2-inch, 2 & 3 Path TrueShot USM Installation Effects Testing

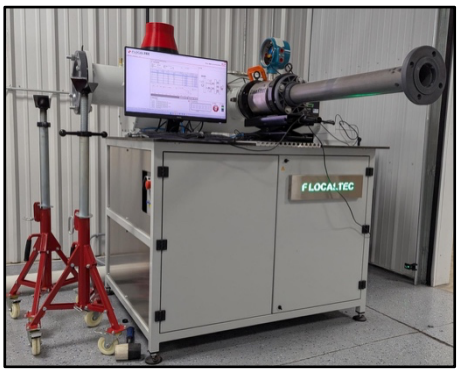
Written by John Lansing

Introduction

Ultrasonic meters today are being used in applications that traditionally have been reserved for turbine, rotary and orifice meters. This is in part due to the improved technology over the past 10+ years, and the ability to manufacture smaller meters more cost effectively. Additionally, the performance of these smaller meters, say 2" thru 4", has significantly been improved by refined machining techniques and more reliable and reproducible transducer performance.

Ultrasonic meter benefits are well known and include extreme reliability, very low maintenance, rangeability, internal diagnostics benefits, high rangeability, no damage if over-ranged or slugged with liquids, ability to operate at very low pressures (like in flare applications or replacing turbine meters in Distribution applications), and cost-effective compared to traditional primary measurement technologies just to name a few.

Clients today want to use ultrasonic technology to replace rotary meters where the inlet upstream piping lengths are often not available compared to new meter station designs. ANSI 150 turbine meters are also an application that can benefit from improved USM low pressure transducer technology and inherent large rangeability.



This Application Note discusses installation effects testing with very short (or no) upstream piping to allow retrofitting existing turbine and rotary meters where upstream piping lengths are often less than ideal. Testing was conducted at atmospheric pressure by using a rotary meter prover as a reference. This special rotary meter prover is specially designed to be pulsation free, and has for a rangeability of greater than 500-1 with uncertainties less than 0.5%. The figure to the right shows what the 38M (38,000 ACFH) prover looks like.

Testing Protocol

Testing was performed on a 2" meter configured as both a 3-path and 2-path chordal meter design. The 2-path was the same meter body, with all the transducers still installed, but with the electronics configured to only utilize the two outer paths and ignore the middle path. The reason for testing both configurations is to demonstrate the improved performance of a 3-path meter in these very small line sizes. The image in the upper right is an example of a 2" ANSI 150 3-path meter.

For this Application Note, 5 tests were conducted using a variety of installation lengths, some with and some without a CPA 55E, and only a single elbow (90 degree) to simulate what might be in the field. This would include rotary and close-coupled turbine meter applications (as shown in AGA Report No. 7), and some flare applications where there isn't the traditional upstream piping lengths available. Previous testing has shown that two elbows in plane don't yield any significant effect on the meter's performance, and two elbows out of plane (DEOOP) are not as common, so this Application Note does not include any DEOOP data [Ref 1].

Testing covered the range from 108 FPS down to 1 FPS for a total of 9 flow rates. Velocities for each test included 108, 80, 54, 30, 18, 12, 6, 3 and 1 FPS. Transducer performance (percent accepted pulses) remained at 100% for all tests. Ambient conditions were about 72 °F and atmospheric pressure was about 14.2 PSIA. The Meter Under Test (MUT) was upstream of the 38M prover. Thus "air was drawn thru the meter" before it was introduced into the prover for measurement. A variable-speed blower draws air thru the rotary meter, and is computer controlled. The following 5 tests were conducted on both 3-path and 2-path meters.

A baseline test was done with 3D + CPA 55E + 3D + MUT + 5D + Prover (see picture on the left below). The 3D piping package has been tested by CPA and is approved in Canada for fiscal measurement. One

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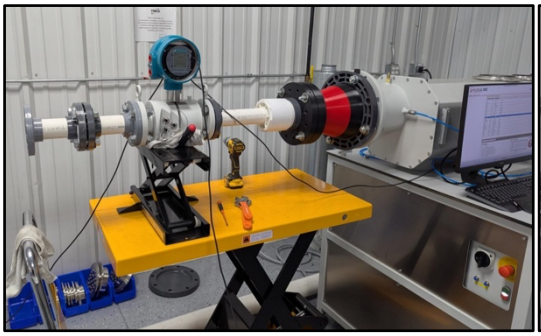
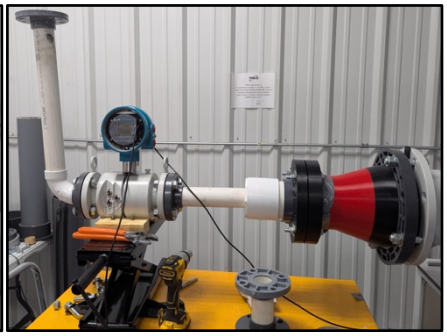
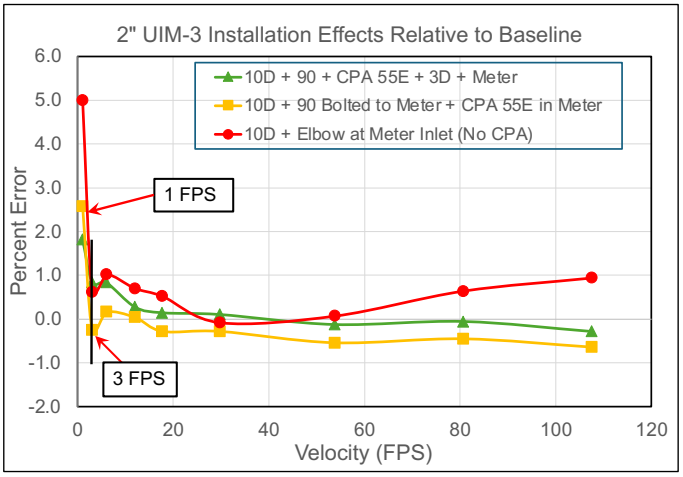
of the installation effects tests was performed with this baseline piping and included: 10D + 90^{O} + 3D +CPA 55E + 3D + MUT + 5D + Prover (not shown below). **Note:** The elbow in the middle picture below was bolted to the flange that contained the CPA 55E, so there was no 3D "settling zone" upstream. A second Baseline Test was performed with the CPA 55E inserted into the meter, with 6D upstream (6D + CPA 55E + Meter + 5D + Prover) as shown in lower left picture. This was to demonstrate the effects of an elbow bolted directly to the meter with the CPA 55E in the meter (10D + 90^{O} + CPA 55E + MUT + 5D + Prover) as shown in the lower right picture. A final test was conducted using no flow conditioner in the following configuration: 10D + 90^{O} + MUT + 5D + Prover. The following pictures show the various piping tests.

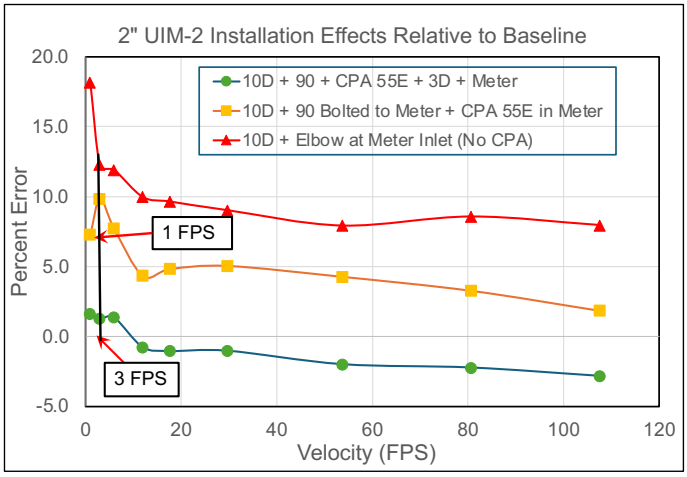




The following graphs summarize test results. The graph on the left represents the 3-path meter (UIM-3), and the graph on the right is the 2-path meter (UIM-2).



Test Results for UIM-3 (3 Path Meter)



Test Results for UIM-2 (2 Path Meter)

Summary

Summary and additional language and updated graphs will be included once I have the baseline testing with 6D in front of the meter with the CPA 55E in the meter.

References

1. *Ultrasonic Meter Installation Configuration Testing,* Terrance A Grimley, Senior Research Engineer, Southwest Research Institute, 2000 AGA Operations Conference, Denver, Colorado