and the meter. There are thousands of USMs installed with this piping combination. As technology improved, clients (both Canadian and USA) are now asking for shorter upstream



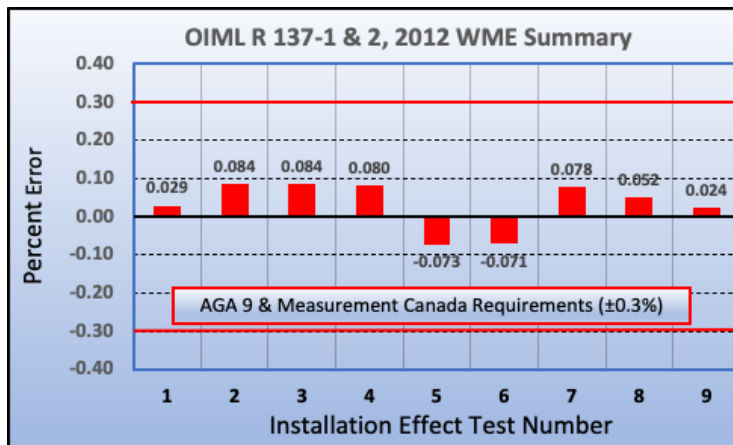
piping lengths to reduce facility costs. Measurement Canada (MC) requires meters be installed in accordance with their Document PS-G-06 [Ref. 1]. It details minimum piping lengths for use with the CPA 50E. In order to use piping shorter than their current 5D minimum, laboratory data is required to verify performance prior to approval. Recently Canada Pipeline Accessories (CPA) conducted testing at the TransCanada Calibration facility to obtain MC approval using an 8" RMG GT400 6-path USM and their newer CPA 55E (See Figure 1, Page 2) with 3D spools instead of the traditional 5D or 10D.

Test Details

An 8" RMG GT400 USM and CPA 55E were used for testing at TransCanada Calibrations (TCC). Two 24" long (3D) piping spools were supplied by TCC. The initial baseline test included about 80 diameters of straight pipe upstream before the installation effects (flow disturbance) testing. The same upstream piping baseline was repeated after installation effects to validate the meter and facility repeatability. Once the baseline was complete, 8 upstream flow disturbances were installed. Figures 2 & 3 (Page 2) represent drawings showing piping details per OIML R 137-1 & 2, 2012 Edition [Ref. 2]. The OIML test protocol is also referenced in the American Gas Association (AGA) Report No. 9, Appendix C [Ref. 3]. When a manufacturer of a flow conditioner, or USM, wants to qualify their product for AGA 9, this appendix discusses what testing is needed to meet accuracy the $\pm 0.3\%$ requirements of both AGA & MC. Four velocities, 9, 25, 40 and 98 FPS were selected to cover the flow range (Q_t to Q_{max}). TransCanada Calibration recommended these based on previous MC approval testing.

Data Analysis

In total there were eight installation effects tests, and one final baseline repeat verification. Graph 1 below shows the Weighted Mean Error (WME), as computed per the OIML document, for each of the test conditions. **No test exceeded $\pm 0.1\%$.** The two red lines at $\pm 0.3\%$ represent the error limits for both Measurement Canada and AGA Report No. 9. Table 1 below provides a description of the various piping installation effects tests. Figures 4, 5, 6 & 7 on Page 2 show the meter installed at TCC.



Graph 1 – Testing Summary

Installation Effect Description	Test No.	OIML Error (%)
Single Elbow Left Turn (LT)	1	0.029
Single Elbow Right Turn (RT)	2	0.084
Double Elbow Out of Plane RT	3	0.084
Double Elbow Out of Plane RT HMP	4	0.080
Double Elbow Out of Plane RT HMP (Dual 55E)	5	-0.073
Double Elbow Out of Plane LT HMP (Dual 55E)	6	-0.071
Double Elbow LT HMP	7	0.078
Double Elbow LT	8	0.052
Repeat Baseline	9	0.024

Table 1 – Piping Disturbance Descriptions

Summary

Testing at the TransCanada Flow Calibration facility confirms that the RMG GT400 ultrasonic meter, in conjunction with the **CPA 55E with 3D long spools** upstream and downstream, **easily meets or exceeds both Measurement Canada and AGA Report No. 9 accuracy requirements.** The calculations in the above graph and table are per the OIML R 137-1 & 2 document, Section 3.2.5. The AGA 9 document also states the following: "Since the response of an ultrasonic meter to a flow conditioner is unique to the meter/flow conditioner (specific manufacturer) combination, tests with one meter/flow conditioner combination should not be used to infer results when either component or the accompanying piping configuration is changed."

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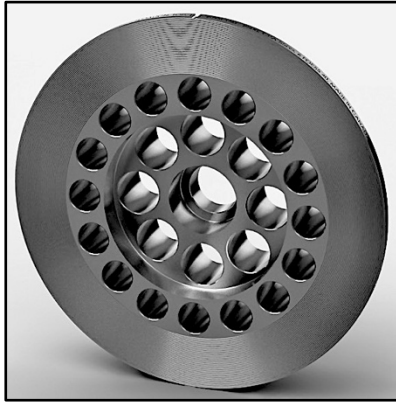


Figure 1 – CPA 55E

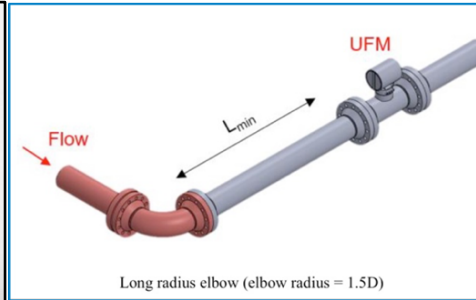


Figure 2 – OIML Disturbance

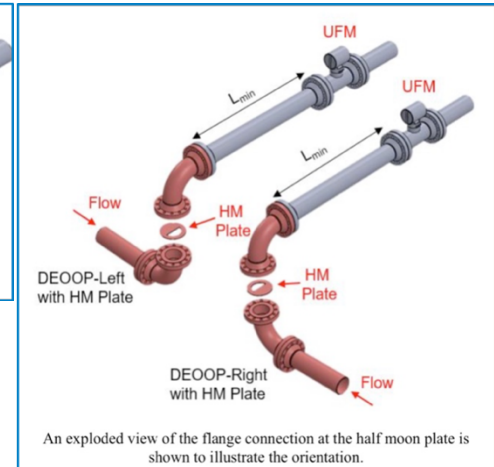


Figure 3 – OIML Disturbances

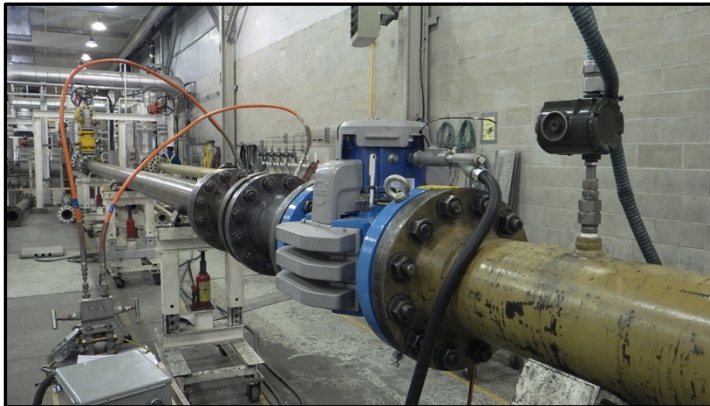


Figure 4 – OIML Baseline Testing at TCC



Figure 5 – DEOOP – Right Turn (Test 3)



Figure 6 – DEOOP – Right Turn (Test 3)

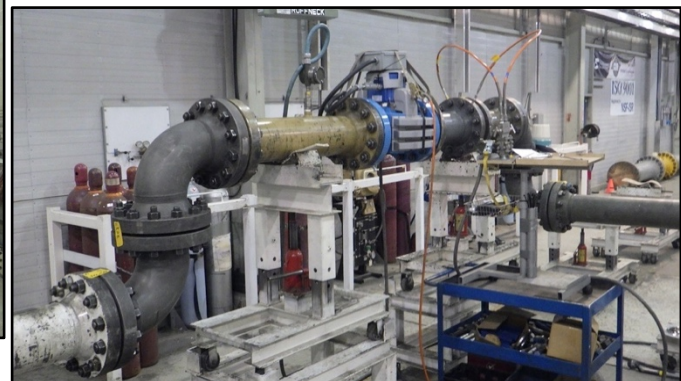


Figure 7 – DEOOP – Left Turn (Test 6)

RMG Tech Notes

Tech Note 1: RMG GT400 6-Path Gas USM Performance Summary

Tech Note 2: RMG GT400 6-Path Gas Ultrasonic Meter Wet Gas Test Summary Results

References

1. *Measurement Canada PS-G-06-Provisional specifications for the approval, verification, reverification, installation and use of ultrasonic meters, Revision 4, dated 2017-11-15.*
2. *OIML R 137-1 & 2, Edition 2012(E), Including Amendment 2014, International Organization of Legal Metrology.*
3. *AGA Report No. 9, Measurement of Gas by Multipath Ultrasonic Meters, Third Edition, July 2017, American Gas Association, Washington, DC.*