

Challenges with Calibrating Electromagnetic Flowmeters in the Water and Wastewater Industry

Endress+Hauser expands capabilities to serve the industry's needs

Electromagnetic flowmeters are one of the most commonly used measurement devices in the water and wastewater (W/WW) industry. They are used extensively in a variety of W/WW applications from 1/12" to 120" pipe sizes.

Typical applications include monitoring influent, effluent, RAS (return activated sludge), WAS (waste activated sludge), water and chemical feed/dosing injection.

Electromagnetic flowmeters are highly accurate, repeatable, have no pressure loss, monitor flow in both directions and have a long lifecycle of >20 years without replacement.

This article focuses on the use of electromagnetic flowmeters in the W/WW industry. It also covers Endress+Hauser's capabilities to manufacture electromagnetic flowmeters from 1/12" to 120", calibration, the company's new innovative sensor with multiple sensing electrode pairs and verifying calibration in place after installation.

Calibration capabilities

Endress+Hauser is one of the largest manufacturers of electromagnetic flowmeters and operates calibration rigs in various countries. The production and calibration facilities in the US, France, India, Brazil, and China have worldwide accreditation and complete traceability of test equipment back to national and international standards (ISO/IEC 17025). Each production/calibration facility has multiple methodologies to wet calibrate electromagnetic flowmeters. Endress+Hauser has the capability to calibrate electromagnetic flowmeters via gravimetric measurement with weighing system or volumetric measurement with master meters as references.

Calibration is offered with standard options for either three or five measurement points. More points on request from $\pm 0.2\%$ to $\pm 0.5\%$ o.r. accuracy. Endress+Hauser has

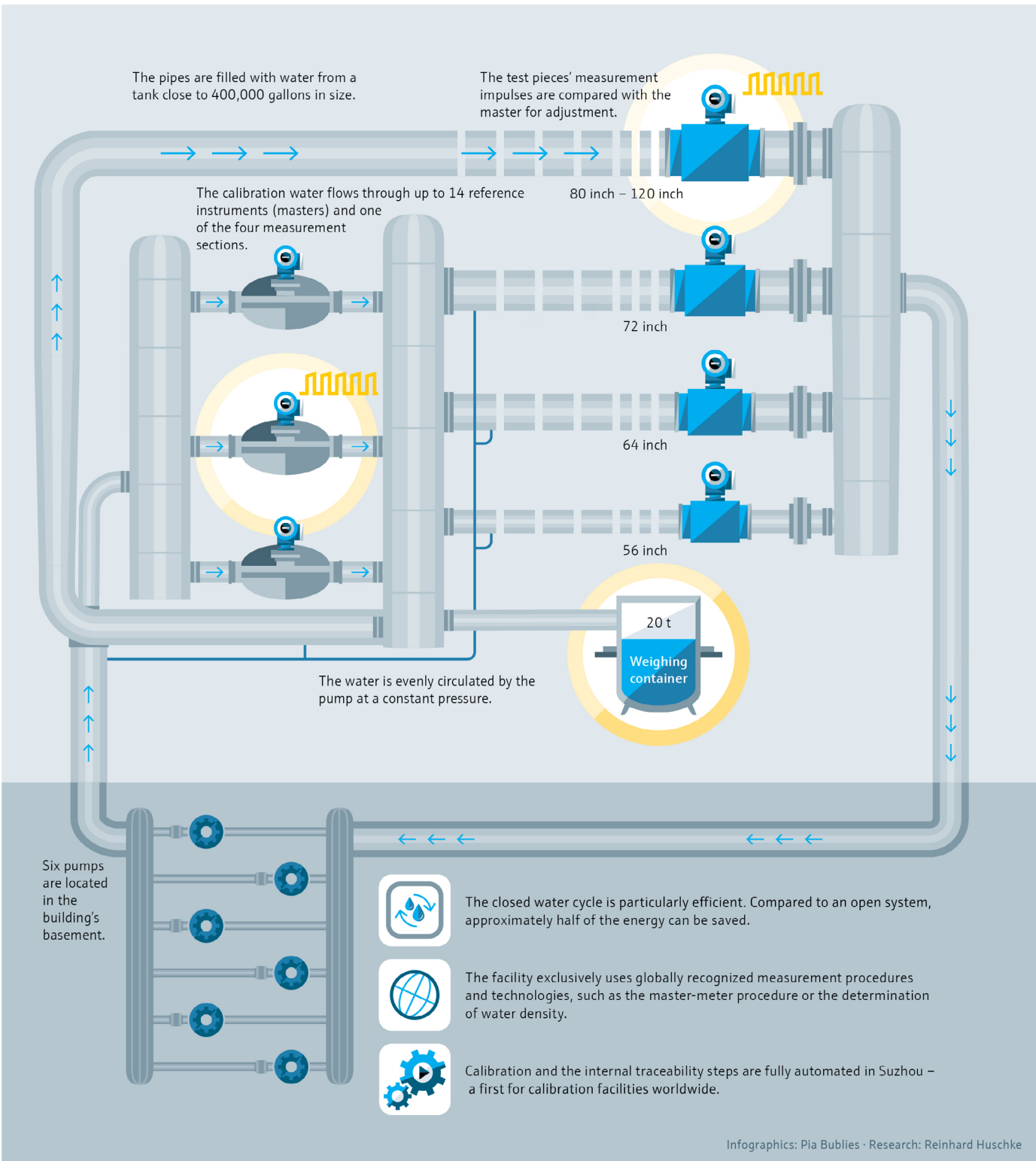
the capability to calibrate electromagnetic flowmeters in a wide range of sizes, and each meter produced is fully calibrated under flowing conditions.

Calibration of smaller electromagnetic flowmeters (<24") is fairly routine, but as electromagnetic meters' sizes get larger and heavier, wet calibration can become more challenging, as they require a certain volume of water to calibrate. In addition to volumetric flow rate, maintaining a steady, stable flow for enough time to generate a precise calibration factor and zero point is also a challenge.

To support customers' ever-growing needs for calibration in large diameter meters, Endress+Hauser has upgraded its world-class calibration rig in Suzhou, China for electromagnetic flowmeters ranging from 54–120".

Most calibration facilities for larger diameter electromagnetic flowmeters consist of a water tower type arrangement, where the tower is filled and then drained under gravity through the device under test (DUT). This type of arrangement was used in the past to counter challenges of moving such large volumes of water, but comes with inherent limitations, such as limited duration of calibration, and lack of flexibility for flow ranges and test points.

To overcome some of these challenges, Endress+Hauser developed its FCP-18 flow calibration rig as one of the largest, fully flowing, closed loop, production calibration rigs in the world. This accommodates not only standard Endress+Hauser calibration protocols, traceable to accredited national and international standards, but it also gives us flexibility to meet customers' needs such as extended calibration testing, testing of multiple flow rates and calibration at up to ten specific points – or more upon

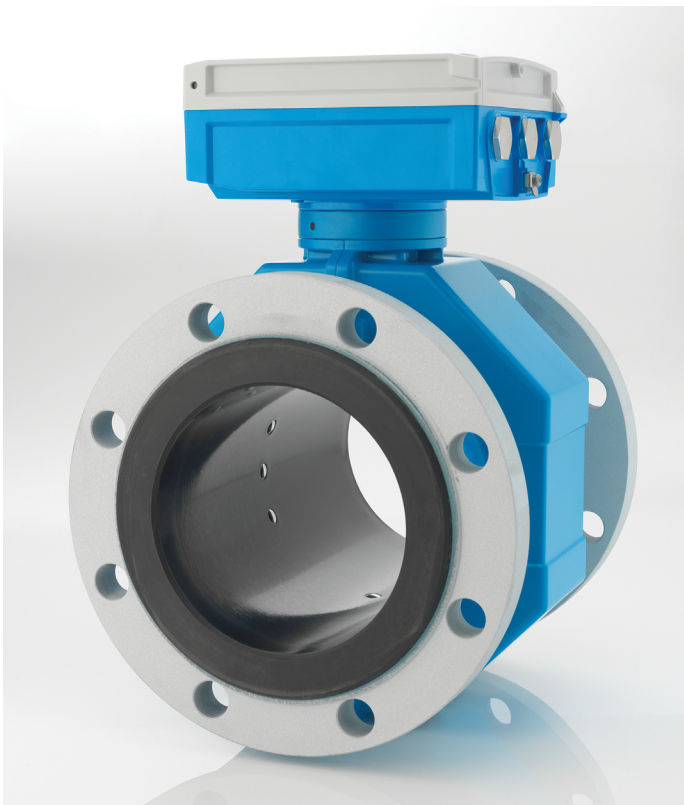


Endress+Hauser's world-class calibration rig, diagram of the FCP-18

customer request. This rig can support flow rates of more than 100,000 GPM, all in a closed loop rig with an expanded uncertainty of only 0.066% of rate and is equipped to use either 14 x 12" Coriolis meters as master meters, or a fully calibrated 20-ton weigh scale for gravimetric calibration. Endress+Hauser's commitment to world-class calibration facilities has resulted in new, expanded capabilities to serve the industry's needs and to measure ever more accurately our most precious resource – water.

Multi-electrode full bore sensor for unrestricted mounting

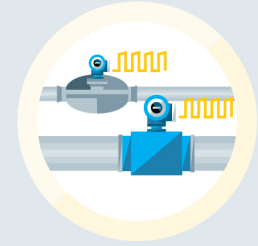
Endress+Hauser has developed an electromagnetic flowmeter sensor to support customers and engineers by eliminating challenges when it comes to straight pipe requirements both upstream and downstream of the meter. These challenges include mounting the electromagnetic flowmeter to close to piping elbows, t-fittings, misaligned seals, insertion devices, butterfly or gate valves or if there is process build-up in the piping which creates turbulence in the flow profile which can lead to inaccurate flow readings and totals.



Endress+Hauser's unrestricted mounting multiple electrode (six electrodes) Proline Promag W series

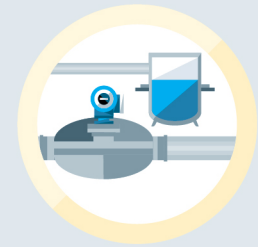
Calibration of the measurement devices

Calibration of the test pieces with Coriolis reference devices (master-meter procedure). The masters display at least four times less measurement inaccuracy than the test devices.



Traceability of the master

Automatic individual calibration of the Coriolis master with the help of a scale, during which the flow of water is redirected into a 20-ton weighing container.



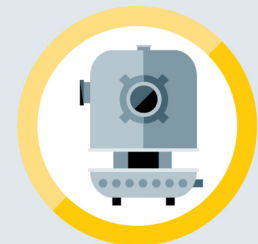
Traceability of the scale

Automatic calibration of the 20-ton scale through 10 high-precision two-ton reference weights.



National standard

Regular auditing of the reference weights by an accredited laboratory which in turn is traceable to national metrology institutes.



SI unit

National standards are traceable to the realization of the respective SI unit – such as the primary kilogram in Paris.



Infographics: Pia Bublies · Research: Reinhard Huschke

As you can imagine, if an engineer was designing a 36" line for a municipality it would require approximately 21 ft. of straight pipe run for a traditional two-electrode electromagnetic flowmeter to perform with $\pm 0.5\%$ of rate accuracy. For this same example, Endress+Hauser's unrestricted mounting multiple electrode (six electrodes) Promag® W series flowtube with enhanced coil system and advanced signal processing electromagnetic flowmeter can eliminate the straight pipe run requirements and the associated cost of installation without sacrificing $\pm 0.5\%$ o.r. accuracy.

Field verification after installation

Electromagnetic flowmeters can be verified in place to the original wet calibration without end users having to remove the meter from the process. W/WW treatment plants run 24 hours a day and removing flowmeters for recalibrations is challenging, time consuming and costly. Large size meters can be particularly challenging as the 36" electromagnetic flowmeter mentioned above weighs approximately 1,700 lb., which makes removal and replacement very difficult.

Municipalities can offset this meter verification challenge by using Endress+Hauser's Heartbeat Technology®. The electromagnetic flowmeter verification is performed while leaving the electromagnetic flowmeter in place and does not require shutting down the process. This internal verification method can be performed via the transmitter's faceplate, a laptop with Ethernet cable via webserver, Endress+Hauser's Field Xpert® SMT70 industrial tablet/HART® communicator or through the plantwide distributed control system (DCS). Once the verification is complete, the customer is able to print a detailed report to maintain for his records.

Endress+Hauser has a strong commitment to do its part in supporting the W/WW industry in the United States and globally. Accurate flow measurement and totalization is an important measurement parameter for both process control and EPA compliance reporting. Endress+Hauser is one of the few manufacturers that can manufacture and calibrate electromagnetic flowmeters up to 120" in size to support this growing market.

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