Calibration Verification Practices Rosemount 8700 Magnetic Flowmeters

INTRODUCTION

This document is intended for users of Rosemount series 8700 magnetic flow meter transmitters and sensors to use as a guideline for plant calibration and verification procedures and is focused on calibration and verification practice only. The user is responsible for the implementation of these guidelines in the plant, and should consider process criticality, product, plant and personnel safety, and legal and regulatory requirements when establishing the plant specific procedures. This document provides the standard practice calibration for Rosemount transmitter models 8712 and 8732, and sensor models 8705, 8707, 8711 and 8721. It does not include calibration procedures associated with Foundation Fieldbus or Profibus PA communication protocols.

Guidelines for Calibration/Verification

- The criticality of the loop has little impact on the technical requirements for calibration or verification of the flow meter. For standard loops, minimum calibration/verification should be required. However, in the case of critical loops that can directly impact plant or personnel safety, product safety, or are regulated by law or agency, the user should consider adjusting verification steps and/or frequency according to the risk in the case where the measurement fails.
- Standard: Section 2 through Section 3 should be completed as required. If these criteria are met, there will be no significant change in meter performance from the time of calibration.
- Critical: Section 2 through Section 3 should be completed as required. There will be no significant change in flowmeter performance from time of calibration for at least 5 years. If a new calibration is required, the meter can be sent back to Rosemount Inc., Eden Prairie, MN USA to be calibrated.

Documentation

This documentation is unique for each flow meter, and should be retained as a baseline.

- Factory Calibration Report (this data is shipped with the sensor and should be filed as a baseline reference.)
- Rosemount 8700 Magnetic Flowmeter System Configuration Data Sheet, P/N 00813-0100-4727 http://www2.emersonprocess.com/siteadmincenter/PM%20Rosemount%20Documents/00806-0100-4727.pdf

This documentation is common across the product model(s) indicated.

- Applicable Instrument Specifications (optional)
- 8712D Magnetic Flowmeter Transmitter Documentation:
  - Quick Installation Guide, P/N 00825-0100-4661 (shipped with product) http://www2.emersonprocess.com/siteadmincenter/PM%20Rosemount%20Documents/00825-0100-4661.pdf
- Magnetic Flowmeter Transmitter Manual, P/N 00809-0100-4661 (optional)
  - http://www2.emersonprocess.com/siteadmincenter/PM%20Rosemount%20Documents/00809-0100-4661.pdf
- 8712E Magnetic Flowmeter Transmitter Documentation:
  - Quick Installation Guide, P/N 00825-0100-4664 (shipped with product) http://www2.emersonprocess.com/siteadmincenter/PM%20Rosemount%20Documents/00825-0100-4664.pdf

- Magnetic Flowmeter Transmitter Manual, P/N 00809-0100-4664 (optional) http://www2.emersonprocess.com/siteadmincenter/PM%20Rosemount%20Documents/00809-0100-4664.pdf
- 8732E Magnetic Flowmeter Transmitter Documentation:
  - Quick Installation Guide, P/N 00825-0100-4662 (shipped with product) http://www2.emersonprocess.com/siteadmincenter/PM%20Rosemount%20Documents/00825-0100-4662.pdf
  - Magnetic Flowmeter Transmitter Manual, P/N 00809-0100-4662 (optional) http://www2.emersonprocess.com/siteadmincenter/PM%20Rosemount%20Documents/00809-0100-4662.pdf
- 375 Field Communicator
  - Field Communicator Manual, P/N 00375-0047-0001 http://www.documentation.emersonprocess.com/groups/public_assetoptprodlit/documents/instruction_manuals/375_allma_usermanual.pdf
- 475 Field Communicator
  - Field Communicator Manual http://www.documentation.emersonprocess.com/groups/public_assetoptprodlit/documents/users_guide/475_alluge_usermanual.pdf
- 8714D Calibration Reference Standard Quick Installation Guide, P/N 00825-0100-4764 (shipped with product) http://www2.emersonprocess.com/siteadmincenter/PM%20Rosemount%20Documents/00825-0100-4764.pdf

If there are any questions, or more information is required, please contact Rosemount technical support at 1-800-999-9307 or via e-mail at http://www.rosemount.com/support/index.html

USING THE 8714I SMART™ METER VERIFICATION DIAGNOSTIC

8714 SMART Meter Verification

The 8714i SMART Meter Verification diagnostic provides a means of verifying the flowmeter is within calibration without requiring a process shutdown or removal of the sensor. This is a manually initiated diagnostic test that provides a review of the transmitter and sensor critical parameters as a means to document verification of calibration. The results of running this diagnostic provide the deviation amount from expected values and a pass/fail summary against user-defined criteria for the application and conditions.

The 8714i SMART Meter Verification diagnostic can be initiated as required by the application. If the advanced diagnostic suite (DA2) was ordered, then the meter verification diagnostic will be available. If DA2 was not ordered or licensed, this diagnostic will not be available.

Meter Verification Theory of Operation

Magnetic flowmeters function on the principle of Faraday's Law which states that a conductor moving through a magnetic field will generate a voltage that is proportional to the speed of the conductor. This relationship is described by the following equation:

$E = k * B * D * V$

where

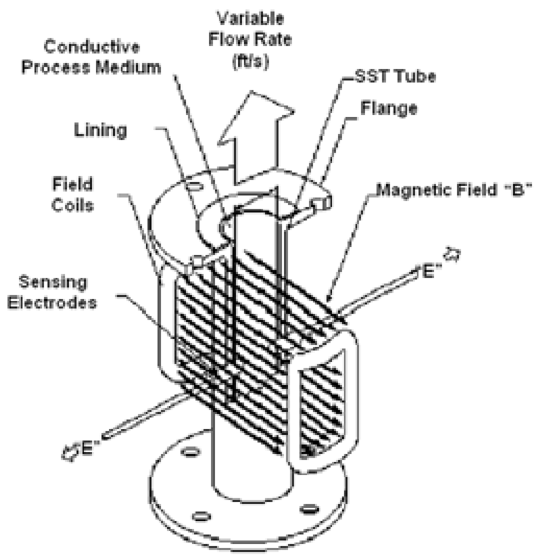
E = The induced voltage generated

k = A unit conversion constant

B = The Magnetic Field Strength

D = The distance between the probes picking up the induced voltage

V = The velocity of the conductor



With magnetic flowmeters, the conductor is the fluid that is passing through the sensor and D becomes the distance between the measurement electrodes which will always be a fixed distance. This means that the relationship between E and B and V needs to be established. This is done through the calibration process which is performed on every Rosemount magnetic sensor. The calibration process determines a 16-digit calibration number that is unique to every sensor. This calibration number then describes the relationship between the velocity (V) and the induced voltage (E).

$$E = k * D * B * V$$

Where:

E = Inducted Voltage (Measured by Electrodes)
V = Velocity of Conductive Liquid
k = Conversion Constant
D = Fixed Distance Between Electrodes
B = Magnetic Field Strength

With this, Faraday's equation can be re-written as:

$E = C * V$

where

C = Calibration constant = $k * B * D$

We have already discussed that k and D are fixed; this means that the only variable that will result in a change in the calibration constant is a change in the magnetic field. Since there are no moving parts to a magnetic flowmeter, and the coil windings and coil current are constant if the meter if functioning correctly, B should not change over time.

By taking baseline measurements of some basic parameters that describe the magnetic field strength (B) during the calibration process, a factory reference point to the magnetic field strength at the time of calibration for that sensor is established. By comparing measured values taken during the meter verification process to the established baseline parameters and checking for deviations it can be determined if the sensor calibration has shifted and corrective action needs to be taken.

8714i SMART Meter Verification Functionality

The 8714i SMART Meter Verification diagnostic functions by taking a baseline sensor signature and then comparing measurements taken during the verification test to these baseline results.

Sensor Signature Values
The sensor signature describes the magnetic behavior of the sensor. Based on Faraday's law, the induced voltage measured on the electrodes is proportional to the magnetic field strength. Thus, any changes in the magnetic field will result in a calibration shift of the sensor. Having the transmitter take an initial sensor signature when first installed will provide the baseline for the verification tests that are done in the future. There are three specific measurements that are stored in the transmitter's non-volatile memory that are used when performing the calibration verification.

Coil Circuit Resistance
The Coil Circuit Resistance is a measurement of the coil circuit health. This value is used as a baseline to determine if the coil circuit is still operating correctly.

Coil Signature
The Coil Signature is a measurement of the magnetic field strength. This value is used as a baseline to determine if a sensor calibration shift has occurred.

Electrode Circuit Resistance
The Electrode Circuit Resistance is a measurement of the electrode circuit health. This value is used as a baseline to determine if the electrode circuit is still operating correctly.

8714i SMART Meter Verification Measurements
The 8714i SMART Meter Verification test will make measurements of the coil resistance, coil signature, and electrode resistance and compare these values to the values taken during the sensor signature process to determine the sensor calibration deviation, the coil circuit health, and the electrode circuit health. In addition, the measurements taken by this test can provide additional information when troubleshooting the meter.

Coil Circuit Resistance
The Coil Circuit Resistance is a measurement of the coil circuit health. This value is compared to the coil circuit resistance baseline measurement taken during the sensor signature process to determine coil circuit health.

Coil Signature
The Coil Signature is a measurement of the magnetic field strength. This value is compared to the coil signature baseline measurement taken during the sensor signature process to determine sensor calibration deviation.

Electrode Circuit Resistance

The Electrode Circuit Resistance is a measurement of the electrode circuit health. This value is compared to the electrode circuit resistance baseline measurement taken during the sensor signature process to determine electrode circuit health.

Establishing the Baseline Comparison - Sensor Signature

The sensor signature describes the magnetic behavior of the sensor. The sensor signature is taken at the time of calibration and sets values for the ***coil signature*** (a measure of the magnetic field strength) and the ***coil resistance*** (an indication of coil circuit health). One signature value that is not established at the time of calibration is the electrode resistance (an indication of the electrode circuit health). Because the ***electrode resistance*** will be dependant on the conductivity of the process fluid in the sensor at the time of calibration, the signature of this parameter needs to be done once the meter is installed and the actual process is flowing through the meter.

Establishing the baseline sensor signature

The first step in running the 8714i SMART Meter Verification test is establishing the reference signature that the test will use as the baseline for comparison. This is accomplished by having the transmitter take a signature of the sensor. Having the transmitter take an initial sensor signature when first installed will provide the baseline for the verification tests that are done in the future. The sensor signature should be taken during the start-up process when the transmitter is first connected to the sensor, with a full pipe, and ideally with no flow in the line. Running the sensor signature procedure when there is flow in the line is permissible, but this may introduce some noise into the signature measurements. If an empty pipe condition exists, then the sensor signature should be run for the coils only. Once the sensor signature process is complete, the measurements taken during this procedure are stored in non-volatile memory to prevent loss in the event of a power interruption to the meter.

Integrally mounted transmitters will come with the sensor signature already loaded into the non-volatile memory. For integrally mounted transmitters this is a standard part of the calibration procedure. Once the sensor is installed and the line is filled with process fluid, the user should perform an electrode circuit signature. The electrode circuit signature is not taken at the time of calibration due to the wide variety of process fluids used with magnetic flowmeters.

Transmitters that have been paired to a specific sensor will also come with the sensor signature preloaded into the non-volatile memory.

Transmitters that have not been paired to a specific sensor, or transmitters ordered as a replacement will need to have the sensor signature established once they are installed in the field.

Understanding the Re-Signature Parameters

When performing a re-signature of the sensor, there are three signature options available. Note that when a re-signature is done, it overwrites the existing signature values stored in the non-volatile memory.

All
Re-signature all values for the sensor. This includes the coil signature, coil resistance, and electrode resistance.

Coils
Re-signature the coil values only. This includes the coil signature and the coil resistance. The electrode resistance is not measured.

Electrodes
Re-signature the electrode resistance value only. The coil signature and coil resistance are not measured. A re-signature of the electrodes only should be done for new installations once the sensor is installed and the pipe is filled with the process fluid.

Understanding the 8714i Test Paramaters

The 8714i has a multitude of parameters that set the test criteria, test conditions, and scope of the calibration verification test.

Test Conditions for the 8714i SMART Meter Verification

There are three possible test conditions that the 8714i meter verification test can be initiated under. This parameter is set at the time that the test is initiated.

No Flow
Run the meter verification test with a full pipe and no flow in the line. Running the 8714i Calibration Verification test under this condition provides the most accurate results and the best indication of magnetic flowmeter health. Under this condition the 8714i tests against the criteria limits entered for Full Pipe, No Flow.

Flowing, Full
Run the 8714i SMART Meter Verification test with a full pipe and flow in the line. Running the test under this condition provides the ability to verify the magnetic flowmeter health without shutting down the process flow in applications where a shutdown is not possible. Running under flowing conditions can cause false fails of the transmitter verification test if the flow rate is not at a steady flow, or if there is process noise present. Under this condition the 8714i tests against the criteria limits entered for Full Pipe, Flowing.

Empty Pipe
Run the meter verification test with an empty pipe. Running the 8714i SMART Meter Verification test under this condition provides the ability to verify the magnetic flowmeter health with an empty pipe. Running the calibration verification under empty pipe conditions will not check the electrode circuit health and may result in false fails of the transmitter verification test as empty pipe conditions generate significant background noise during the transmitter verification test. Under this condition the 8714i tests against the criteria limits entered for Empty Pipe.

8714i SMART Meter Verification Test Criteria

The meter verification diagnostic provides the ability for the user to define the maximum allowable deviation for the transmitter calibration and sensor calibration verification tests. Deviations results that exceed the established test criteria will cause the test to fail. The test criteria can be set for each of the flow conditions discussed above.

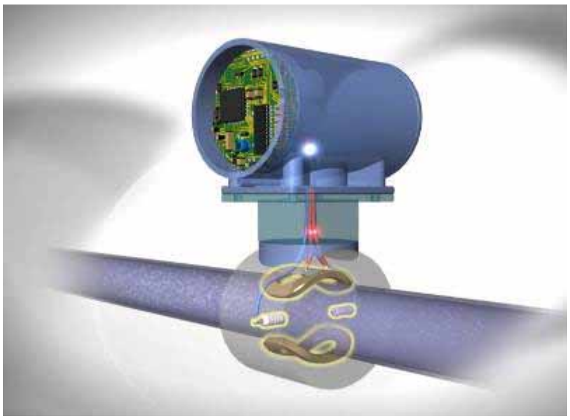
Full Pipe, No Flow
Set the test criteria for the No Flow condition. The factory default for this value is set to two percent with limits configurable between one and ten percent.

Full Pipe, Flowing
Set the test criteria for the Flowing, Full condition. The factory default for this value is set to three percent with limits configurable between one and ten percent.

Empty Pipe
Set the test criteria for the Empty Pipe condition. The factory default for this value is set to five percent with limits configurable between one and ten percent.

8714i SMART Meter Verification Test Scope

The meter verification can be used to verify the entire flowmeter installation, or individual parts such as the transmitter or sensor. This parameter is set at the time that the test is initiated.



All
Run the 8714i SMART Meter Verification test and verify the entire flowmeter installation. This parameter results in the calibration verification performing the transmitter calibration verification, sensor calibration verification, coil health check, and electrode health check. Transmitter calibration and sensor calibration are verified against the percentage associated with the test condition selected when the test was initiated.

Transmitter
Run the 8714i SMART Meter Verification test on the transmitter only. This results in the verification test only checking the transmitter calibration against the limits of the test criteria selected when the test was initiated.

Sensor
Run the 8714i SMART Meter Verification test on the sensor only. This causes the verification test to check the sensor calibration against the limits of the test criteria selected when the test was initiated. This test will also verify the coil circuit health, and the electrode circuit health.

		Test Scope		
		All	Transmitter	Sensor
Test Condition	No Flow, Full	Sensor Cal Test Coil Circuit Test Electrode Circuit Test Transmitter Cal Test	Transmitter Cal Test	Sensor Cal Test Coil Circuit Test Electrode Circuit Test
	Flowing, Full	Sensor Cal Test Coil Circuit Test Electrode Circuit Test Transmitter Cal Test	Transmitter Cal Test	Sensor Cal Test Coil Circuit Test Electrode Circuit Test
	Empty Pipe	Sensor Cal Test Coil Circuit Test Transmitter Cal Test	Transmitter Cal Test	Sensor Cal Test Coil Circuit Test

Understanding the 8714i Test Results

Once the 8714i SMART Meter Verification test is initiated, the transmitter will make several measurements to verify the transmitter calibration, sensor calibration, coil circuit health, and electrode circuit health. The results of these tests can be reviewed and recorded on the Rosemount Magnetic Flowmeter Calibration Report (00816-0200-4727). This report can be used to validate that the meter is within the required calibration limits to comply with governmental regulatory agencies such as the Environmental Protection Agency or Food and Drug Administration.

Sensor Characteristic	Signature Baseline Values	8714i Measured Values	Deviation	Criteria	Pass/Fail
Coil Signature	19.5	19.6			
Coil Resistance	15.2	15.6			
Electrode Resistance	260.7	245.6			

Sensor Characteristic	Signature Baseline Values	8714i Measured Values	Deviation	Criteria	Pass/Fail
Coil Signature	19.5	19.6	0.51	1%	Pass
Coil Resistance	15.2	15.6			
Electrode Resistance	260.7	245.6			

Viewing the 8714i SMART Meter Verification Results

Depending on the method used to view the results, they will be displayed in either a menu structure, as a method, or in the report format. When using the HART Field Communicator, each individual component can be viewed as a menu item. When using the LOI, the parameters are viewed as a method using the left arrow key to cycle through the results. In AMS the calibration report is populated with the necessary data eliminating the need to manually complete the report found on page xx.

The verification results are displayed in the following order on the LOI:

Test Condition
Displays the test condition under which the 8714i was performed.

Test Criteria
Displays the maximum allowable deviation percentage before a verification test will fail.

8714i Result
Displays the overall result of the 8714i SMART Meter Verification test as either a Pass or Fail.

Simulated Velocity
Displays the simulated velocity used to verify the transmitter calibration.

Actual Velocity
Displays the velocity measured by the transmitter during the calibration verification process.

Velocity Deviation
Displays the deviation in the Actual Velocity compared to the Simulated Velocity in terms of a percentage. This percentage is then compared to the test criteria to determine if the transmitter is within calibration limits.

Transmitter Calibration Verification
Displays the results of the transmitter calibration verification test as either a Pass or Fail.

Sensor Calibration Deviation
Displays the deviation in the measured coil signature to the baseline coil signature to determine if the sensor calibration has shifted. This percentage is compared to the test criteria to determine if the sensor is within calibration limits.

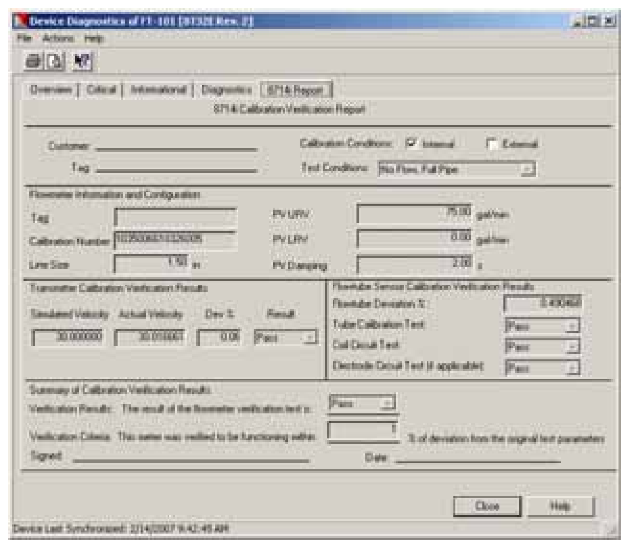
Sensor Calibration Verification
Displays the results of the sensor calibration verification test as either a Pass or Fail.

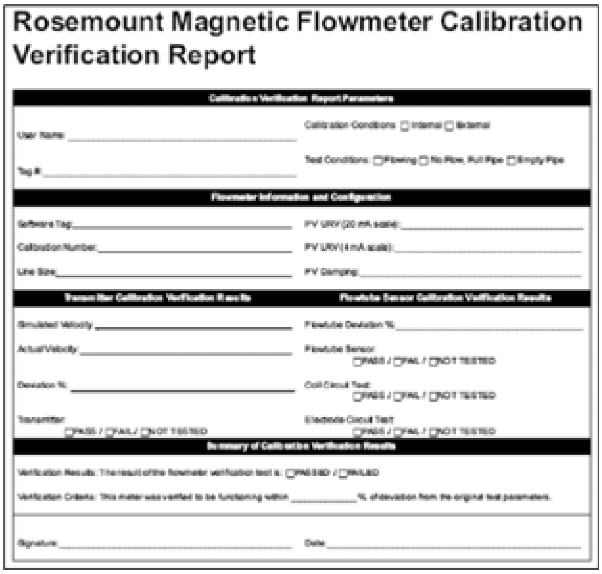
Coil Circuit Verification
Displays the results of the coil circuit health check as either a Pass or Fail.

Electrode Circuit Verification
Displays the results of the electrode circuit health check as either a Pass or Fail.

Meter Verification Report Examples

Once the meter verification diagnostic has completed, it is possible to print a verification report for submission to a regulatory agency or file with the instrument file. If using AMS, the report is populated automatically with the appropriate information. If using a 375 or the LOI, a report is available to fill out manually.





Rosemount Magnetic Flowmeter Calibration Verification Report

Calibration Verification Report Parameters

User Name: ____________
Calibration Conditions: ☐ Internal ☐ External
Tag #: ____________
Test Conditions: ☐ Flowing ☐ No Flow, Full Pipe ☐ Empty Pipe

Flowmeter Information and Configuration

Software Tag: ____________ PV URV (20 mA scale): ____________
Calibration Number: ____________ PV LRV (4 mA scale): ____________
Line Size: ____________ PV Damping: ____________

Transmitter Calibration Verification Results | **Flowtube Sensor Calibration Verification Results**

Simulated Velocity: ____________ Flowtube Deviation %: ____________
Actual Velocity: ____________ Flowtube Sensor: ☐ PASS / ☐ FAIL / ☐ NOT TESTED
Deviation %: ____________ Coil Circuit Test: ☐ PASS / ☐ FAIL / ☐ NOT TESTED
Transmitter: ☐ PASS / ☐ FAIL / ☐ NOT TESTED Electrode Circuit Test: ☐ PASS / ☐ FAIL / ☐ NOT TESTED

Summary of Calibration Verification Results

Verification Results: The result of the flowmeter verification test is: ☐ PASSED / ☐ FAILED
Verification Criteria: This meter was verified to be functioning within ________ % of deviation from the original test parameters.

Signature: ____________ Date: ____________

Optimizing the 8714i SMART Meter Verification

The 8714i SMART Meter Verification diagnostic can be optimized by setting the test criteria to the desired levels necessary to meet the compliance requirements of the application. The following examples below will provide some guidance on how to set these levels.

Example
An effluent meter must be certified every year to comply with Environmental Protection Agency and Pollution Control Agency standards. These governmental agencies require that the meter be certified to five percent accuracy.
Since this is an effluent meter, shutting down the process may not be viable. In this instance the meter verification test will be performed under flowing conditions. Set the test criteria for Flowing, Full to five percent to meet the requirements of the governmental agencies.

Example
A pharmaceutical company requires bi-annual verification of meter calibration on a critical feed line for one of their products. This is an internal standard, but plant requirements require a calibration record be kept on-hand. Meter calibration on this process must meet one percent. The process is a batch process so it is possible to perform the verification with the line full and with no flow. Since the test can be run under no flow conditions, set the test criteria for No Flow to one percent to comply with the necessary plant standards.

Example
A food and beverage company requires an annual calibration of a meter on a product line. The plant standard calls for the accuracy to be three percent or better. They manufacture this product in batches, and the measurement cannot be interrupted when a batch is in process. When the batch is complete, the line goes empty. Since there is no means of performing the test while there is product in the line, the test must be performed under empty pipe conditions. The test criteria for Empty Pipe should be set to three percent, and it should be noted that the electrode circuit health cannot be verified.

Once the test criteria is established and the sensor signature values taken, it is suggested to run the 8714i SMART Meter Verification test to verify that the verification test can provide the desired results. This also serves to provide a baseline as it provides an initial “good” test point to compare to in the event that the verification fails in a future test.

Troubleshooting the 8714i SMART Meter Verification Test

In the event that the 8714i SMART Meter Verification test fails, the following steps can be used to determine the appropriate course of action. Begin by reviewing the 8714i results to determine the specific test that failed.

Test	Potential Cause of Failure	Steps to Correct
Transmitter Calibration Verification Test Failed	* Unstable flow rate during the verification test	* Perform the test with no flow in the pipe
	* Noise in the process Transmitter drift Faulty electronics	* Check calibration with an external standard like the 8714D * Perform a digital trim Replace the electronics
Sensor Calibration Verification Failed	* Moisture in the terminal block of the sensor *Calibration shift caused by heat cycling or vibration	* Remove the sensor and send back for recalibration.
Coil Circuit Health Failed	* Moisture in the terminal block of the sensor * Shorted Coil	* Perform the sensor checks detailed in the manual.
Electrode Circuit Health Failed	* Electrode Signature was never performed	* Perform the electrode signature and re-run the verification test.
	* Moisture in the terminal block of the sensor * Coated Electrodes * Shorted Electrodes	* Perform the sensor checks detailed in the manual.

PERFORMING A MANUAL VERIFICATION

Hardware and Tools

All hardware and tools are required unless noted.

- Power supply: 90-250 V ac, 50 – 60 Hz; 12-42 V dc (8712D) or 15-30 V dc (8732C)
- Multi-meter: 4-1/2 digits (within NIST traceable calibration compliance time period)
  - Example: Fluke 25, 27, 83, 85, 87, or 8060A or equivalent
- LCR meter (optional)
  - Example: B&K Model 878A or equivalent
- 8714D Calibration Reference Standard
- 375 / 475 Field Communicator (optional)
  - Precision Load Resistor: 250 ohms +/- 0.01% 2 watt or 500 ohms +/- 0.01% 2 watt

NOTE
250 ohm resistor plug assembly is included with HART 375 communicator.

NOTE
All equipment used in calibration/verification should be calibrated on a regular schedule per plant metrology procedures.

NOTE
Most portable equipment does not meet ANSI Z540 accuracy requirements. Therefore, field calibration is not desirable.

NOTE
Most ammeters only display two decimal points. Therefore, Rosemount standard calibration practice utilizes a precision 500-ohm load resistor. The output of the transmitter is measured across the load resistor giving 2.000 Volts at 4.00 mA and 10.000 Volts at 20.00 mA. This procedure increases the resolution of the output signal measurement.

Transmitter Configuration Verification

This section identifies the steps required to confirm the hardware and software configuration of the flow meter transmitter. Verifying the configuration insures that the flow meter is configured as intended for this application. A more comprehensive explanation of installation steps including wiring, basic configuration, handling, mounting and grounding is presented in the Quick Installation Guides and Magnetic Flowmeter Transmitter Manuals. Refer to these documents for more detailed information.

Hardware Configuration Verification

The transmitter electronics boards are equipped with three user-selectable hardware switches. These switches set the Failure Alarm Mode, Internal/External Analog Power, and Transmitter Security. The standard configuration for these switches when shipped from the factory is as follows:

Failure Alarm Mode	HIGH
Internal/External Analog Power	INTERNAL
Transmitter Security	OFF

In most cases, it is not necessary to change the setting of the hardware switches. If you need to change the switch settings and need to understand the functions of the switches, complete the steps outlined in the manual.

Failure Alarm Mode

If the transmitter experiences a catastrophic failure in the electronics, the current output can be set to be driven outside the normal 4-20 ma range, either HIGH (23.25 ma) or LOW (3.75 ma).

Internal/External Analog Power

The transmitter's 4 – 20 mA loop may be powered internally or by an external power supply. The Internal/External Analog Power jumper or switch determines the source of the 4 – 20 mA loop power. The external power option is required for multidrop communications.

Transmitter Security

The Transmitter Security switch allows the user to lock out any configuration changes attempted on the transmitter. No changes to the configuration are allowed when the switch is in the ON position. The display and totalizer function remain active.

Software Configuration Verification

A minimum of five parameters are required to commission the device: Flow Rate Units, URV (Upper Range Value), LRV (Lower Range Value), Line Size, and Calibration Number. This section provides a quick reference to verify the basic configuration of the transmitter. These parameters may be verified via a 375/475 Field Communicator, an optional local operator interface (LOI) or Asset Management software (AMS.) The following examples use the HART commands of the 375/475 Field Communicator. A complete listing of the HART commands, keys and menu tree can be found in the Quick Installation Guide and in the Magnetic Flowmeter Transmitter Manual.

Verify Tag

HART Fast Keys	1, 3, 1
LOI Key	XMTR INFO

Tag is the quickest and shortest way of identifying and distinguishing between transmitters. Transmitters can be tagged according to the requirements of your applications. The tag may be up to eight characters.

Verify Flow Rate Units

HART Fast Keys	1, 3, 2, 1
LOI Key	Units

The flow rate unit variable specifies the format in which the flow rate will be displayed. Units should be selected to meet your particular metering needs. The maximum flow rate on the second line of the display is for informational purposes and can not be changed by the user.

Verify URV (Upper Range Value)

HART Fast Keys	1, 3, 4
LOI Key	Analog Ouput Range

The upper range value (URV), or analog output range, is preset to 30 ft/s at the factory. The units that appear will be the same as those selected under the Units parameter.

The URV (20-mA point) can be set for forward and reverse flow rate. Flow in the forward direction is represented by positive values and flow in the reverse direction is represented by negative values. The letter R will also be displayed in the corner of the local display if the flow is in the reverse direction. The URV can be any value from –30 ft/s to 30 ft/s, as long as it is at least 1 ft/s from the lower range value (4-mA point). The URV can also be set to a value less than the lower range value which would cause the transmitter analog output to operate in reverse with the electrical current increasing for lower (or negative) flow rates.

Verify LRV (Lower Range Value)

HART Fast Keys	1, 3, 5
LOI Key	Aux. Function

Reset the lower range values (LRV), or analog output zero, to change the size of the range (or span) between the URV and LRV. Under most circumstances, the LRV should be set to a value near the minimum expected flow rate to maximize resolution. The LRV must be between –30 ft/s and 30 ft/s.

The LRV can be set to a value greater than the URV, which would cause the analog output to operate in reverse. In this mode, the analog output will increase with lower (more negative) flow rates.

Verify Line Size

HART Fast Keys	1, 3, 3
LOI Key	Tube Size

The line size (sensor size) must be set to match the actual sensor connected to the transmitter. The size is specified in inches. The second line on the LOI screen, MAX FLOW, is for informational purposes only. The MAX FLOW value is defined as the URV on the Model 375/475 and most control systems.

Verify Calibration Number

HART Fast Keys	1, 3, 6
LOI Key	Tube Cal. No.

The sensor calibration number is a 16-digit number used to identify sensors calibrated at the Rosemount factory. The number provides detailed calibration information to the transmitter. The calibration number is also printed inside the sensor terminal block. To function properly within accuracy specifications, the number displayed on the transmitter must match the calibration number on the sensor exactly.

Transmitter and Sensor Testing and Verification

This section identifies the steps to verify proper operation of the flow meter.

Transmitter Output Verification and Self-Test

The three following tests verify the basic operation of the transmitter and are accessible through the LOI or the Model 375/475 Field Communicator. The functions listed appear in the BASIC DIAGNOSTICS AND SERVICE section of the menu tree or under the AUXILIARY function key on the Model 8712D/E LOI.

Analog Output Test

HART Fast Keys	1, 2, 2, 2
LOI Key	Aux. Function

The analog output test allows the user to drive the transmitter output terminals to a desired electrical current output. This capability allows the user to check the entire 4 – 20 mA current loop. The test will end after five minutes if the transmitter is not returned to normal operation manually.

Pulse Output Test

HART Fast Keys	1, 2, 2, 3
LOI Key	Aux. Function

The pulse output test allows the user to drive the frequency output terminals to a desired value. This capability allows the user to check auxiliary output. The test will end after five minutes if the transmitter is not returned to normal operation manually.

Self Test

HART Fast Keys	1, 2, 2, 1
LOI Key	Aux. Function

The Self Test initiates a series of diagnostic tests that are not performed continuously during normal operation. It performs diagnostic tests of the transmitter display, RAM and PROM. During the test, all outputs respond to flow signal. The test requires approximately 10 seconds to complete.

Transmitter Electronics Verification

A Rosemount 8714 Calibration Standard can be used to verify that the transmitter is working correctly. The 8714 Calibration Standard simulates a functioning sensor operating at user selectable, pre-set flow rates. The following steps will verify that the transmitter is functioning correctly and within specification.

1. Power down the transmitter.
2. Remove covers to access main transmitter board. (In the case of the 8732 transmitter with LOI, you will need to remove the LOI temporarily to complete step 3 and 4.)
3. Disconnect the cables connecting the sensor to the transmitter.
4. Connect the transmitter to a Model 8714D Calibration Standard simulator using cables provided with the 8714D.
5. Power up the transmitter.
6. Change the calibration number in the transmitter to match the calibration number of the 8714D.
7. Change the flow rate units to ft/sec, the URV to 30 and LRV to 0.
8. Set the flow rate of the 8714D to 30 ft/sec.
9. Read the flow rate on either the LOI or 375/475 Field Communicator. The flow rate reading after warm-up should be between 29.97 and 30.03 ft/s.
10. If the reading is within the range, disconnect the 8714D and re-connect the sensor cables, remembering to change the calibration number in the transmitter to match the sensor calibration number and the other parameters to the original configuration.
11. If the reading is not within the range, initiate the electronics trim with the LOI or 375/475 Field Communicator. The electronics trim takes about six minutes to complete. No transmitter adjustments are necessary.

HART Fast Keys	1, 2, 5, 3
LOI Key	Aux. Function

12. If the electronics trim fails, the transmitter

Sensor Verification

There are no moving parts on a magnetic flowmeter that wear under normal operation, and it is very unusual that a magnetic flowmeter will require a new calibration because of wear in normal applications. Magnetic flowmeters measure the voltage across the electrode, which is a function of the fixed magnetic coils and the distance between the electrodes. The Calibration Number is established during factory calibration and accounts for minute differences in coils and electrodes that do not change over time with normal use. While these physical properties cannot be adjusted in the field, the electrical integrity of the sensor can be tested and verified.

NOTE:
Highly corrosive processes or processes with very abrasive solids content may cause wear, which over an extended period could have a small effect on the accuracy. Selecting the correct electrode and liner materials for the application can significantly reduce or eliminate corrosion or abrasive wear. If recalibration is required, the sensor can be sent back to Rosemount for recalibration. Contact your sales or service representative for details.

Sensor Electrical Test

Measuring the resistances in the sensor will identify electrical failures including open or shorted coils, electrode failure and extraneous moisture related current paths. These tests can be done to base line a new sensor or to confirm the operational status of a sensor. Detailed instructions can be found in the Magnetic Flowmeter Transmitter Manuals, Section 5, Maintenance and Troubleshooting.

The following chart, Table 1, can assist in verifying the performance of the sensor. Before performing any of the sensor tests, disconnect or turn off power to the transmitter, and disconnect the sensor from the transmitter and any field wiring. To interpret the results, the product certification for the sensor must be known. These codes are listed in the model number on the sensor and are: N0, N1, N5, E5, CD, and KD. Always check the operation of test equipment before each test. A combination of tests, required equipment, expected values, and corrective actions are listed in Table 1. If possible, take all readings from inside the sensor junction box.

Readings taken at the terminals of remote-mount transmitters that are more than 100 feet of cable length away from the sensor may provide incorrect or inconclusive information and should be avoided.

Test equipment is needed to conduct these tests. Some of these tests will require measuring conductance (nS, nanosiemens), the reciprocal of resistance. It is possible to test a LCR meter by selecting nS as the units and holding the leads apart. The value should be less than one, while touching the leads together should result in an overload value. The LCR meter may be used with process fluid in the sensor.electronics should be replaced.

TABLE 1.

Test	Sensor Location	Required Equipment	Measuring at Connections	Expected Value	Potential Cause	Corrective Actions
Step 1: Sensor Coil	Installed or Uninstalled	Multimeter	1 and 2	2Ω ≤ R ≤ 28Ω	Open or Shorted Coil	Replace Sensor
Step 2: Shield to Case	Installed or Uninstalled	Multimeter	17 and Ω	α.2 Ω	Moisture in terminal block	Clean terminal block
Step 3: Coil Shield to Coil	Installed or Uninstalled	Multimeter	1 and Grnd 2 and Grnd	α Ω α Ω	Process behind liner Leaky electrode	Clean terminal block Confirm with Sensor Coil Test
Step 4: Electrode shield to electrode	Installed	LCR (set to resistance and 120 Hz)	18 and 17 = R_1 19 and 17 = R_2	R1 and R2 should be stable N0:| R1 – R2|≤ 300Ω ___________N1, N5, E1, E5, CD, K1, K5, KD: $\|R_1 - R_2\| \leq 1500\Omega$	Unstable readings indicate coating Shorted electrode Empty pipe Low conductivity	Remove sensor Use bulletnose electrodes Repeat measurement

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