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The Micro Motion® ELITE® Promise



www.micromotion.com

Introduction

Micro Motion meters have long been considered both:

- Easy to use – Micro Motion® meters are preferred over so many other technologies and competitors' products for this reason
- Difficult to use – Everyone has heard this statement at least once about Coriolis meters

So how can our meters be easy and difficult to use *at the same time*? The answer lies in the definition of “easy” and “difficult.”

Micro Motion meters are easier to use than a number of competing technologies. For example, they are clearly easier to use and configure than an orifice plate. An orifice plate not only requires three independent measurements – temperature, static pressure, and delta-pressure – but the user must also be cognizant of straight-run requirements and flow profile effects. And that's not all. With an orifice plate, density measurement must be provided (by measurement or calculation), which requires additional instrumentation or a flow computer.

A Micro Motion meter takes care of all of these limitations. With a Micro Motion meter only one instrument is required (no pressure, temperature, or flow computer instruments are needed), and there are no flow profile effects so the meter can be installed anywhere in the pipe-work.

Although Micro Motion meters are easy to use, we haven't exactly highlighted this fact. Historically, the advantages gained by measuring mass flow directly with Micro Motion have been somewhat diminished by the company's own conservative history. Micro Motion has imposed rigorous installation requirements on our equipment and we have traditionally required the meters to be zeroed upon installation. These requirements, dating back to the earliest designs in the evolution of Coriolis technology, helped to ensure the best measurement possible over the widest possible flow range and in the broadest range of applications, but also fostered the belief that Micro Motion meters are difficult to use.

With the introduction of our newly improved and enhanced Micro Motion ELITE® meters, Micro Motion will offer all the benefits of a mass flow meter that is truly simple to install and use. Of course all the traditional advantages remain. Micro Motion meters still provide the most accurate measurement

possible by measuring mass flow and density directly. Now, new advances enable mounting and zeroing requirements to be minimized: Micro Motion meters do not require any additional mounting supports¹ and they do not need customers to adjust the factory zero under most operating conditions.

Not only do these improvements to Micro Motion meters enable us to enter a new era of Coriolis technology, they also provide us the opportunity to make “Micro Motion meters” synonymous with “easy to use.”

What Is the ELITE Promise?

The Micro Motion Promise is about delivering unparalleled expertise and innovation to our customers around the world. Micro Motion ELITE meters truly represent the Promise.

Micro Motion ELITE meters will provide good, stable, and accurate measurements over all conditions in real-life installations. Meters will be immune to all field affects – that is, things in real-life that can change. This list includes (but is not limited to) changes in:

- Pipe stress and loads
- Fluid pressure
- Fluid temperature
- Ambient temperature and humidity
- Fluid density
- Vibration

We have all grown accustomed to some aspects of the very good performance ELITE meters provide. For instance, we know that the factory water calibration is valid for fluids of all densities: gases, TiO₂, and crude oil, to name just a few. Micro Motion ELITE meters are also very accurate over a wide range of fluid pressures and temperatures. In these examples, we have internalized the message as “the flow calibration factor” or simply “the calibration” is unchanged.

But what about the zero? Should we also treat the zero as a calibration constant that is set at the factory? This is one important aspect of the Promise. The zero of the meter is indeed set at the factory, and only under a select few application conditions should there be a need to change the zero from this factory calibrated value. Figure 1 shows the test results from a liquid nitrogen test performed at NIST (laboratory uncertainty = ±0.2%).

¹ Normal pipeline support is all that is required.

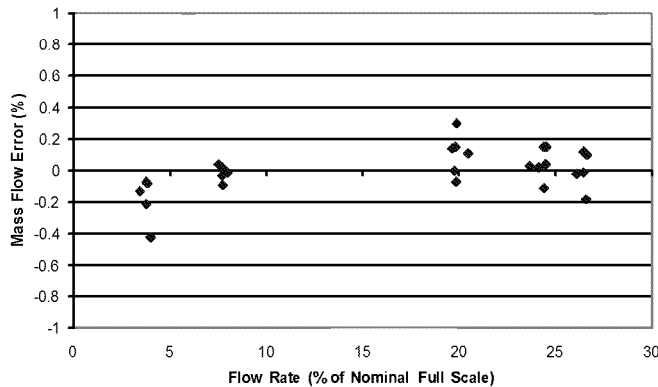
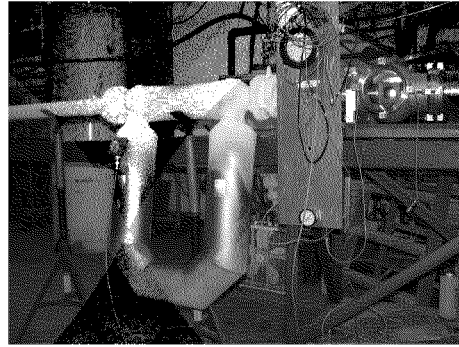


Figure 1. NIST Liquid Nitrogen Test on CMF300 Enhanced ELITE Meter



This Micro Motion ELITE meter was:

- Calibrated in the Micro Motion Service Center (water at 20 °C)
- Zeroed in the Micro Motion Service Center (water at 20 °C)
- Tested at NIST (liquid nitrogen at -190 °C)

Note that there was no change in the calibration (including the zero) over a temperature range of 210 °C!

- 1) When we speak of calibration at the factory, it is not just the calibration factor anymore. Calibration is an all-encompassing term that means all of the calibration constants, namely: Flow and density calibration factors, and
- 2) Zero, have been established by our precision calibration facilities in the Service Center. Neither of the calibration values should require modification in the field.

What are the ELITE Improvements?

The improvements that have had a large impact on robustness can be grouped into three main categories: sensor dynamics, electronics and software, and temperature measurement.

Sensor Dynamics

Coriolis meters vibrate. This is an obvious statement, but what is less obvious is that we want to contain the vibration and isolate it to the sensor only. For example, if the vibration “bleeds out” to the pipeline, the sensor can be susceptible to pipeline loading and stress. Our design engineers have redistributed the small balance weights and other internal components of the sensor to minimize the potential of vibration “bleeding out.”

While this may seem like an obvious design criteria (and it is), it is much easier said than done. Micro Motion meters are used over such a wide range of conditions, from low density gas to high density slurries and from cryogenic temperatures to over 400 °C that it was a big design challenge to make the meters perform over such a wide range.

Electronics and Software

The first big change to Micro Motion electronics in 10 years occurred when MVD™ technology was released in 1999. MVD (multi-variable digital) technology allowed for the first truly digital signal processing-based (DSP) Coriolis transmitter commercially available. The technology in MVD electronics brought a new level of performance to users in the form of repeatability, accuracy, and fast response time – all at the same time. Now, there is an enhanced version of MVD electronics with greater processing power and new signal processing algorithms.

When products like our MVD transmitters have earned such a high regard in the marketplace, how do you make improvements that are of real value? Although the accuracy and repeatability of the new enhanced electronics is even better than its MVD predecessor, improvements in this area will be difficult to recognize in all applications because MVD technology was already so good.

Therefore, to increase value that is easily recognizable, both functionality and utility were also improved. The new enhanced electronics signal processing now includes a digital drive system. This means the drive circuitry is synthesized and filtered digitally allowing a great deal of versatility in the way we vibrate the sensor.

As a result, with the new enhanced electronics signal processing and digital drive we can make accurate mass flow measurements when entrained air levels exceed even 10% void fraction. The electronics improvements also enable new functionality that is not available anywhere else. Micro Motion can now measure the structural integrity of the flow tube, giving a clear indication of tube changes due to corrosion, erosion, over-pressurization, or product buildup, with the meter still installed and under normal process conditions. The recognizable benefit of this is to minimize, if not eliminate, the need for periodic recalibration.

² Consult the price list for the price adder for the 0.2 kg/m³ density measurement.

Temperature Measurement

We have always measured the tube temperature, which is used in our mass flow and density measurements. When any metal gets hot it gets softer (conversely, when a metal gets cold it gets harder). For a fixed mass flow, we get a larger raw signal when the meter is hot than when it is cold, so we have to make a compensation.

It turns out that the influence of temperature measurement errors on mass flow accuracy is very small. However, temperature measurement errors on density and volume flow accuracy can sometimes be significant. We have improved our temperature measurement and speed of response on all meters to the point that we can measure density better than 0.5 kg/m^3 from -20 to $60 \text{ }^\circ\text{C}$. The temperature measurement improvements, when taken together with a special factory density calibration², allow an improvement in the density specification to $\pm 0.2 \text{ kg/m}^3$.

How Do We Validate the Improvements in ELITE Meters?

Micro Motion has invested over \$1.2M in the past three years in state-of-the-art test facilities. A summary of the test facilities include the following capabilities:

- Water, 20 to $85 \text{ }^\circ\text{C}$
- High viscosity fluids up to 100,000 cp
- High density fluids up to 1500 kg/m^3
- Gas up to 750 psi and rates up to 2000 lb/min
- Brooks Compact Prover, rates up to 25,000 lb/min
- Fast batching, with fill times less than 0.5 seconds
- Response time measurements to less than 10 milliseconds
- Ambient test systems that introduce rain, humidity, and temperature extremes between -40 to $+55 \text{ }^\circ\text{C}$
- All Micro Motion facilities are traceable to $<0.014\%$, validated by ISO17025 accreditation.

The standard test protocol for Micro Motion is to evaluate meters in the engineering facilities as if we are a customer. That is, we don't change *any* calibration constants (remember, calibration constants include the zero) from the Service Center, and test just as if we were a customer installing a meter for the first time. Performance is always very good.


When Should an ELITE Meter be Zeroed?

The only time we recommend zeroing the meter in the field is when metering low pressure gas. Because the gas density is low, the mass flow is usually low and the meter is often operating at a very low flow rate for the size of meter.

What Does the ELITE Promise Mean to You?

In two words – rest easy! Micro Motion has made great strides in improving the stability of our measurements over a tremendous range of conditions. You can expect that the improved ELITE meters will perform to your expectations under almost any condition. Not only can you expect that an ELITE meter is accurate over the long-haul with changing conditions, you can count on it being accurate the moment you take it out of the box, with no changes to the factory calibration. The promise of the ELITE meter, like the Micro Motion Promise, assures you that your process is supported by unparalleled expertise and innovation – day in, day out.

The Micro Motion ELITE Promise

 www.micromotion.com

Micro Motion supports PlantWeb[®] field-based architecture, a scalable way to use open and interoperable devices and systems to build process solutions of the future.

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