

Improving Ultrasonic Flow Meter Accuracy Using Proprietary Flow Profile Correction Techniques

Practical flow measurement solutions for non-conforming straight runs

PANA097DS Rev. 3

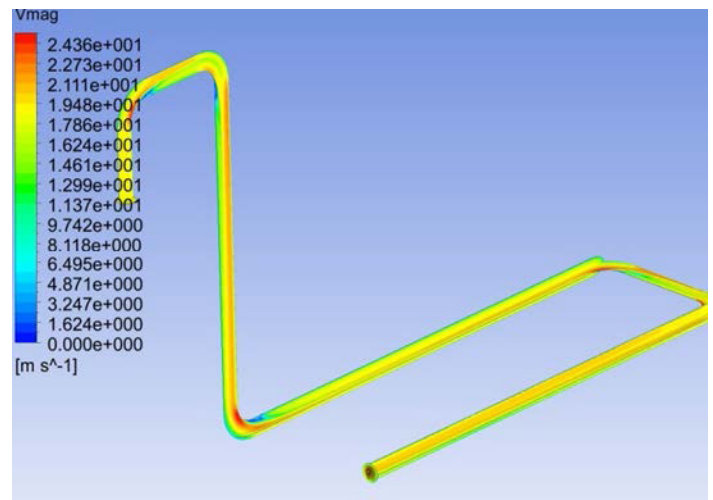
For decades, the Panametrics line of ultrasonic flow meters has proven to be the reliable solution for challenging gas flow measurement applications. By using Computational Fluid Dynamics (CFD), Panametrics has compiled a body of work resulting in the ability to implement ultrasonic flow profile accuracy correction factors for a variety of piping run conditions that compare favorably to accuracies normally obtained in straight runs of 20 diameters or more.

Using advanced technologies to overcome limited available straight runs

Maintaining accuracy in applications with limited straight run has been, and remains today an industry challenge. In gas flow measurement, ideal conditions require upstream straight runs as much as 20 diameters or more. In practice, this may be difficult, costly, or in some cases impossible to achieve. The stakes can be enormous, as re-laying new pipe runs to accommodate increased straight runs can easily amount to a huge cost.

Recognizing the challenges associated with limited straight run requirements, Panametrics developed a process to quantify pipe bend and other effects on flow profiles under a wide range of conditions. In most cases CFD analysis can accommodate pipe runs as short as 6 diameters upstream and 2 diameters downstream, with minimal effects on meter accuracy.

Especially useful in hot tap or cold tap applications when existing piping limits meter straight run, flow profile modeling provides dynamic flow correction that in most cases meets or exceeds accuracy requirements.



Actual Flow Profile Model of Piping Installation

How flow profile correction works

Providing Panametrics with an isometric drawing of an existing or planned installation that requires a flow measurement, along with the process parameters, Panametric's engineering team models the flow and defines a set of correction factors that will cover a wide range of flow and process conditions. These correction factors are then entered into the transmitter and act as a calibration correction curve over the range of flow velocities.

Added inaccuracy for a flow profile corrected straight-run will typically be in the 0.5% to 1.5% range, depending on the actual available straight run, process conditions, and the complexity of the upstream disturbances. Consider that many non-conforming, uncorrected straight runs may add 10% or more of additional inaccuracy to a flow meter reading, essentially rendering the meter non-compliant in many applications.

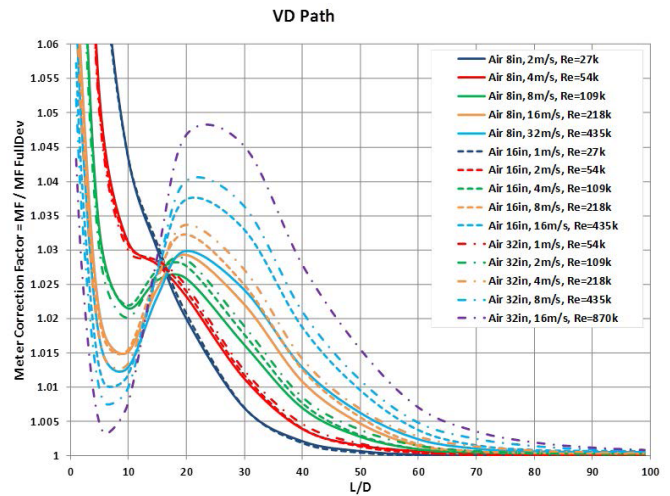
The chart at the right illustrates the range of flow correction factors as a function of meter position for a selected meter configuration, in this case, a horizontal diameter path. Notice that in this configuration added inaccuracy can be as much as 6% at 15 L/D*, even at very high flow velocities. Flow profile corrections aid in defining the optimum path configuration and meter placement to minimize meter inaccuracy. Nearly all installations can benefit from some form of profile correction, especially in low density fluids like gas, to improve overall system accuracy.

What CFD is not

CFD is NOT a calibration. A meter corrected with CFD modeling is no more accurate than if the same meter was placed in a position with a fully developed flow profile. In fact, relative to a fully developed flow profile, assuming 20 diameters or more of straight run, there is added inaccuracy due to calculation modeling and meter positioning. As noted earlier, typical added inaccuracy for a non-fully developed flow that is compensated with CFD is about .5% to 1.5%; however, this can vary widely by application.

In some cases, depending on the complexity of the upstream disturbance, CFD may not be able to compensate for the undeveloped flow profile. This is a risk that one must consider before purchasing a CFD analysis. Unfortunately the results of the profiling are not known until it is complete. If this does occur, a piping modification may allow for a CFD profile correction to succeed, but this is not known for sure until another CFD analysis is completed. These considerations need to be weighed before pursuing a CFD correction, but relative to adding more straight run, CFD may still be the best choice.

* L/D denotes length in pipe diameters.



Ordering information for a flow profile analysis

Part number

FLOW SPECIAL-CFD

Description

Five point flow profile correction

Requirements

Isometric of piping to be analyzed starting at the seal or knock-out drum, ending 8 diameters past the last disturbance of the meter run, and a completed applications data sheet detailing the flow conditions.

Pricing

Contact your Panametrics representative for a quote.

Lead Time

A typical profile correction analysis will require from two to four weeks of programming and computer run time. Depending on the queue, lead time may vary.

Deliverables

- Summary report of results of the flow profile modeling
- Recommended location of the flow meter
- Recommended flow meter configuration
- A series of five correction factors by flow velocity
- Meter total inaccuracy at each correction point
- A presentation of the details of the flow profile analysis