



Periodic Verification & Calibration of Micro Motion Coriolis Flow Meters

Ensuring your flow meters are performing accurately is essential for managing product quality, reducing waste and rework, providing a safe work environment, and to provide assurance that you've measured exactly what was delivered. How often an instrument's accuracy is verified is really a function of risk - what if the measurement is off for a week, a month, or a year? What are the consequences of failing a quality audit, or reporting an incorrect number to a regulating agency? Is there a safety risk to employees if a leak is not detected or a tank is overfilled? To assist customers in maintaining a regular verification schedule, or to identify if a flow meter needs to be calibrated, Micro Motion has developed a comprehensive in-situ diagnostic technology called Smart Meter Verification. Adding the Smart Meter Verification option when ordering new meters, or retrofitting qualified installations, can greatly enhance a user's ability to assess the current performance of a given flow meter.

Calibration versus Verification

For the purposes of this paper, calibration is defined as a comparison between a meter's readings and a known reference in order to establish a relationship between measured and actual. The uncertainty of the reference may vary – for instance, the controlled conditions at a Micro Motion factory Service Center provide the best possible assurance that your meter is performing to its original specifications (with flow stand uncertainties as low as $\pm 0.014\%$ of the mass flow reading!). If shipping your meter is not preferable, or not possible, there are many methods available to validate a meter's calibration in the field - such as comparing to a "master" Coriolis meter installed on-site by a factory-trained technician, volume proving, or catching-and-weighing a batch on scales or load cells. Alternatively, verification is defined as an analysis of secondary variables associated with flow (such as the meter's structural integrity) in order to provide confidence that the operation of the meter (and hence the accuracy) has not been compromised – this is the basis of Micro Motion's Smart Meter Verification technology.

Coriolis Meter Considerations

The main attributes of a Coriolis flow meter are both the absence of any moving parts and the nonintrusive design of the measuring sensor. There are no bearings or rotors to wear, turbines to be deformed, electrodes to coat, or degradation of orifices to be concerned about. However, the flow tubes *do* vibrate – controlled by a drive coil mounted on the exterior of the internal flow tubes – and most sensor designs include a flow-splitting manifold to evenly divide the flow into two paths. It has been our experience, and that of our customers, that when appropriate materials are selected Coriolis meters do not drift or lose their calibration during the life of the meter. When performance issues arise, the cause of the problem is typically traceable to the meter installation, user changes to the electronics, customer maintenance procedures or a characteristic of the process that was not previously taken into consideration – such as entrained gas, erosion, corrosion, or coating.

Verification Interval

The question of how often any flow meter should be verified or calibrated, including Micro Motion Coriolis meters, is something typically left to the discretion of the end user. When

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possible, customers should first establish an acceptable verification schedule based on company-specific policy, industry accepted guidelines, or any other regulations that may apply to them or their business activities. And only when warranted, following a failed Smart Meter Verification result for instance, or when required in accordance with a 3rd party requirement (like API, AGA, or EPA standards), should a meter be sent back for a complete factory evaluation and recalibration.

Calibration Interval

For customers that have not otherwise established a company policy, and have no industry guidelines to follow, a 3-year calibration interval is suggested - however, when equipped with Smart Meter Verification, this interval may be extended indefinitely if tested regularly with a passing result - at least once every 3 months is recommended. (See the Appendix for a White Paper discussing the validity of using Smart Meter Verification results to verify meter accuracy.)

Regularly Scheduled or As-Needed

Any time a flow measurement issue is suspected, a verification should be performed. For an appropriately equipped meter¹, users can run Smart Meter Verification at any time via the local display, with a 475 or TREX Field Communicator, through a digital host standard such as HART, Foundation Fieldbus, or Ethernet/IP, with AMST[™] Suite: Intelligent Device Manager, or even wirelessly via a Smart Wireless THUM[™] adapter. However, a more practical approach is to monitor the meter's performance over time. This method provides not only a singular Pass/Fail result each time a test is run, but also a history of the meter's performance over time. Any sharp deviation or abnormal trend would indicate that further investigation is needed. The ability to identify a deteriorating trend in the data can enable your maintenance staff to predict when a meter might need service in the future (in known erosive/corrosive services for example). Smart Meter Verification can be set to run automatically on a schedule and stores at least 20 prior test results in memory² - which can be downloaded and analyzed on demand.

Repairs and Field Service

Routine repairs like replacing electronics (a transmitter or core processor^{2,4} for example), may not necessarily warrant a factory recalibration if the meter was known to be in good working order prior to the replacement (based on the results of regular diagnostic verifications). Emerson's certified Lifecycle Services Field Service technicians can perform such repairs and are available in most locations to reduce downtime and minimize the impact to your maintenance personnel. Services include: performing routine maintenance, troubleshooting, upgrading transmitters with new diagnostics where applicable¹, taking field baseline signatures, certifying witnessed Smart Meter Verification reports, and performing factory-certified field calibrations.

Smart Meter Verification

All Micro Motion Coriolis meters equipped with "enhanced" MVD³ core processors or integral mount 2400S, 4200, and 5700 Series Transmitters are available with Micro Motion's optional Smart Meter Verification – which verifies the complete health of the meter without breaking the process seal, or even stopping flow! In less than two minutes, the meter's current performance is compared against a series of baseline signature values taken at the factory to verify the structural integrity of the flow tubes, the signal processing performance, and the transmitter electronics.

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Appendix:

1. ***“Allow Smart Meter Verification to Reduce your Proving and Proof-Test Costs”*** (2012) by Timothy J. Cunningham and Tom O’Banion. White paper.
www.emerson.com/documents/automation/white-paper-allow-smart-meter-verification-to-reduce-your-proving-proof-test-costs-micro-motion-en-65138.pdf
2. ***“Time for Calibration?”*** (2009) by Jonas Berge, Director of PlantWeb Consulting, Emerson Process Management - article from **Control Engineering: Asia**.
<https://www.emerson.com/documents/automation/article-time-for-calibration-micro-motion-en-37684.pdf>
3. For EPA CFR 40 Part 98 Greenhouse Gas Compliance, please refer to the Micro Motion Manufacturer Recommended Calibration Practices document for Greenhouse Gas:
<https://www.emerson.com/documents/automation/flyer-recommended-best-practices-for-calibration-of-coriolis-meters-used-to-comply-epa-40-cfr-part-98-green-house-gas-rosemount-en-60754.pdf>
4. Video: ***“Reduce Downtime w/ Micro Motion Smart Meter Verification”***, 2013, (Micro Motion YouTube Channel - www.youtube.com/user/MicroMotionVideos):
<http://www.youtube.com/watch?v=DKINaUrckj8>
5. ***“Verification of Coriolis Flow Meter Calibration: Theory and Practice, Including Lab and Field Results”*** Paper #2015-0164 CsHm (2015) by Timothy J. Cunningham, P.E., Technical Fellow, Micro Motion, div. of Emerson Automation Solutions.
<https://www.emerson.com/documents/automation/white-paper-verification-of-coriolis-flow-meter-calibration-2015-0164-micro-motion-en-66688.pdf>

1. Smart Meter Verification (SMV) is available on all Micro Motion 4-wire MVD™ transmitters paired with an “enhanced” core processor, on all integral mount 2400S, 4200, and 5700 Series transmitters, and on enhanced core MVD™ Direct Connect™ meters wired directly to a Modbus host system. Retrofitting existing sensors from standard core processors to “enhanced” is not possible, but some meters *can* be upgraded in the field or at the factory.
2. Replacing “enhanced” core processors used in conjunction with Smart Meter Verification will cause the meter to lose all factory signature baseline data and prior field test results. A field signature should be performed immediately upon replacement to capture new baseline values for meters known to be in good working order.
3. MVD™ stands for Multi-Variable-Digital – Micro Motion Coriolis meters measure three primary variables in real-time: mass flow, density, and temperature – from which many other variables can be derived.
4. If your meter was ordered with an accredited ISO 17025 calibration, replacing electronics voids the accreditation. To obtain re-accreditation, please return meter to a Micro Motion ISO 17025 accredited facility for recalibration.

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