



# The Superiority of Coriolis Meters for CO<sub>2</sub> Vapor Measurement in CCS Pipelines

## Application Note

**Establishing carbon capture and sequestration (CCS) at the scale and reliability needed to achieve environmental goals, support safety requirements, and reduce financial exposure for CO<sub>2</sub> trading requires accurate and consistent measurement of CO<sub>2</sub> vapor. Many CO<sub>2</sub> pipelines operate at pressures where the measured CO<sub>2</sub> exists in vapor phase and several technologies exist for measuring vapor flow, but Coriolis mass flow meters have key advantages that make them leading candidates for this purpose.**

One key advantage of Coriolis meters is their ability to perform direct mass measurements which enables field performance verification through advanced meter diagnostics and eliminates the need for fluid density calculations. With a demonstrated track record of measuring CO<sub>2</sub> in enhanced oil recovery (EOR) applications, Micro Motion™ ELITE® Series Coriolis meters are designed for superior mass flow, density, and volume measurement in the widest variety of line sizes and materials.

### Field Verification Without Standards

A challenge for CO<sub>2</sub> pipeline operators, many of whom are in the midstream space of the oil and gas (O&G) sector, is the lack of industry best practices for vapor-phase CO<sub>2</sub> measurement and field verification. While there are currently no industry-accepted standards for CCS applications, the American Gas Association's Report No. 11 (AGA 11), Measurement of Natural Gas by Coriolis Meter, provides best practices for applying Coriolis mass flow meters to natural gas measurement that can be used for vapor-phase CO<sub>2</sub> installation guidance. Section 9 of AGA11 guides installation and field verification of Coriolis meters which is accomplished by checking meter zero, monitoring advanced meter diagnostics, and verifying meter temperature. Coriolis flow meters help overcome this challenge with the ability to check measurement performance in situ, which eliminates the need for expensive and time-consuming manual verification processes or ex situ meter calibration.

CO<sub>2</sub> measurement is regulated by the US EPA under Title 40 CFR Part 98.3 which establishes mandatory greenhouse gas (GHG) reporting requirements for owners and operators of certain facilities that directly emit GHG. US EPA allows the use of "manufacturers recommended procedures" for meter field verification. Micro Motion has formal recommended field verification procedures which can be provided to users to comply with this regulation and follow AGA11 recommended field verification procedures.

### The Criticality of Instrumentation Materials

Another challenge for CCS pipeline operators is corrosion. Highly corrosive carbonic acid can form in the pipeline when CO<sub>2</sub> and water combine during CO<sub>2</sub> transportation and distribution. Carbonic acid corrosion can quickly undermine the integrity of instrumentation and pipeline elements and lead to costly repairs or shutdowns. To guard against this threat, the quality of materials used in measurement instrumentation is paramount. When evaluating vendors, it is important to consider instruments constructed from materials such as alloy C or super duplex stainless-steel alloys that resist this type of corrosion. Similarly, 316 stainless steel wetted parts should be applied to dry CO<sub>2</sub> vapor measurement.

## Micro Motion Innovations

Emerson's Micro Motion Coriolis meters deliver the most accurate and repeatable mass flow measurement for CO<sub>2</sub> vapor and have been continually refined to include features that help streamline operations and increase reliability.

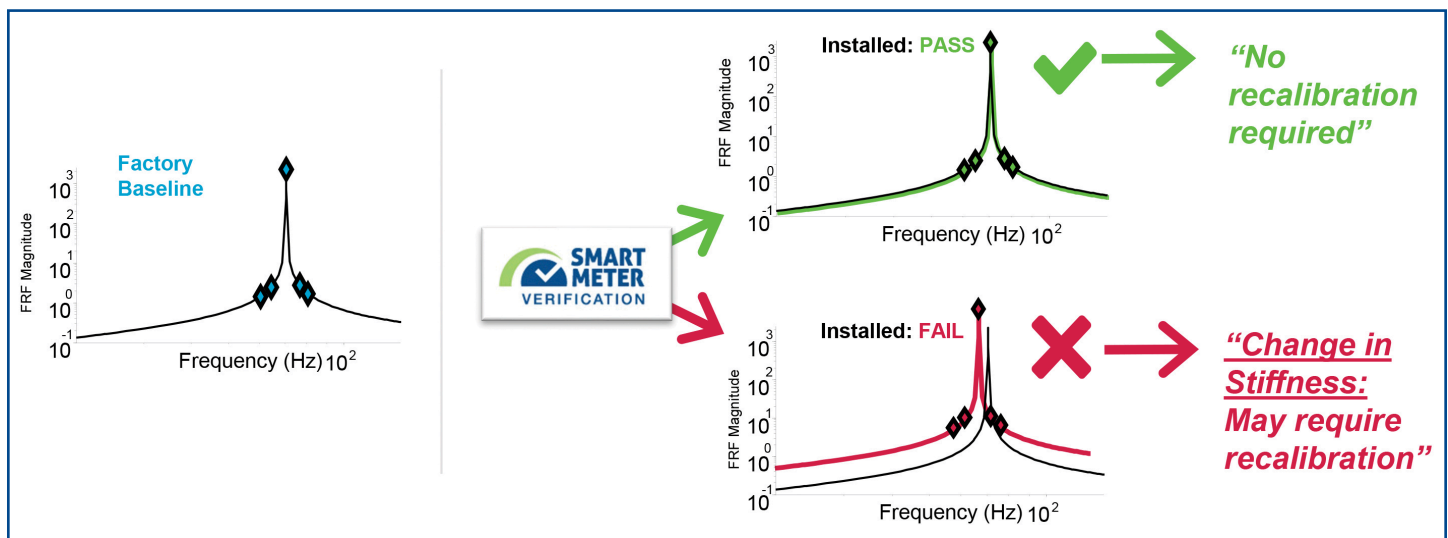
ProLink III is an intuitive, Microsoft Windows-based configuration and service tool available exclusively for Micro Motion meters. ProLink III includes functionality to verify whether a meter zero value needs to be changed based on current operating conditions. The software allows meter zero to be verified without changing the zero value. A meter zero verification report is generated that records the as-found and as-left meter zero values.

Smart Meter Verification is another exclusive feature that provides an advanced online diagnostic function to verify Coriolis meter, transmitter, and interconnecting wiring while a meter is in normal operation. Meter measurement is not impacted while Smart Meter Verification is running, and Smart Meter Verification initiated on-demand or scheduled to run automatically.

Coriolis meter integrity is field verified by calculating meter tube stiffness at the inlet and outlet pickoff coils. The Coriolis meter is exposed to five frequencies and the frequency response is used to determine tube stiffness. As shown in Figure 1, a comparison is made between the field-measured frequency response (tube stiffness) and factory-stored values.

Additional Smart Meter Verification diagnostics test the integrity of the Coriolis meter electronics, interconnecting wiring, and transmitter functionality. Successful completion of Smart Meter Verification provides a high level of confidence Coriolis meter measurement is measuring within the specified accuracy.

To extend the value of Smart Meter Verification, the Micro Motion model 5700 Coriolis Transmitter can be configured to provide a discrete output in the unlikely event of a Smart Meter Verification test failure.



**Figure 1** Emerson's Smart Meter Verification software continually compares actual meter performance against factory baselines and automatically alerts your operators if discrepancies arise.

## Conclusion

As the energy transition moves forward, CCS will become more prevalent and will be especially important in heavy industries like power, metals production, and O&G. With that shift comes the need to measure and monitor CO<sub>2</sub> vapor at different points in the processes. Coriolis mass flow meters provide some key advantages for CO<sub>2</sub> vapor measurement and can be applied by following existing guidance for installation and field verification. Emerson's Micro Motion Coriolis meters are constructed with the highest quality materials to help resist corrosion and include features like ProLink III and Smart Meter Verification that enable reliable meter diagnostics and documentation of successful meter verification events. To help facility owners and operators maintain compliance with tightening GHG reporting requirements, Emerson can supply a field verification procedure for EPA Title 40 CFR Part 98.3 reporting compliance.

## References

Learn about: [ELITE Series Coriolis Meters](#)

Learn about: [Smart Meter Verification](#)

Article: <https://www.worldoil.com/magazine/2023/march-2023/special-focus-sustainability/measurement-of-co2-throughout-the-carbon-capture-utilization-and-storage-chain/>

Smart Meter Verification: <https://www.emerson.com/en-us/automation/brands/micro-motion/smart-meter-verification>

Emerson ProLink III: <https://www.emerson.com/en-us/catalog/micro-motion-sku-plk>

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