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# Estimating Gas Ultrasonic Meter Field Error


**Randy Miller, Energy Transfer**
**Ed Hanks, CEESmaRT**
**John Lansing, CEESI**


## 1 INTRODUCTION

For nearly a decade the North American Fluid Flow Measurement Council (NAFFMC) has investigated a variety of ultrasonic meter effects on both low and high-pressure ultrasonic meters. The NAFFMC is comprised of 5-6 industry experts that request testing be performed and subsequently published at the annual CEESI Ultrasonic Conference.

During the 10+ years of the NAFFMC's existence, research has studied effects ranging from header designs, upstream piping configurations, various meter tube end-treatments, and inline filters. While this paper examines some of the history behind the NAFFMC research, much of the data used for the final analysis is not included in order to keep the paper to a manageable length. Thus this paper will summarize some of the tests, and then focus on the use of an ultrasonic meter's diagnostics to determine the health and predict the meter's uncertainty based on the diagnostic parameters.

## 2 HEADER EFFECT ON USM, T TYPE HEADER INSTALLATION

There were two NAFFMC studies performed on the installation effects of headers. The first discussed is a presentation developed by Jonatan Mustafa (Kinder Morgan) and Joel Clancy (CEESI), and presented by Reese Platzer (Enterprise Products). The research was titled "Header Effects on USM, Type Header Installation."

Due to the difficulty of transporting the headers to a test calibration facility, ultrasonic meters are commonly calibrated individually then placed on a meter skid with multiple runs. Because of this, there has been interest from the industry to test the effect of headers on ultrasonic meters. The purpose of these tests is to determine the effect a "T-type" header has on ultrasonic meter performance. Figure 2.1 shows the dimensions of the header used for this series of tests.

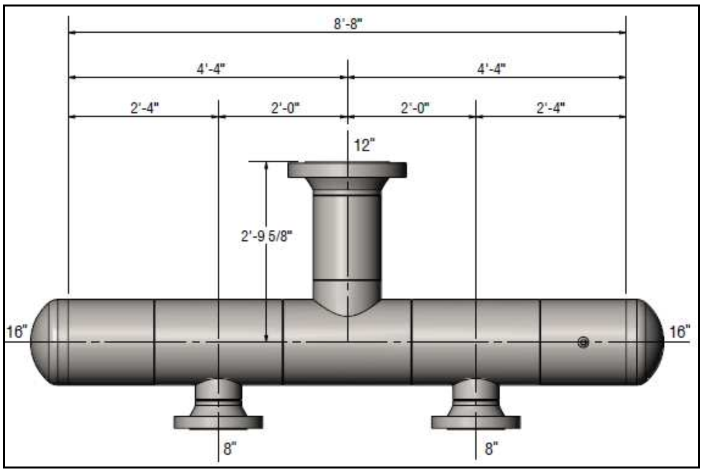


Fig. 2.1. - T-Header

Figure 2.2 shows the "Elongated Attenuating Tees (EA T's)" testing which included the following:

- Test at three flow rate points for run one at 7.5, 15 and 23 m/s (no header).
- Install both meter runs with EA Tees in the header.
- Take the same three points with just run one flowing.
- Take the same three points with both runs flowing.

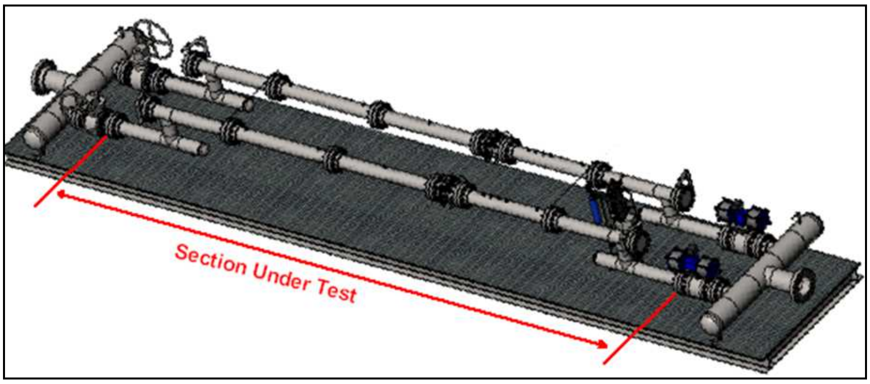


Fig. 2.2. Elongated Attenuating Tees (EA T's)

Figure 2.3 shows the "Straight Pipe Header Effect" testing which included the following:

- Test at three points for run one at 7.5, 15 and 23 m/s.
- Install both meter runs in the header (no tees).
- Take the same three points with only run one flowing.
- Take the same three points with both runs flowing.

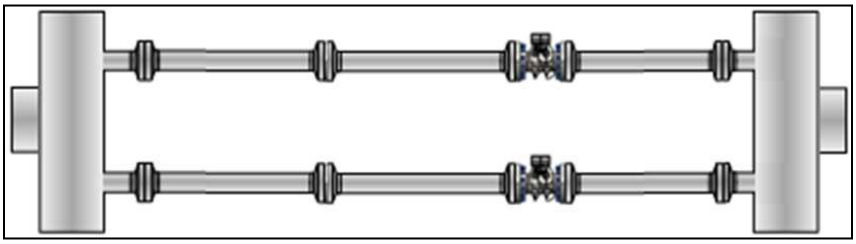

Fig. 2.3. Straight Pipe Header Effect

The final set of tests run in this series was with AGA-9 Tees with an Elbow to a Header. The piping configuration is illustrated in Figure 2.4. The tests included the following:

- Test at three points for run one at 7.5, 15 and 23 m/s (no header).
- Install both meter runs with AGA-9 tees + elbow in the header.
- Take the same three points with only run one flowing.
- Take the same three points with both runs flowing.

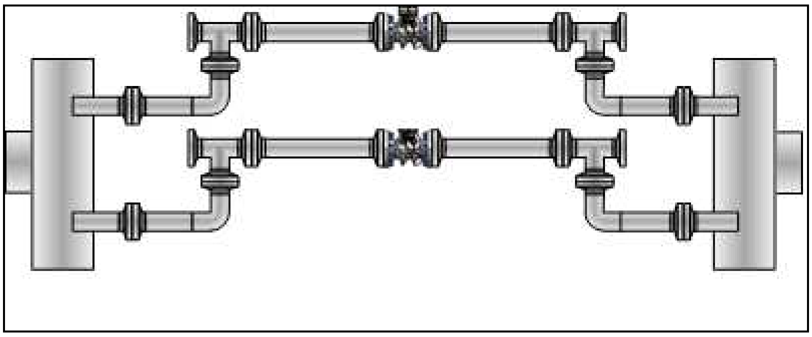

Fig. 2.4. AGA-9 Tees + Elbow Header Effect

For this series of tests, a 16-inch header and two each 8-inch SICK FLOWSIC600, Daniel SeniorSonic and Instromet Q.Sonic-Plus meters were all fitted with typical AGA 9 meter piping which consisted of 10D, CPA 50E, 10D, Meter, and 5D meter tubes. Figures 2.5 through 2.10 show the various piping configurations and meters. The straight pipe test runs were all used for the baselines. For this series of testing, results displayed are as found, (not adjusted to a baseline test run result). All tests used the same pipes.

Fig. - 2.5. Straight Pipe No Header

Fig. - 2.6. - Elongated Attenuation Tees

Fig. 2.7. - AGA 9 Tee w/Elbow

Fig. 2.8. - Parallel Runs Straight Pipe

Fig. 2.9. - Elongated Tees

Fig. - 2.10. - AGA 9 Tees W Elbows

Figure 2.11 shows the test results for the SICK meter. The test with the header and elongated tees created the most deviation from baseline in the SICK meter. Using the straight pipe data for a baseline, the shift was just over 0.1% at the 23 m/s test point, but on the order of 0.05% for the 7.5 m/s test point. Figure 2.12 shows the percent shift in profile factor for the various test runs.

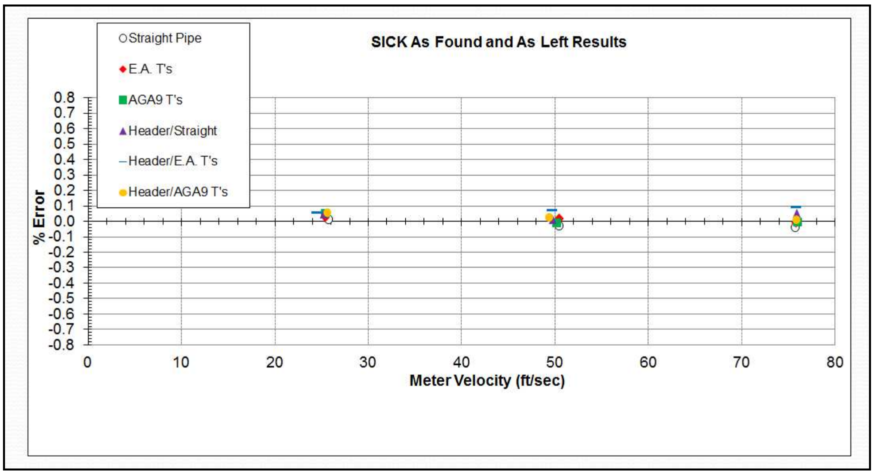


Fig. 2.11. - SICK Meter Test Results

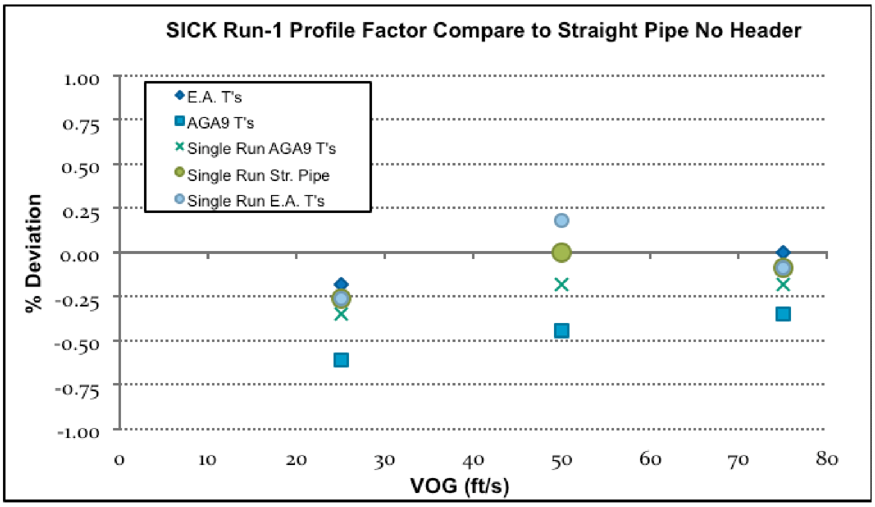


Fig. 2.12. SICK Meter Profile Factor Percent Shift

Figure 2.13 shows the test results for the Instromet meter. For the Instromet meter test, there was no significant difference between the test runs with the elongated tees and no header at 23 m/s, and the elongated tees with the header at 15 m/s. These two tests created the most measurement shift from baseline with an effect of just over 0.1%. Figure 2.14 shows the profile factor percent shift from baseline. The profile factor shifts were minimal but the elongated tee with a header test runs had the greatest profile factor shift around 0.5%

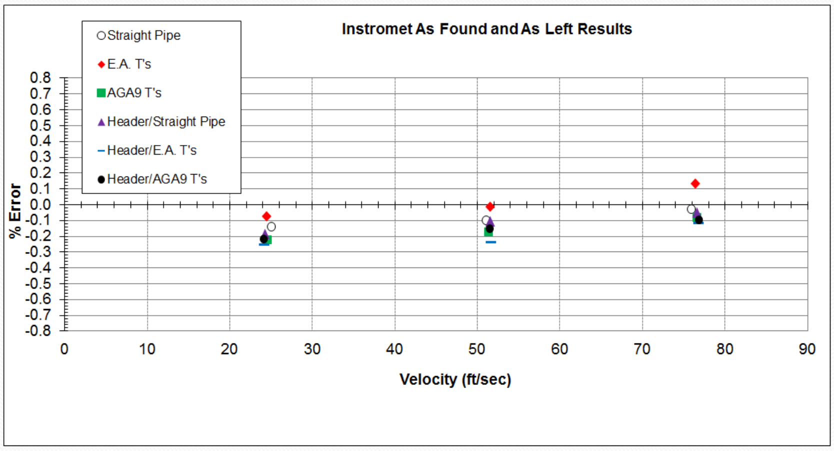


Fig. 2.13. – Instromet Meter Test Results

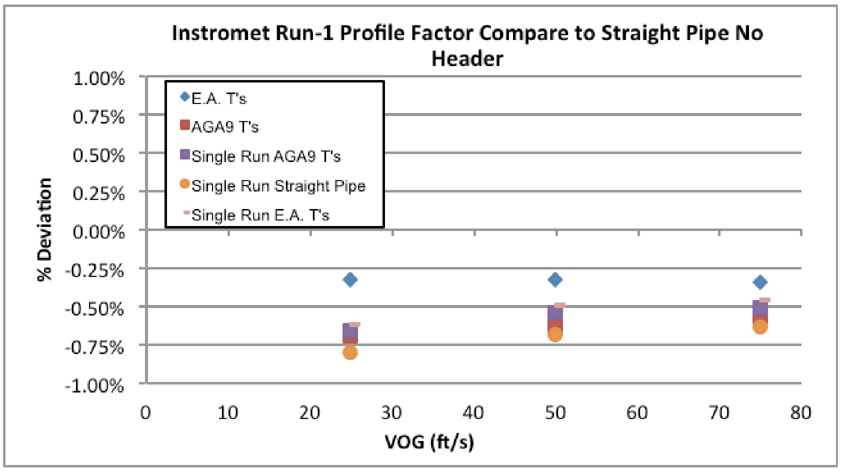


Fig. 2.14. - Instromet Meter Profile Factor Percent Shift

Figure 2.15 shows the Daniel test results. For the Daniel meter the test run with the AGA 9 Tees and the Header shifted the meter approximately +0.25% at the 23 m/s velocity. Figure 2.16 shows the profile factor percent shift was -0.42% for the test run with the AGA 9 Tees and for the Header.

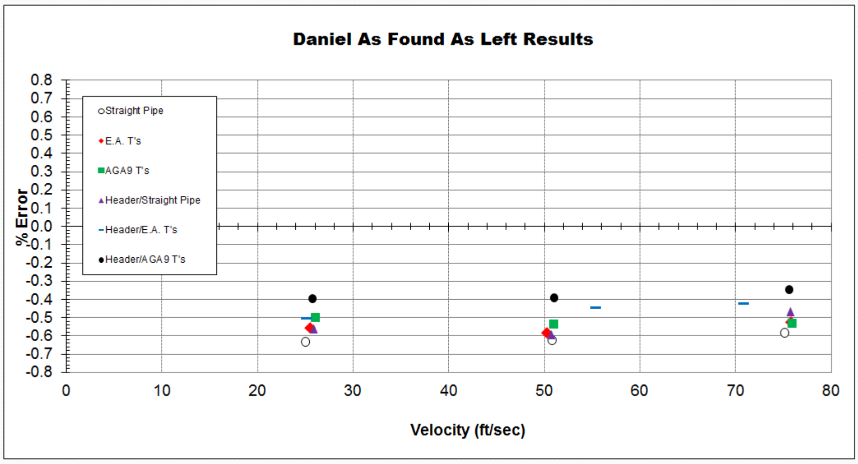


Fig. 2.15. - Daniel Meter Test Results

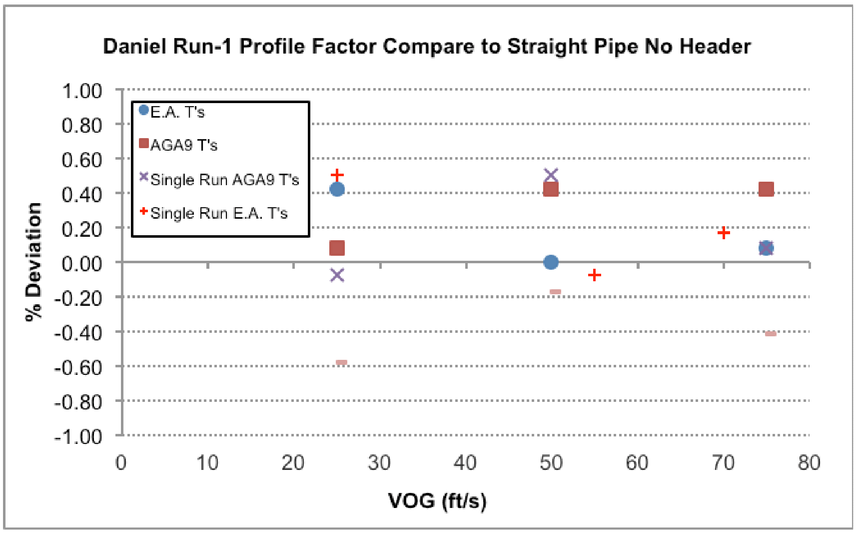


Fig. 2.16. - Daniel Meter Profile Factor Percent Shift

## 3 EIGHT-INCH USM INSTALLATION EFFECTS

The next NAFFMC research overview is on a presentation given by Randy Miller (Energy Transfer) titled "NAFFMC 2013 Testing." This test was the result of a customer approaching CEESI to perform some research. They wanted to study erratic behavior occasionally experienced when a meter was equipped with close-coupled tees and a Yale inspection closure on the upstream and downstream ends of the meter tube. The customer had two identical meters, meter tubes, and end-treatments. During calibration one meter displayed the erratic behavior, and the other did not.

The CEESI flow lab staff has seen this phenomenon before, so it was hoped this this issues could be re-created in order to study the problem closer. In this series of tests, researched various piping "end-treatments" on 8-inch Daniel and SICK meters were researched. This Instromet meter was not included in this testing as the NAFFMC chose to test only the Daniel and SICK meters. The baseline, as well as all end-treatment tests, were performed on both brands 8-inch meters with typical AGA 9 meter tube configuration of 10D, CPA 50E flow conditioner, 10D, Meter, 5D. The following bullets summarize the wide variety of end-treatment test configurations.

- Elbow and Blinded Tee - Elbow and Flat Closure
- Elbow and Blinded Tee – Elbow and Yale Closure
- Tee and Blinded Tee – Tee and Yale Closure
- Tee and Blinded Tee – Tee and Flat Closure
- Tee and Blinded Tee – Extended Tee and Flat Closure
- Tee and Yale Closure – Tee and Yale Closure
- Tee and Yale Closure – Tee and Yale Closure with Elliptical Deflector upstream
- Extended Tee and Yale Closure – Extended Tee and Yale Closure
- Extended Tee and Yale Closure – Extended Tee and Yale Closure with Elliptical Deflector downstream
- Extended Tee and Yale Closure – Extended Tee and Yale Closure with Elliptical Deflector upstream
- Elbow and Yale Closure – Elbow and Yale Closure

Figures 3.1 through 3.9 illustrate some of the different piping configurations and shows the Elliptical Deflector.

Fig. 3.1. Tee / Tee Flat Closure Left

Fig. 3.2. - Elbow / Tee Blind Flange Right

Fig. 3.3. - Tee/Tee Blind Flange Right

Fig. 3.4. - Tee/Tee Yale Closure Left

Fig. 3.5. - Extended Tee/Yale Closure

Fig. 3.6. - Elbow/Tee Yale Closure

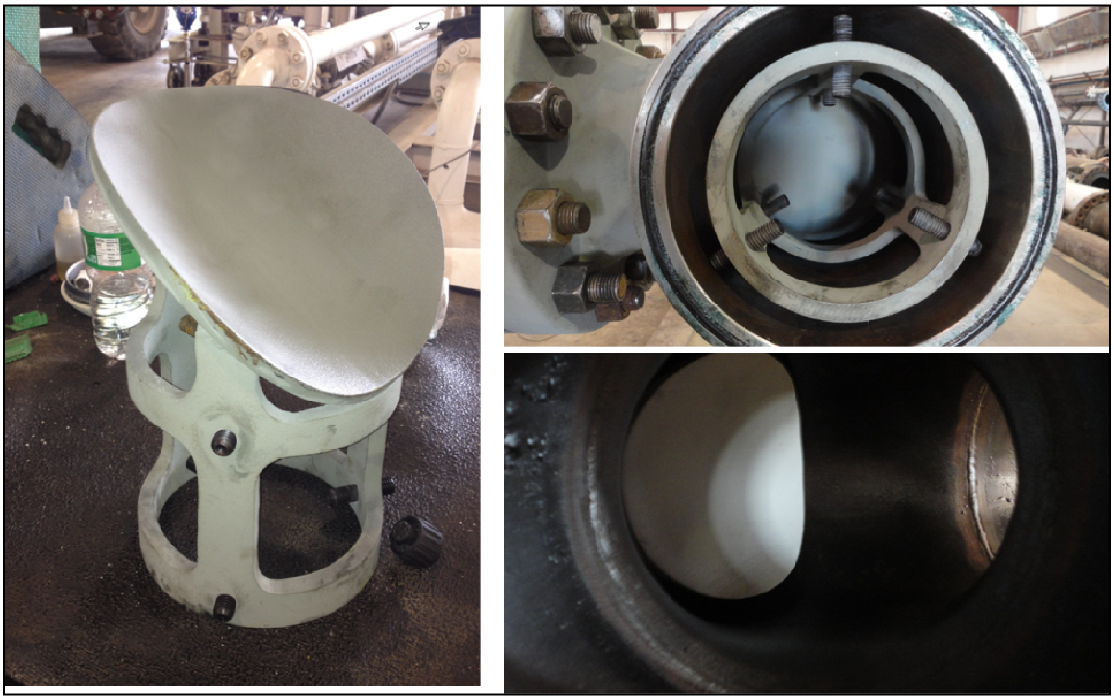

Fig. - 3.7, 8 & 9. Eight-Inch Elliptical Deflector Designed for Closure Caped Tees

The first objective was to look at the disturbances of each type of end treatment and to ultimately recreate the erratic behavior that had been seen in the customer's meter. While we were unable to achieve this erratic behavior to the point seen in the past, we were able to create some substantial disturbances worth studying. In Figures 3.10 and 3.11 the error vs. velocity is plotted on the graph for both meters.

Of note, both meters shifted up in (over-registered) every case as the upstream and downstream piping was modified. This may be due to the fact that the piping configurations always generated the swirl in the same direction throughout this series of tests.

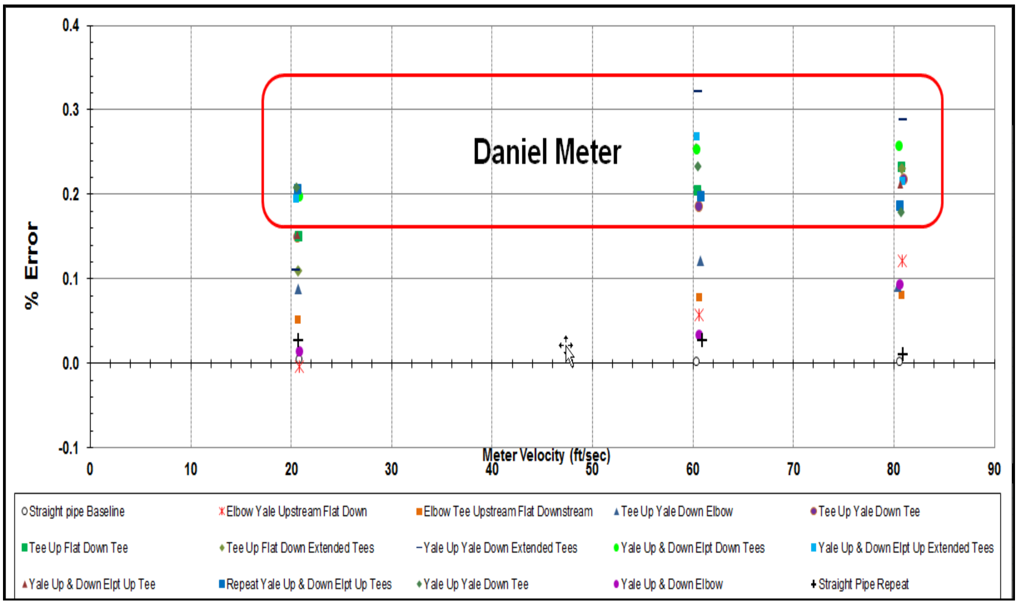


Fig. 3.10. - Eight-Inch Daniel Meter Test Results

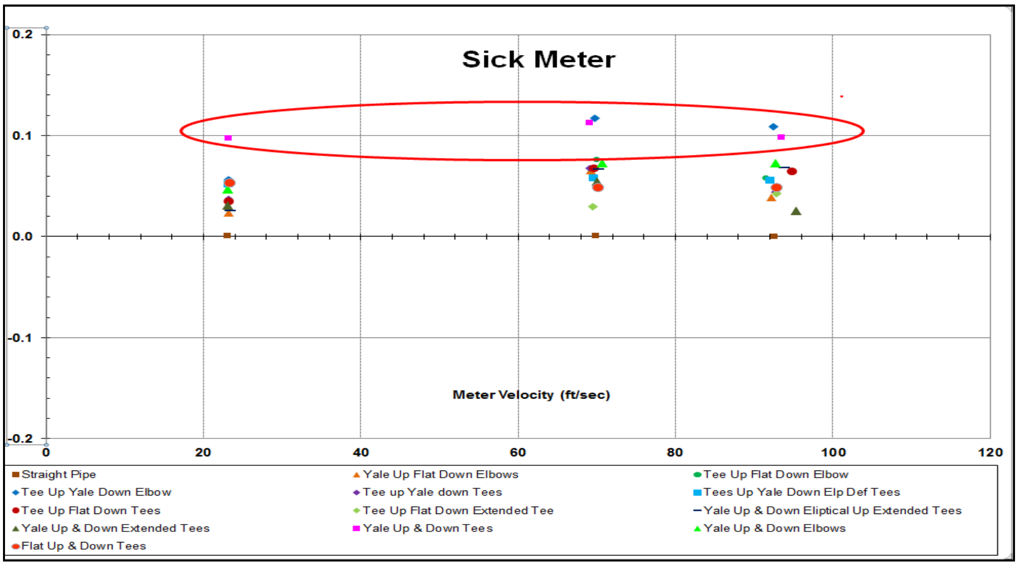


Fig. 3.11. - Eight-Inch SICK Meter Test Results

In the case of both meters, any combination of two close-coupled tees, installed on the inlet of the meter, created the highest measurement shift and instability and turbulence in the meters.

## 4 2014/2015 8-INCH USM DIAGNOSTIC DATA

In 2014 CEESI presented diagnostic maintenance logs from different brands of USMs taken during the test runs that created the greatest shift in each meter. Because the exact same tests were conducted in 2014 and 2015, with the exception of the swirl direction, it was decided to summarize diagnostics from both years of testing for each meter's extreme test case. Examining the measurement shift in these next tests, the reader should be aware that many of these tests created extreme conditions for the meters. These extreme conditions would not normally be found in the field, but do provide us with some indication of the meter's performance under severe conditions.

In 2014, a special device called a CPA Swirl Generator (CSG) was setup to create clockwise swirl (more in Section 5 on the CSG). For the SICK meter the most severe condition was created with the CSG set at 72-degrees and the valve wide open. Figure 4.1 shows the results from the 2014 test run and Figure 4.2 is from the 2015 data. The diagnostic graphs quickly indicate the difference between the two sessions. The CSG was setup to create counterclockwise swirl for the first series of tests (2014). Both conditions created similar error and in the same direction even though the Path Velocity Ratios were inverted (different swirl direction).

The SICK software was used to summarize the diagnostics that follow. The profile factors in both cases were 1.06, which is a 4.5% shift from the baseline profile factor. The symmetry factors shifted substantially more and in the opposite direction. The 2014 symmetry factor was 0.827, which is a 17% shift from the baseline, and the 2015 symmetry factor was 1.26, which was a 25% shift from the baseline. The turbulence values were extremely high in both tests. For this series of tests, the asymmetry and turbulence were the two indicators of measurement issues. The performance, speed of sound comparison and profile factor values were all within typical alarm limits.

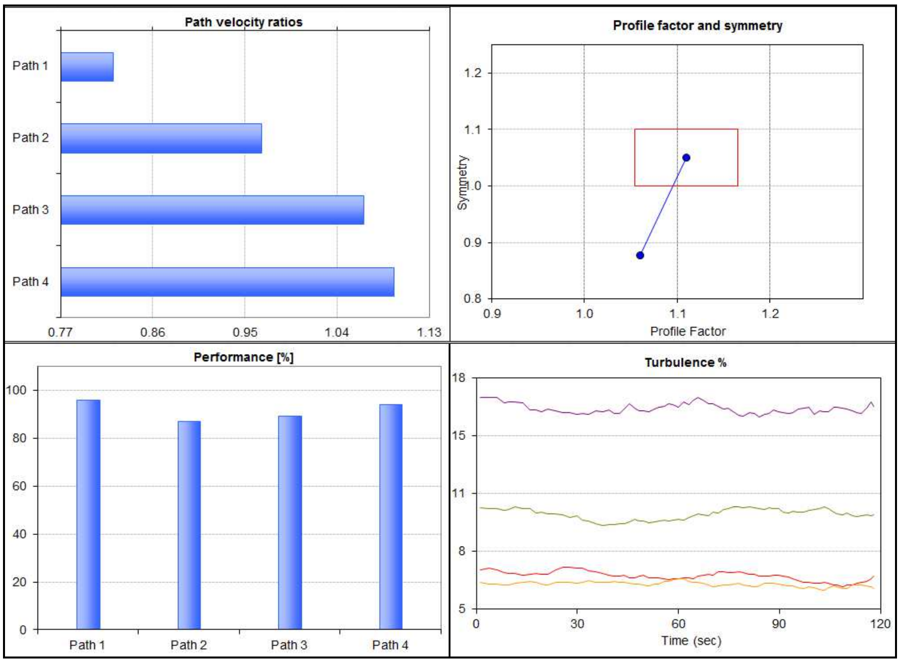


Fig. 4.1. - SICK Meter 2014 Data High Swirl Significant Symmetry Shift

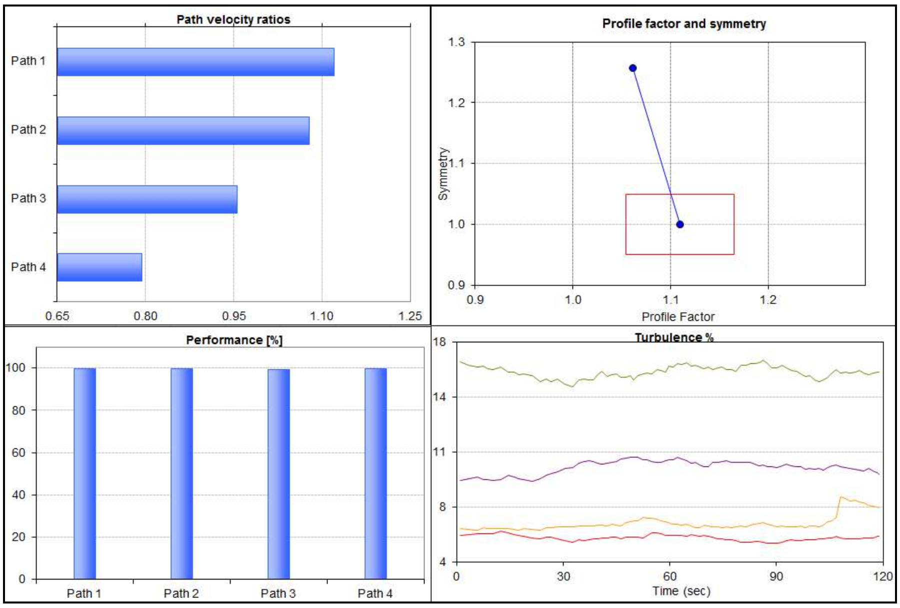


Fig. 4.2. - SICK Meter 2015 Data High Swirl Significant Symmetry Shift

For the Daniel meter the NAFFMC examined the maintenance logs from the CSG set at 72-degrees, and valve pinch set at 30%. Figure 4.3 is from the 2014 test data, and Figure 4.4 is from the 2015 data. Again, the diagnostic graphs quickly indicate the difference between the two sessions. As with the SICK meter in 2014, our CSG was setup to create clockwise swirl, and in 2015 the CSG was setup to create counterclockwise swirl.

The counterclockwise swirl created more measurement shift in the meter, and the errors were in opposite directions. The profile factor in 2014 was 1.259, a 9% shift from the baseline profile factor. In 2015 the profile factor for this same test scenario was 0.9, a shift of 22%. The symmetry factors shifted quite differently as well. The 2014, symmetry factor was 0.92, an 8% shift from the baseline and the 2015 symmetry factor was 0.99, a 1% shift from the baseline.

In this instance the profile factor and turbulence were the two indicators of measurement issues for both years, as well as the symmetry in the 2014 test. The performance and speed of sound comparison values were within typical alarm limits.

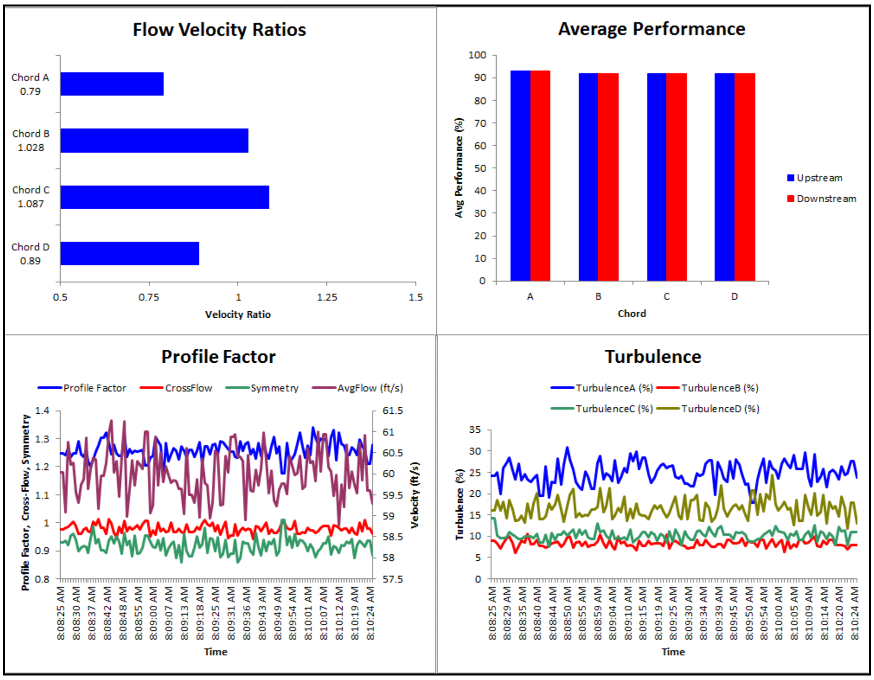


Fig. 4.3. - Daniel Meter 2014 Data High Swirl & High Symmetry


Fig. 4.4. - Daniel Meter 2015 Data High Swirl & High Symmetry

Next the NAFFMC looked at the diagnostics from the 2014 and 2015 Instromet Q.Sonic-Plus maintenance logs. The test runs were with the CSG set at 72-degrees, and the valve pinch set at 30%. Graphs in Figure 4.5 are the diagnostics for the 2014 test and in Figure 6.6 are the diagnostics for the 2015 test. As with the other meters, it is quite easy to see the difference in the diagnostics due to the change in swirl direction.

The error was somewhat higher for the 2015 test than it was in 2014, but both errors were in the same direction. The profile factor was 1.009 in 2014, a 3.26% shift from the baseline. The profile factor was 1.013 in 2015, a 3.0% shift from the baseline. The symmetry factor from the 2014 data was 0.82 which was calculated by the clockwise swirl paths divided by the the counterclockwise swirl paths. This was a 18% shift from the baseline. The symmetry factor from the 2015 data was 1.14, a 14% shift from baseline.

The primary indicators of measurement shift from both the 2014, and 2015 data were the symmetry factors which were 18% and 14% shifts from the baseline and the profile factors, that while under 5% from the baseline, were in alarm in the Sonic Explorer Health Care Report. Of note, the symmetry calculated from the axial paths were within limits, but the symmetry calculated from the swirl paths were not. The speed of sound comparisons were within their alarm limits.

Since the Instromet meter computes a value for swirl, this data is another diagnostic tool that can be used as an indicator of potential error. In the 2014 test, the meter measured +4 degrees of swirl, and in 2015 the meter measured a value of -6 degrees of swirl. In both cases the swirl values fell outside of normal alarm limits.


Fig. 4.5. - Instromet Meter 2014 Data High Swirl & High Symmetry

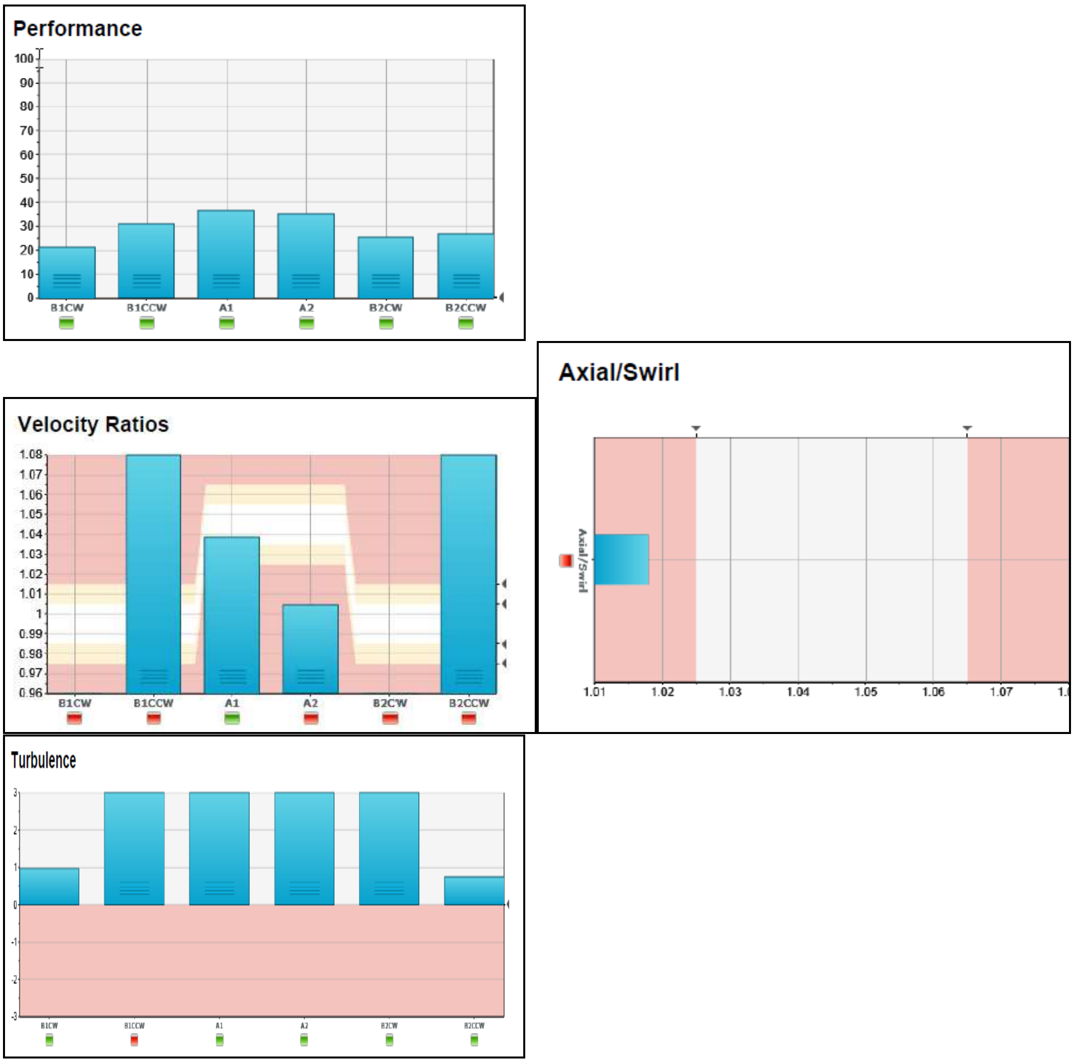


Fig. 4.6. - Instromet Meter 2015 Data High Swirl & High Symmetry

## 5 2004-2015 12-INCH USM DIAGNOSTIC DATA

The NAFFMC next examined installation effects research with a look at each meter's diagnostic indicators. Using the vast amount of data available on 12-inch ultrasonic meter installation effects, the group wanted to see if it could create models to provide approximate measurement shift indicators. The objective of this research is to analyze and present the ultrasonic meter diagnostics in a manner the user can employ to better manage their measurement risk associated with diagnostic shifts from the calibration to the field.

As stated in the previous section, in some cases the measurement shift in these tests created extreme conditions for the meters. These extreme conditions would be unusual to see in the field when the installation included a flow conditioner, but do provide data outside of normal conditions that was used to improve our modeling of the measurement shift and diagnostic parameters. Subsequently, the extreme perturbation testing performed also gave a valuable overall look at how these meters operate under such extreme conditions. In the case of all three meters under test, they performed with a reasonable amount of uncertainty while being pushed to excessive limits.

Data collected from installation effects testing in 2004, 2009, 2011, 2014 and 2015 was used the following analysis. All of the testing done in 2004, 2009 and 2011 involved combinations of tees and elbows upstream and downstream of a typical AGA 9 piping configuration of 10D, CPA 50E flow conditioner, 10D, Meter, 5D, to create disturbed flow profiles. The NAFFMC decided to utilize the same 8-inch CPA Swirl Generator (CSG) for testing on 12-inch meter.

The 2014 and 2015 piping configuration consisted of the CSG and a pinched block valve located 5D from the meter with no flow conditioning. In 2015 the CSG was configured to create swirl in the opposite direction as the 2014 tests.

Figure 5.1 is a picture of the CSG, one offset paddle plate is welded to the horizontal flat plate and the other offset paddle plate is then rotated to create variable degrees of swirl. Figure 5.2 is an upstream view of the ball valve pinched at 30-degrees which was used to create variable amounts of asymmetrical swirling profile.

Fig. 5.1. CSG CPA Swirl Generator

Fig. 5.2. Upstream Ball Valve 30% Pinch

Figures 5.3 and 5.4 illustrate the 2004 test-piping configuration using elbows and tees to induce various installation effects. 2009 testing was a repeat of the 2004 installation effects testing.

Fig. 5.3. - 2004 DOOP Elbows


Fig. 5.4. - 2004 DOOP Elbows/Tee

In 2011 upstream piping simulations, again using tees and elbows to reproduce common installation effects, were tested. As seen in Figures 5.5 and 5.6, two meters were bolted back-to-back and tested. They were also rotated, in combination with the different tee and elbow piping configurations, to create different upstream disturbance installation effects.

Fig. 5.5. - 2011 Meters Horizontal Fig. 5.6. - 2011 Meters Rotated 90°

Figure 5.7, shows the CSG position during the 2014 testing. Figure 5.8 shows the CSG position during the 2015 testing. The opposite rotation of the downstream paddle plate allowed us to create varying degrees of clockwise or counterclockwise swirl. Figure 5.9, is the piping setup for the baseline tests. Figure 5.10, shows the CSG, 5D, pinched valve, 5D, Meter, piping configuration.

Fig. 5.7. - 2014 CSG CW Swirl Setup Fig. 5.8. - 2015 CSG CCW Swirl Setup

Fig. 5.9. - 2015 Baseline Testing Fig. 5.10. - 2015 CSG, 5D, Pinched Valve

Figure 5.11 shows the CSG, 5D, pinched valve, CPA, 10D, Meter, piping configuration. Figure 5.12 is the CSG, 5D, pinched valve, 5D, CPA 50E, 10D, CPA50E, 10D, Meter piping configuration. Figure 5.13 is the tee and elbow-piping configuration used for the final day of 2015 testing.

Fig. 5.11. - 2015 CSG, 5D, Pinched Valve, 5D, CPA 50E, 10D, Meter

Fig. 5.12. CSG, 5D, Pinched Valve, 5D, CPA 50E, 10D, CPA 50E, 10D, Meter

Fig. 5.13. 2015 Final Day Testing With Elbows and Tees

## 6 INSTALLATION EFFECT ERROR DIAGNOSTIC MODELING ANALYSIS

This section provides the following information:

- Analyzes the installation effect research.
- Develops installation effect estimate models based on diagnostics.
- Applies diagnostic control limits to the models to demonstrate a method to control installation effect uncertainty.

Only the 2014 and 2015 data was used to generate the models. The models were used to estimate installation effect for the 2011 data.

Since the research took place over multiple years, a new Baseline was obtained each year. The baseline piping consisted of considerable straight upstream piping and a CPA 50E flow conditioner installed at 10D. The error recorded for each test run was adjusted by the Baseline error for that particular year of testing. This reduced the uncertainty caused by changes in the meter and/or laboratory over time. The adjusted error is referred to as Meter %Dev. from Baseline or simply Meter %Dev. throughout this section of the paper.

Shifts in the velocity ratio diagnostics such as the Profile Factor, Symmetry, and Swirl Ratios were all measured from the 2015 baseline ratios (not adjusted each year like the error).

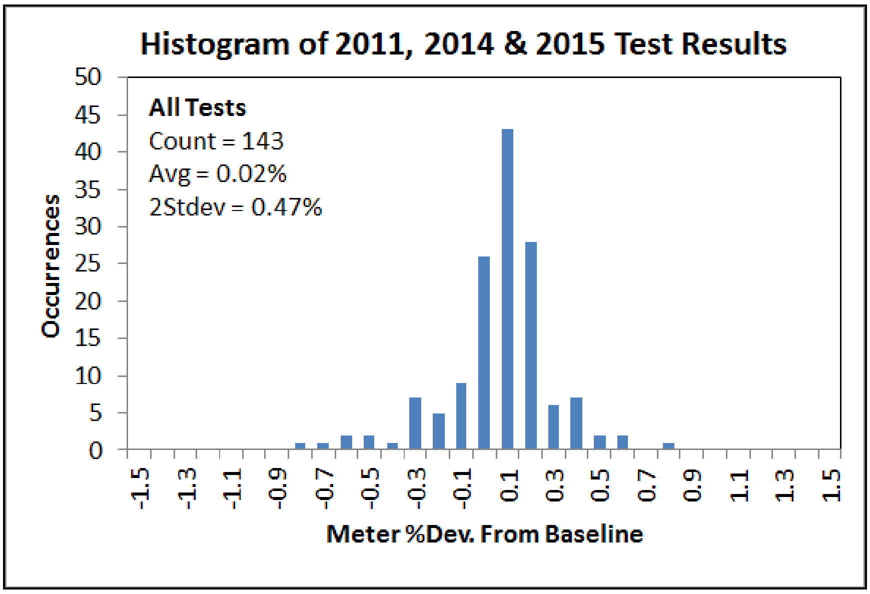


Fig. 6.1. - Histogram of 2011, 2014, and 2015 Test Results

Figure 6.1 illustrates the results of the 143 Installation Effects testing conducted between 2011 and 2015. The results include all three meter brands tested: Daniel SeniorSonic, Instromet Q.Sonic-Plus, and SICK FLOWSIC600. The histogram shows that the average error was near zero and reasonably symmetric. The variance was +/- 0.47% (at 2 Standard Deviations). The meters handled extreme, harsh, non-real world installation effects typically not seen when a flow conditioner is utilized.

### 6.1 Daniel Seniorsonic Modeling

Linear regression modeling techniques were applied to the Daniel data. The Profile Factor, Symmetry, and Cross Flow were tested as regressors to model the Meter %Dev. from Baseline. The analysis found a strong inverse linear relationship between the Meter %Dev. and the Profile Factor. Figure 6.2 below illustrates the relationship. The F-statistic for the model was 31. The $R^2$ was 51%. The slope of the line was -1.42 $\pm$0.51 (95% CI). Thus, on the average, for every 1% change in the Profile Factor the Meter %Dev. changed by -0.014%.

The Symmetry and Cross Flow ratios did not correlate with the Meter %Dev. For example, the $R^2$ for the model including the Profile Factor, Symmetry, and Cross Flow only increased 4% from the $R^2$ for the Profile Factor only model.

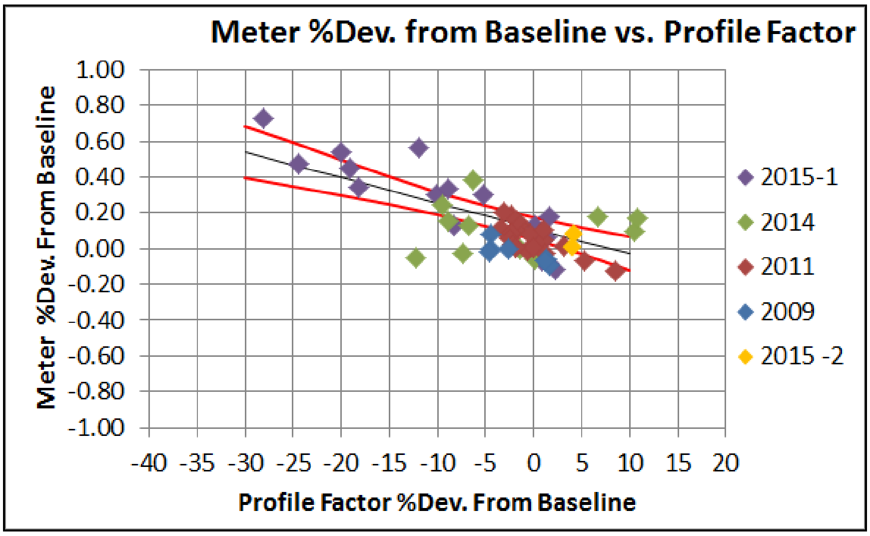


Fig. 6.2. - Daniel SeniorSonic Meter %Dev vs. Profile Factor

## 6.2 Instromet Q.Sonic-Plus Modeling

The analysis of the Instromet Q.Sonic-Plus data indicated a relationship between the Meter %Dev. and the Profile factor. The analysis suggested that for Profile Factor shifts less than ± 2% the installation effect error could be estimated as 0.0% ± 0.15% (at 2 Standard Deviations). For Profile Factor shifts > ± 2%, the analysis indicates that the error could be estimated at -0.24% +/- 0.42% (at 2 Standard Deviations). Figure 6.3 illustrates the relationship.

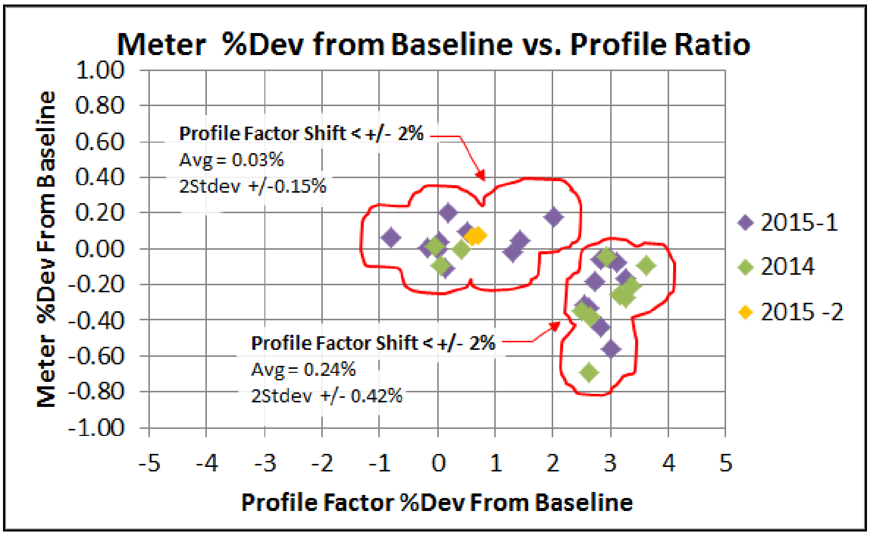


Fig. 6.3. - Instromet Q.Sonic-Plus Meter %Dev vs. Profile Factor

Linear regression modeling techniques were also applied to the Instromet data. Various velocity ratios were tested as regressors. The most statistically significant ratios were found to be either the ratio of the Clockwise velocities or the ratio of the Counterclockwise velocities. Modeling the Meter %Dev. from Baseline as a function of the Clockwise Velocity Ratio yielded a model with an F-statistic of 31 and an $R^2$ of 53%.

Figure 6.4 illustrates the relationship. The slope of the line was -29.6 ± 10.5 (95% CI). Thus, on the average, for every 0.05% change in the Clockwise Velocity Ratio the Meter %Dev. changed by -0.15%.

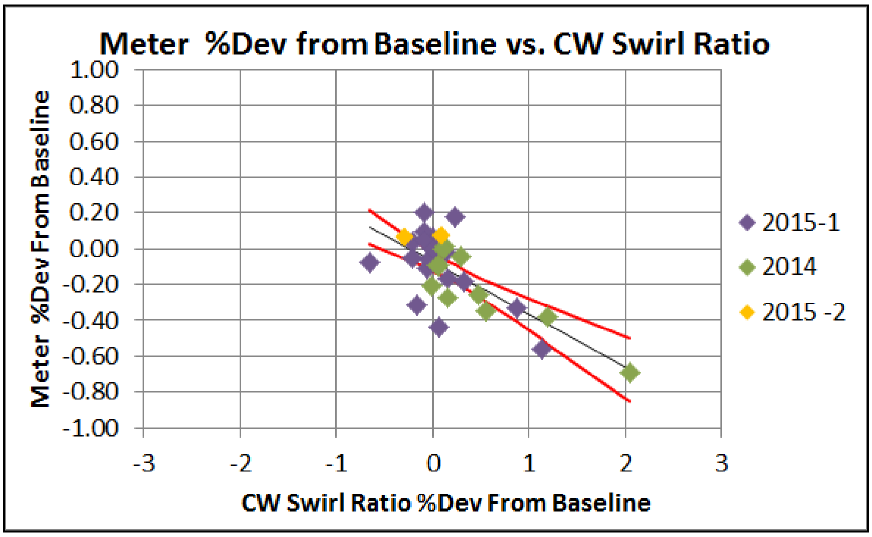


Fig. 6.4. - Instromet Q.Plus Meter %Dev vs. Clockwise Velocity Ratio

The analysis suggests a 2-step approach to estimating the Instromet Q.Sonic-Plus installation effect error. First, check the Profile Factor. If the shift is less than ± 2%, consider the error not detectable. If the shift is > ±2%, estimate using either -0.24% or the Clockwise Velocity Ratio model. The > ±2% estimate using the -0.24% criteria simply tells us if we have a profile factor shift greater than ±2% the data analysis indicates the measurement shift will be in excess of ±0.2%. Because the Profile Factor diagnostic is available in Q.3 and Q.5 meters, it may also be a good indicator of installation effect uncertainty for those meters."

### 6.3 Sick Flowsic600 Modeling

Figure 6.5 below illustrates the relationship between the Sick Meter %Dev. from Baseline and the Symmetry. Both the Symmetry and Profile Factor were tested as regessors and the Symmetry relationship was found to be significant. Figure 6.5 shows Symmetry shifts away from the baseline Symmetry (regardless of whether the shift was positive or negative) correlated with increasing, negative installation effect error.

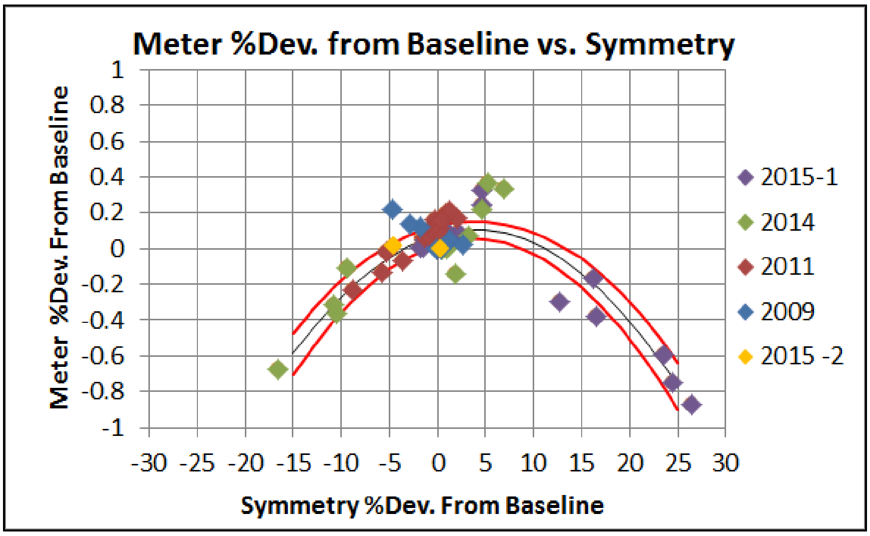


Fig. 6.5. - SICK FLOWSIC600 Meter %Dev vs. Symmetry

Figure 6.5 illustrates that Symmetry also shows swirl direction. The green data points to the left are clockwise swirl test points, while the purple points to the right are counterclockwise test points. The points that fall outside the 95% Confidence Region at the +5% Symmetry shift were high symmetry tests. The model does not fit these points well. Other diagnostics, such as turbulence, would have identified installation issues associated with the high symmetry points.

Figure 6.5 also suggests that modeling the Meter %Dev. as a function of the absolute value of the symmetry shift would transform the parabolic relationship into a linear relationship. Figure 6.6 illustrates the results of the transformation.

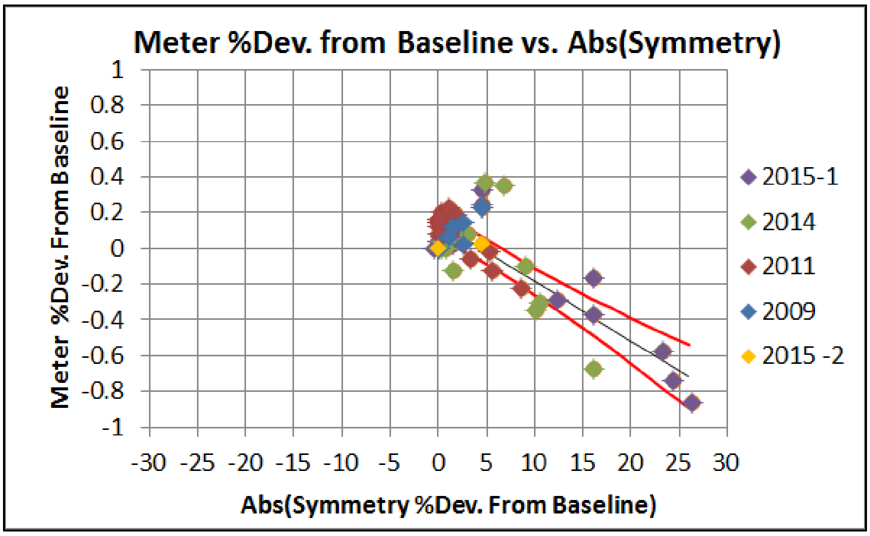


Fig. 6.6. - SICK FLOWSIC600 Meter %Dev vs. Symmetry

The transformation shown above exhibits a strong, inverse linear relationship. The F-statistic for the model was 66. The $R^2$ was 69%. The slope of the line was -3.31 $\pm$0.82 (95% CI). Thus, on the average, for every 1% change in the Symmetry, the Meter %Dev. Changed by -0.033%.

### 6.4 Applying Control Limits to the Models

From the modeling results, the following control limits were selected to identify installation effect tests with high Meter %Dev. The tests elimination criteria were as follows:

- Daniel SeniorSonic: Profile Factor shift **> $\pm$ 5%** from Baseline.
- Instromet Q.Sonic-Plus Profile Factor shift **> $\pm$ 2%** from Baseline.
- SICK FLOWSIC600 Symmetry shift **> $\pm$ 4%** from Baseline.

The criteria eliminated 59 of the 143 installation effect tests yielding a distribution with an average of 0.06% $\pm$0.15% (at 2 Standard Deviations). The orange data series in Figure 6.7 below illustrates the resulting Meter %Dev. distribution. The illustration shows that the elimination criteria effective controlled the installation effect uncertainty.

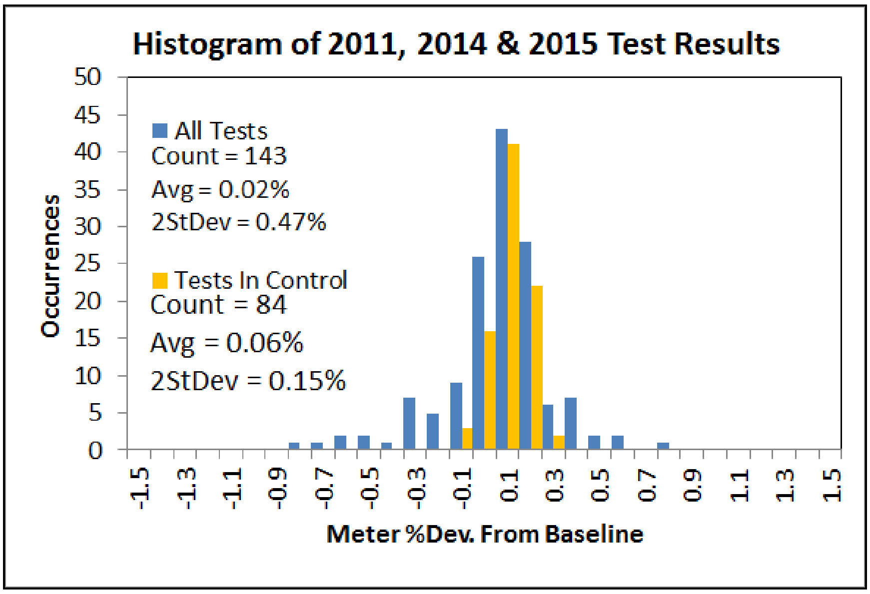


Fig. 6.7. - Histogram of Meter %Dev. from Baseline

## 7 ANALYSIS AND MODELING CONCLUSIONS

The research continues to point towards the feasibility of creating diagnostic models to estimate installation effect error and developing diagnostic criteria from the models to control installation effect uncertainty. **However, the analysis and modeling presented in the paper should not be generalized**. Further research could determine if the modeling can be generalized to other sizes, types of meters, and velocity ranges, and could provide guidance to AGA 9 with regards to installation effect uncertainty. Testing is on going and each year new information is obtained from the testing directed by the NAFFMC, and presented at the annual CEESI Custody Transfer Conference.

## 8 REFERENCES

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[8] 2015 NAFFMC Director Board; Bob Wurm – Tallgrass Energy, Reese Platzer – Enterprise Products Company, Gary McCargar – Oneok Partners, Jonatan Mustafa – Sunoco, Dan Rebman – Universal Pegasus, Randy Miller – Energy Transfer, Ed Hanks – CEESmaRT, John Lansing – CEESI, Joel Clancy – CEESI.