Methods for In-Situ Calibration Verification of FCI ST100 Series Thermal Mass Flow Meters

To comply with internal procedures and ensure process integrity and quality, and/or comply with regulations and government mandates, flow meter users are often required to periodically validate and verify the meter’s calibration and operational integrity. Traditionally, the only way to meet this requirement was to pull the meter out of service and return it to a factory calibration center or a third-party calibration laboratory to have it checked. Clearly the expense and time to shut down the process, plus the labor to physically disconnect the meter and remove it, plug or by-pass the pipe, and to box and ship the meter, are very high. And after all this, to have the laboratory advise the meter’s calibration was still valid and no adjustments were needed, is exasperating. Further, many regulations and best practices recommend checking the flow meter in its actual operating environment rather than the pristine conditions of a laboratory. Until now this ability to field-verify a flow meter’s calibration on site has been elusive and, while still installed in the process piping, virtually impossible.

In response to these challenges, a few manufacturers of thermal flow meters now offer some type of self-checking capability. These range from a crude single point “zero” check, to fully extracting the sensor and transmitter out of the process and bench testing with DMM while a wet towel is wrapped around the sensor head. Another manufacturer answers the challenge by recommending a second meter be purchased and installed as a check-meter. All of these techniques provide operational insights, but have limitations, user complexity, purchase expense and costs/time to conduct the test. These verification techniques are categorized as a “dry” verification, which simply means there is not actual fluid flow being measured. There is only one “wet” verification system, and that is an FCI exclusive as discussed here.

FCI’s ST100 Series thermal mass flow meters respond to this in-situ calibration verification challenge by offering an embedded, no cost dry method and a true wet method. The best-in-class three point dry test is a standard feature in all ST100 Series models. FCI’s exclusive and patented VeriCal™ system is optionally available. VeriCal is the only thermal flow meter “wet” in-situ calibration verification system available.

The following pages provide a description and details of these two FCI methods of in-situ verification of calibration with FCI ST100 Series air/gas flow meters.
Unique to the FCI ST100 Series is that the self-test may be initiated in three ways by the user:

1) On demand from the ST100 flow meter's keypad – through-the-glass activation, no need to remove the lid (Figure 2).
2) On demand from a computer connected to the flow meter's USB port (Figure 3).
3) Automatically on pre-set day(s) and time(s), programmable.

The results of the self-tests provide the operator with an easy to understand PASS/FAIL message for each of the three test points, plus the digital reading of the actual base line values shown in comparison to the actual resulting test values. The results are displayed on the ST100’s digital display (Figure 2) and/or the computer connected to the USB port (Figure 3). If the test was initiated automatically, the results are recorded to the ST100’s on-board data logger with day and time stamp in a .csv format for easy user retrieval and creating hard copy reports as desired.

* If the flow meter is a two-point model, e.g. ST102A, ST112A, STP102A or STP112A, there are total of six precision resistors and the self-test will be performed for both sensor circuits.
VeriCal™ In-Situ “Wet” Calibration Verification

Models ST110, ST112, STP110 and STP112

- Only "wet" check system available
- Validate performance on-site in minutes
- Save costs, no need to remove flow meter from process
- Comply with company procedures and local regulations for periodic calibration verification

Models ST110, ST112, STP110 and STP112 include FCI’s exclusive and patented VeriCal system. VeriCal provides the ability to perform field validation and verification of the flow meter’s measuring performance and calibration on demand without disconnecting the flow meter from the pipe or process.

In gas flow processes with procedures or regulations requiring periodic calibration verification, an FCI flow meter configured with VeriCal provides the most convenient and lowest cost solution. Performing a verification with VeriCal also provides a secondary benefit of cleaning the flow element to further ensure performance and reduces the need for routine maintenance.

The VeriCal option is comprised of three components (Figure 4):

- **VeriCal ready flow element** – This specially-constructed flow element includes a flow port at the sensors, internal tubing, sonic nozzle, a valve to select “normal” or “VeriCal” operation, and a welded and sealed inlet check valve to prevent hazardous process gases from escaping. After the flow meter system has been precision calibrated for normal operation gas(es) with NIST and ISO 17025 traceable equipment in FCI’s calibration laboratory (Figure 5), the lab also performs an additional nitrogen calibration and obtains five (5) baseline measurement points across its flow range to which all field checks using the VeriCal system are compared (Figure 6). With each ST110, ST112, STP110 or STP112, FCI provides a printed document showing the five baseline VeriCal flow readings for field technicians’ use. The VeriCal calibration curve is stored as one of the ST100’s calibration groups which is easily selectable via the meter’s keypad or serial port.

- **VeriCal kit** provides the fixtures and fittings to meter and control a precise flow of nitrogen across the ST flow element. The VeriCal kit provides a specially designed 100 psig [6.9 bar(g)] pressure regulator and LCD digital pressure gauge packaged in a NEMA 4 (IP66) rated enclosure, and a 25 foot [7.6 m] air hose with quick disconnect fittings to connect the kit to the VeriCal ready flow element. The kit is fully portable or can be permanently mounted. The VeriCal kit, part number 020849-03, is ordered separately. A single VeriCal kit can be used with and support any number of VeriCal-ready flow elements.

- **Nitrogen or pressurized air source** (user supplied) regulated 125 psig to 150 psig [8.6 bar(g) to 10.3 bar(g)], either from an installed plant line or a portable supply tank. A typical test requires approximately 40 ft³ [1.1 m³] of nitrogen.

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**Figure 4. FCI’s exclusive, patented VeriCal system**

**VeriCal Kit**

- Rugged, portable NEMA 4X/IP66 rated box
- Digital pressure gauge
- Regulator 100 psi [7 bar]

**VeriCal-Ready Flow Meter**

- Sonic nozzle
- VeriCal or Normal operation valve
- Check valve
- VeriCal one-way inlet valve
- ST Series retractable flow element with VeriCal fittings

Nitrogen or compressed air, hose user supplied
How It Works

With the VeriCal kit attached to the ST flow meter and the nitrogen or air source, a positive-pressure nitrogen or air injection is introduced. With the ST flow element fully retracted from the actual flow stream and the ST set in the VeriCal Calibration group mode, the user adjusts the pressure at the VeriCal kit to inject small, controlled doses of nitrogen* or air* at specific pressures (prescribed on the FCI VeriCal calibration document). At each pressure point, a maximum volume of nitrogen is passed through the sonic nozzle, resulting in highly accurate and repeatable flow rates, which are compared to the respective baseline readings in the VeriCal calibration document provided by FCI. This procedure is performed at initial installation, then as often as desired.

* For applications in which nitrogen or air cannot be put into the process, FCI can supply the system with a bleed port to vent calibration check gas into the atmosphere.

**Figure 5. Flow meter calibration**

**Figure 6. VeriCal baseline certificate**

Users of thermal mass air/gas flow meters (TMF) looking to perform field verification of their flow meter’s calibration must be aware of manufacturer’s limitations. The techniques deployed by TMF manufacturers to do field, in-situ calibration verification and drift checks vary significantly in their thoroughness, complexity, and costs. FCI’s “dry” check is the industry’s only three point check and only one that can be pre-programmed to run automatically. FCI’s VeriCal is the only multipoint, full span “wet” verification system available.

**Model ST110:** Single-point insertion flow meter configured with VeriCal

**Model ST112:** Dual-element flow meter; both elements configured with VeriCal

**Model STP110:** Single-point flow meter with pressure measurement configured with VeriCal

**Model STP112:** Dual-element flow meter with pressure measurement option; both elements configured with VeriCal

P/N 020849-03: VeriCal kit
To see videos of the VeriCal operation or for more information on the ST100 Series flow meters, visit FCI online:

www.FluidComponents.com > News/Events > Demos & Videos

FCI VeriCal In-Situ Calibration Sensor Installation And VeriCal Procedure Demonstration
http://www.fluidcomponents.com/verical-demo

VeriCal In-Situ Calibration Demonstration With ST100 Flow Meters
http://www.fluidcomponents.com/verical-ST100

ST100 Demo With Close-Ups Of All Models And Their Features
http://www.fluidcomponents.com/assets/media/fci.swf

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