GE
Measurement & Control

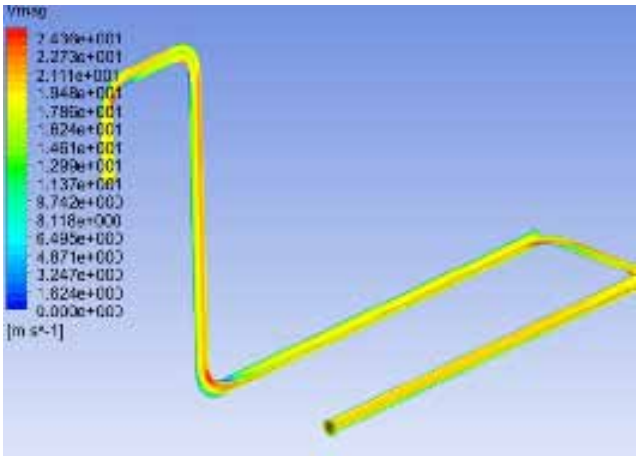
# Improving Ultrasonic Flowmeter Accuracy Utilizing Proprietary Flow Profile Correction Techniques

## Practical flow measurement solutions for non-conforming straight runs

For over 30 years, GE Panametrics ultrasonic flowmeters have proven to be the most reliable solution for challenging gas flow measurement applications. Leveraging GE's vast experience in aircraft engine design and by utilizing Computational Fluid Dynamics (CFD), GE has compiled a body of work resulting in the ability to implement USM flow profile accuracy correction factors for a variety of piping run conditions that compare favorably to accuracies normally obtained in straight-runs of 20D or more.

### Utilizing 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 20D 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 run into the millions of dollars.




*Actual Flow Profile Model of Piping Installation*

Recognizing the challenges associated with limited straight run requirements, GE has embarked on a comprehensive year-long study to quantify pipe bend effects on flow profiles under a wide range of conditions. In most cases CFD modeling can accommodate straights as shorts as 6D upstream and 2D downstream, with minimal effects on meter accuracy.

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

## How Flow Profile Correction Works

Providing GE with an isometric drawing of an existing or planned installation that requires a flow measurement, along with the process parameters, GE's engineering team will model the flow and define a set of correction factors that will cover a wide range of flow and process conditions. These correction factors are then hard-coded into the transmitter and act as 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, un-corrected straight runs may add 10% or more of additional inaccuracy to a flow meter reading, essentially rendering the meter non-compliant in many applications.

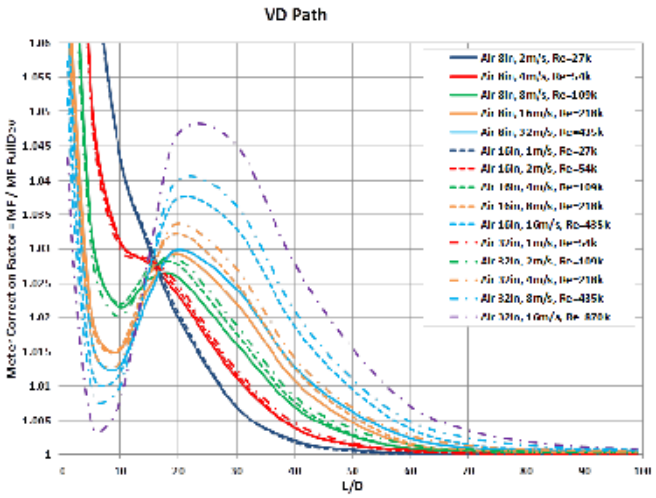
The chart at the right illustrates the range of flow correction factors as a function of meter position for a selected meter configuration, in this case a horizontal diameter path. Notice that in this configuration added inaccuracy can be as much as 6% at 15 L/D*, even at very high flow velocities. Flow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

** L/D denotes length in pipe diameters.*

## What CFD Is Not

CFD is NOT a calibration! A meter corrected with CFD modeling is no more accurate than if the same meter were placed in a position with a fully developed flow profile. In fact, relative to a fully developed flow profile, assumed true at 20D 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 un-developed 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, however, this is not known for sure until another CFD analysis is completed. These considerations need to be weighed before one decides to pursue a CFD correction, however, relative to adding more straight run CFD may still be the best choice.

## 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 8D past the last disturbance of the meter-run, and a completed applications data sheet detailing the flow conditions.

### Pricing
Contact your GE Representative for a quote.

### Lead Time
A typical profile correction analysis will require 4 to 6 weeks of programming and computer run time. Depending on the queue, lead-time may vary.

### Deliverables
- Summary of Report of results of the flow profile modeling
- Recommended Location of the flowmeter
- Recommended flowmeter configuration
- A series of five correction factors by flow velocity
- Meter total in-accuracy at each correction point
- A presentation of the details of the flow profile analysis

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