API 22.3 Testing of the TrueShot™ UIM 3 Ultrasonic Meter

Written by John Lansing

Introduction

This document discusses installation effects test results for a TMCO 4" TrueShot™ UIM 3 (3-path) gas ultrasonic meter obtained from the CEESI Nunn test facility. The purpose of the testing was to qualify this meter for flare gas measurement per the requirements of API 22.3 [Ref 1]. Traditionally flares are measured using single-path insertion meters installed in larger piping. Recently smaller line sizes are now being utilized to improve lower flow flare measurement by using better technology. This is where the TrueShot meter, with its 3-path spool-piece design, can significantly reduce measurement uncertainty while providing a device that requires little, if no, maintenance. A multipath meter inherently is less affected by installation effects like elbows due to its ability to better compensate for swirl and other flow profile distortions.

Testing Details

API 22.3 requires five piping installation effects tests to meet test protocol requirements. These include a baseline test with at least 70 nominal diameters (ND) of straight piping. Results are then compared to four piping installation effects. The first basic test requires a single elbow (EIP) upstream with both a 10 ND and 20 ND separation between the meter and the elbow (two separate tests). The second basic test requires two elbows out of plane (EOP), with a 5 ND spool piece between the elbows, with the meter located at both 10 ND and 20 ND downstream of the second elbow (two separate tests). Figure 1 below is from the API 22.3 document summarizes the baseline and installation effects piping requirements.

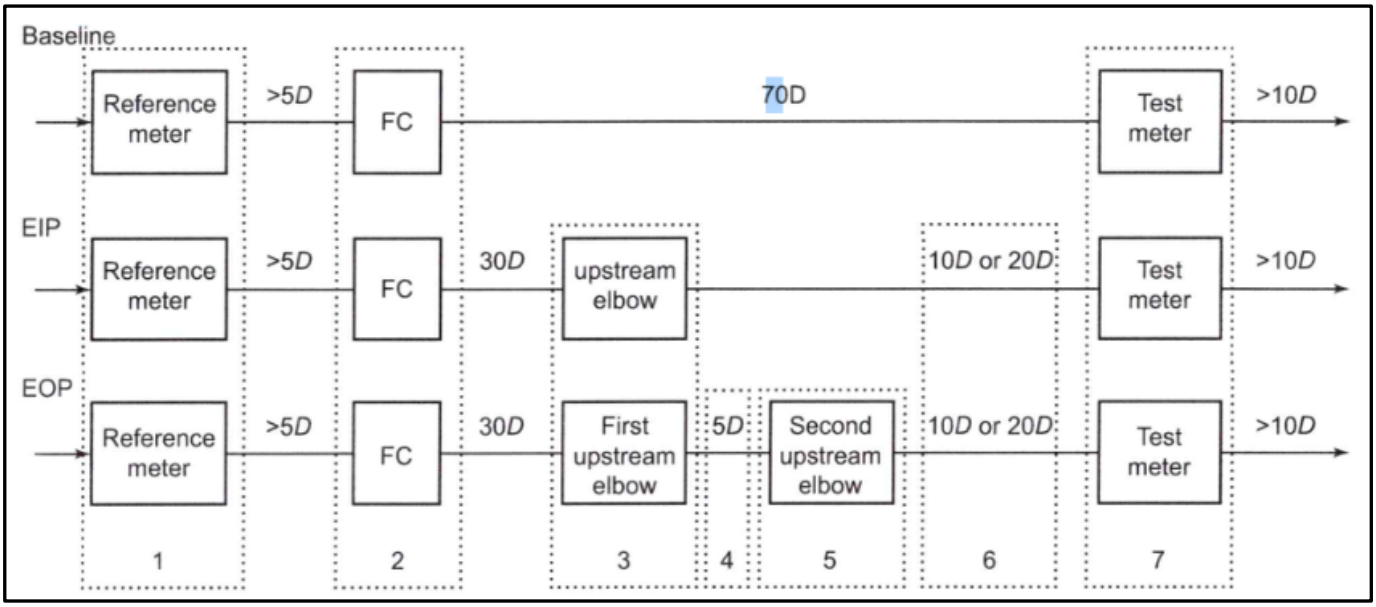

Figure 1-Test Program Piping Configuration

The requirement for the 70 ND of straight piping is to ensure the flow profile entering the meter is stable and has no swirl or asymmetry. Since this testing is done under controlled conditions, a good baseline is required to quantify what effect, if any, the single elbow and the double-elbow tests have on the meter's accuracy. To help ensure minimal thermal stratification at these low flows, testing was conducted indoors.

The meter used for these tests was an **uncalibrated** 4-inch, Schedule 40 meter with ANSI 150 flanges. Because clients are not likely to pay extra for a calibrated meter, all testing was performed with an "out of the box" meter (that is, no flow calibration adjustments). All components, including transducers, electronics, wiring, etc., are the same as installed in higher pressure ANSI 600 meters which are used for applications up to 1,480 PSIG.

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Figure 2 below is from the API 22.3 document represents the single elbow (EIP). This configuration was tested with both 10 ND and 20 ND of straight pipe between the meter and the elbow. Figure 3 represents the double out-of-plane elbows (EOP). It also was tested with 10 ND and 20 ND of piping.

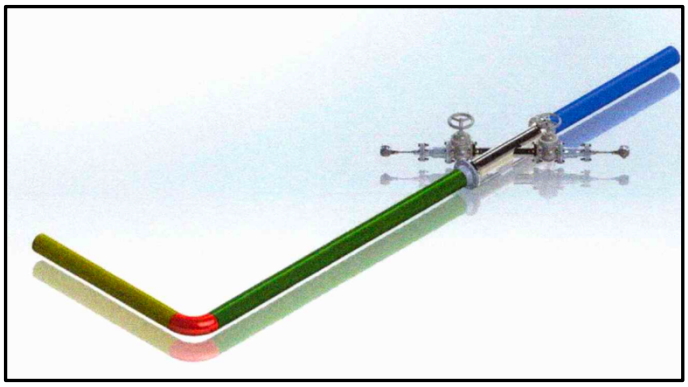

Figure 2 – Single Elbows in Plane (EIP)

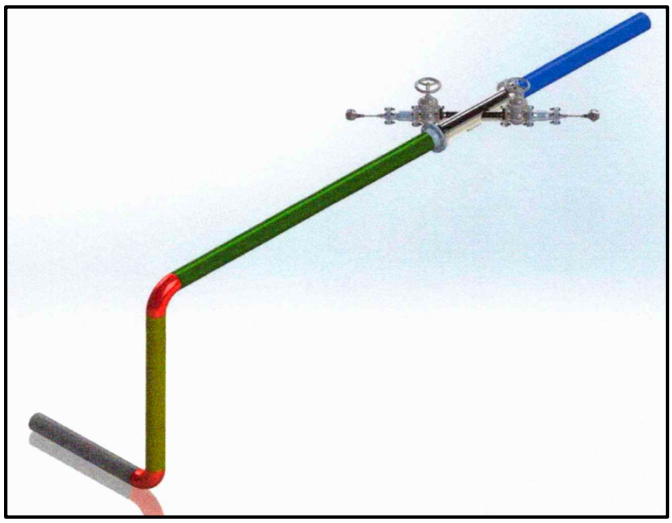

Figure 3 – Two Elbows out of Plane (EOP)

API 22.3, Section 6.7, discusses the mandatory gas velocities that must be tested. It states the following: "*The test points should cover the following velocities: 0.1, 0.5, 1, 2, 5, 10, 20, 50, 100 ft/s. Testing also requires 5 repeats for each flow rate, and a minimum of 30 seconds at each flow rate*". CEESI performed each test for 60 seconds to help reduce the measurement uncertainty. Additionally, repeat gas velocities are required. The test protocol started at 100 FPS and was completed with the 0.1 FPS testing. The following summarizes the gas velocities as tested: 100, 50, 100, 20, 10, 5, 10, 2, 1, 2, 0.5 and 0.1 FPS.

Performance Results

Test results for the 4" TrueShot UIM 3 are summarized in Figure 4 below. It documents the results for all 5 piping installation tests and 12 velocities as required by API 22.3. The meter's error was within 2% from 5 FPS up to 100 FPS.

The CEESI Nunn test facility is located at an altitude above 5,000 feet. They use a sonic nozzle array (multiple nozzles) to create stable flow for each test point. These nozzles are located upstream of the meter, and thus the meter is operating at a significantly reduced atmospheric pressure of approximately 12.2 PSIA.

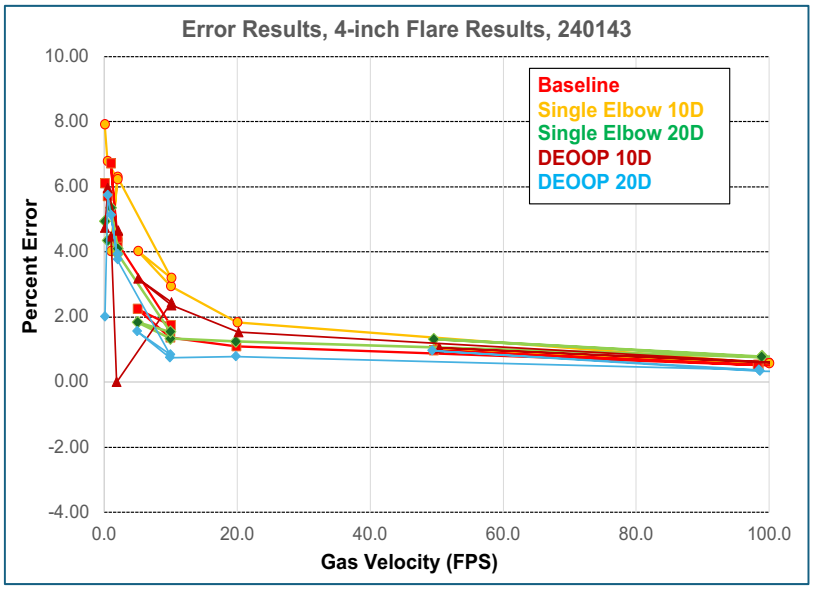

Figure 4 – Performance Results for the TrueShot 4" UIM 3

Conclusions

This **uncalibrated** 4" TrueShot UIM 3 path meter was tested from 100 FPS to 0.1 FPS representing a rangeability of 1000-1! The readings at 0.1 FPS were very stable and repeatable. Even at 0.1 FPS, the error, relative to baseline, was within 4%.

References

1. *Manual of Petroleum Measurement Standards, Chapter 22.3, Testing Protocol for Flare Gas Metering,* First Edition, August 2015.