

# PANAFLOW Z1G: TIGHT GAS WELLHEAD FLOWRATE MEASUREMENT

*For over 30 years, Panametrics flowmeters from GE have proven to be the most reliable solution for challenging gas flow measurement applications. With proven reliability in flare gas, stack gas and steam, GE's robust transducer technology is ideal for shale gas and coal seam gas wellhead applications. In short, GE offers the most reliable ultrasonic meter available, plus local service when and where you need it.*

## Flare Gas Flow Measurement: The Ultimate Reliability Test

As a pioneer in ultrasonic transit-time flow measurement, Panametrics distinguished its flowmeters by providing reliable gas flow measurement solutions in extremely harsh applications for the past three decades. Joining the GE Measurement & Controls group in 2004, provided Panametrics with greater technical reach, and improved greater resource access, resulting in even greater improvements in ultrasonic transducer design.

How can you be sure that your flowmeter will operate reliably in something as challenging as a shale gas or coal seam methane wellhead application? Choose a flowmeter with a proven track record of reliable operation in an even more difficult application! Since the development of the world's first ultrasonic flowmeter for flare gas applications in 1980, GE has been the market leader with over 7,000 installations in an application with gas compositions from 2 g/mol to over 120 g/mol, flow velocities from 0.1 ft/s to over 394 ft/s, and process temperatures from -160oC to 280°C. The world's best performance and vast experience in this difficult application translates directly to outstanding performance in shale gas and coal seam gas flow measurement.

## Flowmeter Reliability Starts With A Reliable Transducer

Reliable ultrasonic flow measurement starts with transducer sound wave signal amplitude and signal to noise ratio (SNR). In shale gas or coal seam gas applications, these signals can be weakened from sulfur, coal fine or other condensate build up on the transducer face.



imagination at work

Solids accumulating on the transducer face act like a muffler and attenuate the signal. As this scaling continues to accumulate, the transmitted and received ultrasonic signals continue to degrade, which results in reduced signal amplitude and degraded SNR. The pictures below are from two different locations of working transducers, pulled for routine maintenance. The better the SNR and signal amplitude exhibited under ideal conditions, the better the transducer will be able to hold up under harsh conditions.

GE's transducers are driven by an industry high 170 volt pulse, providing very high signal amplitude. This high power requires an explosion proof enclosure design, (Ex d rating) to meet hazardous area certification requirements. Other transducer designs, meet hazardous area certification requirements by simply being intrinsically safe (Ex ia). Although intrinsically safe transducers work well in clean applications, they are not well suited to handle the challenges presented in shale or coal seam wellhead gas flow measurement, due to the high level of condensates in the gas stream

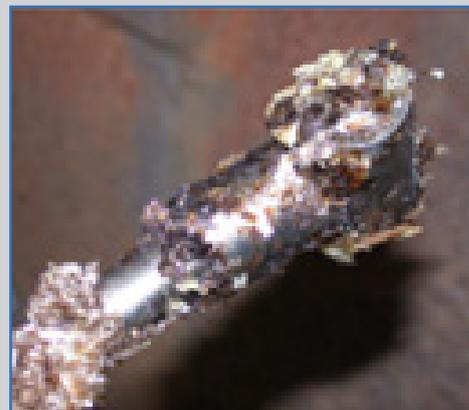
*It's not complicated. Less power means less signal.*

## Fluctuating Well Head Flow Rates Require High Turndown Ratio Metering

Throughout the lifecycle of a coal seam well, flow rates can fluctuate considerably as a result of changing well conditions, therefore it is important to select a meter with a high turndown ratio to assure a long service life. The Panaflow Z1G has a turndown ratio of 240:1, measuring flow rates as low as from 0.5 ft/s and as high as 120 ft/s, and under pressure conditions that are below atmospheric. Under higher flow conditions, background noise degrades SNR, however, with the industry highest signal amplitude, GE transducers overcome this obstacle.

When you have millions of dollars invested in a shale gas or coal-seam gas well, you need reliable, accurate gas flow measurement. As the gas moves from the well distribution network to the gas gathering station for processing, understanding well production trends is a critical element in natural gas production efficiency. As wells age, gas production levels are unstable. This information is a critical part of knowing which wells are producing with maximum efficiency, and which are in need of maintenance.

Maintaining a wellhead is a costly proposition. This is especially true if the well is in a remote location, requires special land access permitting or both. Visitation to the wellhead should be limited to well production



▶ *Despite this significant amine crystal build up, these transducers continued to operate reliably*



▶ *Glycol carry-over and dirt on this transducer was not enough to stop GE's robust transducer technology in this pipeline gas application*



▶ *PanaFlow Z1G Ultrasonic Flowmeter*

improvements and not be dictated by the reliability of the flow measurement. Consider that a site-visit to a well may cost upwards of \$10,000, it is easy to understand why product reliability is so important. Many flow measurement technologies like orifice meters, vortex meters or turbine meters rely on, or create a pressure change to accurately measure flow. In a clean gas this is usually acceptable, however, in wellhead gas flow measurement the raw gas is simply too wet and dirty, as any change in orifice conditions will directly impact flow measurement. Since Ultrasonic gas flowmeters rely on time differential sound waves to measure flow, raw, wet, dirty gas has little or no effect on overall meter accuracy. While ultrasonic flow measurement technology tends to be costlier than traditional flow measurement technologies, advances in system design have greatly reduced the price gap. Consider that even a single unplanned service visit to a well can cost \$10,000 or more, the added reliability of ultrasonic flowmeter technology is well worth the expense.

## Utilizing Advanced Technologies To Overcome Flow Measurement Challenges

Maintaining accuracy in applications with limited straight runs remains an industry challenge. In gas flow measurement ideal conditions require upstream straight runs as much as 20D. In practice, this may be difficult, costly, or in some cases impossible to achieve. Recognizing the challenges associated with limited straight run requirements, especially when applied to well-head flow measurement, GE has embarked on a comprehensive year-long study to quantify pipe bend effects on flow profiles under a wide range of conditions. 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.

The example to the right is the actual piping flow CFD dynamic model of a well head skid after the water separator. With this model GE is able to recommend the optimal meter position on the skid to maximize accuracy and overall meter performance as well as define the Reynolds correction factors to optimize meter accuracy.

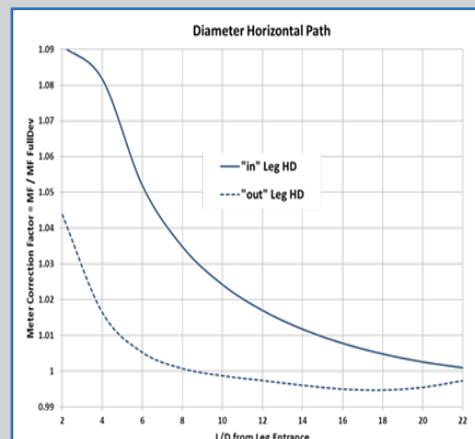
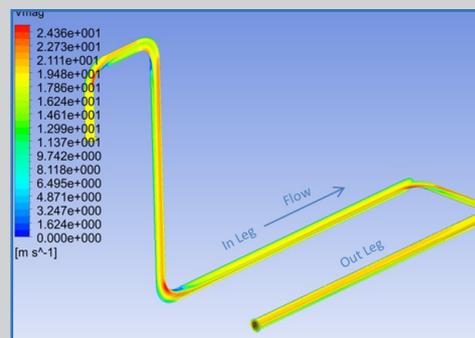
To the right, one can see the detail of how the flow profile behaves after the separator (the "in" leg) and after the u-bend (the "out" leg).



► Coal Seam well-head with water separator



► Tight Gas well-head Installation



The optimal flow meter placement would be on the out leg at 8 to 12D from the bend, as shown on the correction factor curves to the right.

This is a great example of how GE uses CFD to enhance and optimize flowmeter performance in difficult applications. Without this enhanced CFD modeling the meter accuracy would be lost. Consider a meter placed on the in leg. Depending on meter location, un-corrected meter on the in leg may have an additional added inaccuracy of 2-5%.

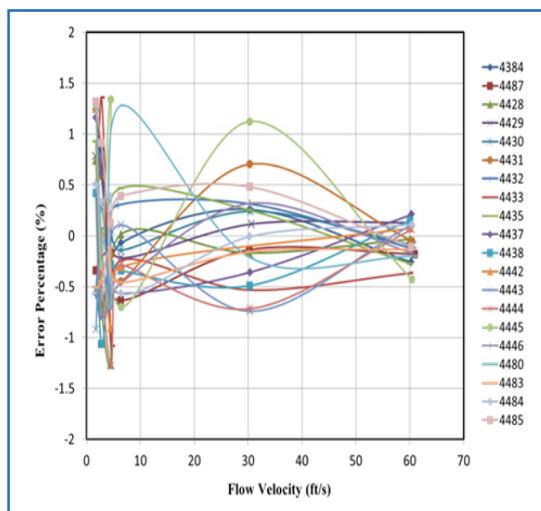
## Accuracy Through True Calibration

Wellhead meter accuracy is another key parameter in the consideration of a flow measurement technology. Z1G ultrasonic flowmeters consistently meet 1.5% accuracy across the documented flow velocity range, from 1.7 ft/s up to 60 ft/s, the limit of the calibration lab. As expected, the flowmeter shows even better accuracy at higher flows; for example, all the meters meet 0.5% accuracy at 60 ft/s and above. All Z1G meters go through a rigorous calibration, assuring accuracy across the entire range of flows.

## Global In Scope Local In Presence

With a footprint that is global in scope but local in presence, GE Measurement and Sensing reaches globally in technical achievement, product performance and product quality; but acts locally in customer focus, service and support. With service and applications centers around the globe, staffed with skilled engineers and technicians, GE Measurement and Sensing is well positioned to provide timely support at remote locations at a moment's notice. GE Measurement and Sensing is your partner in assuring the health and performance of your critical oil and gas assets.

Contact your Local Account Manager for more information.



▶ Z1G Coal Seam meter calibration results



▶ Global Service Centers