CONSIDERING Flowmeter Calibration

A look at the labs that ensure the consistency and accuracy of critical flow measurements

By Jesse Yoder, Ph.D.

The topic of flowmeter calibration is extremely important for flowmeter manufacturers and end-users alike. To ensure a flowmeter is operating properly, it needs to be calibrated after it is assembled and before it is delivered to the customer. Most flowmeter manufacturers have their own calibration laboratories for this purpose, calibrating flowmeters and testing them for accuracy and performance before they are shipped.

Sending a flowmeter to a calibration facility is probably the surest way to verify the correct operation of the meter, and to bring it back into the proper performance specifications. However, this can be a costly operation. Companies do not always have a "back-up" meter that they can substitute for the meter that is being recalibrated. In addition to packing and shipping costs, there is the cost of re-calibrating the meter, and the time that the meter is out of service. However, for some meters, especially those used for custody transfer, this is the only viable solution. This especially applies to ultrasonic and turbine flowmeters.

There are more than 100 independent flowmeter calibration facilities located around the world. Many of these primarily service companies within their geographic region. However, there are a number of large calibration facilities that service flowmeter companies from multiple regions. These include NMi Euroloop and VSL in the Netherlands, and Colorado Engineering and Experiment Station Inc. in Colorado and Iowa.

Gas and Liquid Calibration Facilities

While many calibration labs do calibrations on flowmeters for both gas and liquid measurement, most labs build separate facilities for these purposes. The reason is that the fluid medium used to measure the gas and liquid meters is different, and the methodology used is different. Flowmeters used for gas flow measurement are generally calibrated using air, or using a specific type of gas. Flowmeters used for liquid measurement generally are calibrated with water or some other type of liquid, and they rely on piston provers for calibration purposes. The large flowlabs such as CEESI, NMi Euroloop, and VSL have their gas and liquid labs built in separate locations.

NMi Euroloop

NMi Euroloop is located in Rotterdam, the Netherlands. It is the successor of two earlier flow calibration facilities; one located in Bergum and the other located in Westerbork, the Netherlands. NMi Euroloop, which opened in March 2010, has consolidated and replaced the capabilities of these two earlier facilities, which have now closed down for calibrations.

A number of prominent flowmeter companies cooperated to make NMi Euroloop possible. These include SICK, Honeywell, Emerson Daniel, KROHNE, and Elster.

The gas calibration facility at NMI Euroloop is a closed-loop facility. The gas used for calibration is generated internally from two tanks with a capacity of 7000 cubic meters. Three high-pressure piston compressors are installed to pressurize the system. Seven turbine meters are used as master meters. These seven turbine meters are monitored by seven ultrasonic meters. NMi Euroloop uses the master meter method based on the mass conservation principle. A gas chro-

COURTESY JESSE YODER

An ultrasonic flowmeter gets placed in a test stand at NMi Euroloop.

matograph determines the gas composition of the high-calorific gas.

The creation of NMi Euroloop has significantly increased the flow calibration capability available in Europe, although this facility also calibrates meters from the Middle East and other regions of the world. The need for high-pressure gas calibrations is increasing each year as the installed base of ultrasonic and turbine meters increases. There is also an increased emphasis on custody-transfer measurement, as the production and demand for natural gas increases. Custody-transfer meters are among the ones most likely to be pulled out of service for recalibration, due to the high accuracy requirements for custody-transfer operations.

COURTESY JESSE YODER

Turbine flowmeters that serve as reference meters for natural gas calibrations at CEESI Iowa.

VSL

VSL stands for Van Swinden Laboratory. It is named after Jean Henri van Swinden, who lived from 1746 to 1823, and was a lecturer in Amsterdam. Van Swinden was part of an international committee to define the meter and worked to get the metric system introduced into the Netherlands. He also was the first person to introduce a platinum rod as the standard for the meter, which he did in 1799. VSL is located in Delft, the Netherlands.

COURTESY JESSE YODER

VSL's liquid flowmeter calibration facility in Dordrecht, the Netherlands.

VSL is owned by TNO Companies. One of its main tasks is to develop and maintain the national measurement standards, by commission of the Dutch Government. In addition, the organization maintains both gas and liquid flowmeter calibration facilities. The methods of proving used by VSL for liquid calibrations include master meters, piston provers, gravimetric methods, and proving tanks.

VSL is building a flow calibration facility for liquefied natural gas (LNG) that is scheduled to open in 2016. This facility is being built in Russia. There is currently no flow calibration facility for LNG in existence. The need for LNG flowmeter calibrations is growing as the number of LNG liquefaction and regasification projects continues to grow, and as the demand for LNG continues to expand, especially in Asian countries.

CEESI

While CEESI was formed as a private company in 1986, its history goes back to 1951, when it began as the Engineering Experiment Station Inc., a program of the College of Engineering at the University of Colorado in Boulder. The purpose of the operation at that time was to test small rockets for the Naval Ordinance Test Station. The Station also tested turbine meters in the 1950s, which were being used to measure fuel gas in airplanes.

In 1986, the facility was purchased by Steve Caldwell and Wald Seidl, who renamed it the Colorado Engineering Experiment Station Inc. From this time on, facilities began to expand. Several new test stands were added, including a piston prover system and a high air flow test stand. CEESI helped improve its calibration capabilities by cooperating in measurement comparisons with other American laboratories, and with the calibration facilities of eight other countries. During this time, CEESI's Iowa high-speed natural gas flow calibration facility was constructed. This facility, located in Garner, Iowa, opened in 1999. Unlike Euroloop, which relies on gas compressors to generate its high-speed gas flows, the CEESI facility in Iowa taps into a large natural gas line from Trans Canada Pipeline. The Iowa facility can calibrate a wide variety of flowmeters with diameters of 4 to 36 inches. It relies on a bank of nine turbine flowmeters as its reference meters for calibration purposes. It has recently opened a new low flow loop for calibrating flowmeters at

low flowrates. The flow loop incorporates multiple ultrasonic meters as transfer standards, as well as check meters.

CEESI's facility in Nunn, Colorado provides a wide variety of calibrations, including calibrations of flowmeters for liquid and gas flow measurement. It can handle calibrations of very large meters, such as large Venturi tubes used with differential-pressure transmitters for flow measurement purposes. During the past few years, CEESI has upgraded its facilities and capabilities in multiple ways, including building a water-in-oil test facility, and upgrading its wet gas/multiphase facility to handle custom liquids. CEESI has also jointly developed CEESmarT with RT Technical Solutions. CEESmarT is a cloud-based condition based monitoring system designed to monitor gas ultrasonic measuring stations. It continuously monitors the gas ultrasonic flowmeter, along with ancillary equipment such as pressure and temperature transmitters, flow computers, and gas chromatographs.

As part of its program to facilitate communication and knowledge within the industry, CEESI sponsors several important annual flowmeter conferences, and gives many training courses. These include courses on fundamentals of flow measurement and measurement uncertainty. In June 2016, the North American Custody Transfer Conference will be held in San Antonio, Texas. This conference began as a conference on ultrasonic flowmeters, then was expanded to include Coriolis meters, and now is focusing on custody transfer as its main theme.

The Flow Recalibration Working Group

After doing a series of interviews with end-users in the Middle East, it became apparent that one of the important and unanswered questions is how often flowmeters should be recalibrated. This issue is not formally addressed by organizations such as the American Gas Association (AGA) or the American Petroleum Institute (API). It is, however, the subject of regulation by some countries. As a result of the lack of consensus on this subject, Flow Research (*www.flowresearch.com*) has formed the Flow Recalibration Working Group (FRWG) to address this issue. The FRWG is made up of representatives from flow calibration facilities and flowmeter manufacturers, and will also be soliciting input from end-users. The mission of the FRWG is described at *www.frwg.org*.

The FRWG will attempt to come up with a list of criteria that end-users can apply to determine whether their flowmeters need to be recalibrated. By applying these criteria, end-users will be able to determine what appropriate action to take with respect to their flowmeter.

After a flowmeter is put into service, it needs to be recalibrated periodically to ensure it is still operating within the proper specifications. There are a number of different methods used for recalibrating a flowmeter, or at least checking it for proper performance. These include the following:

- Running diagnostic software to determine if it is operating within acceptable parameters
- Using a check meter to monitor the performance of the flowmeter
- Running a "dry calibration" to check that the components are working according to specifications. This method is often used with ultrasonic flowmeters.
- Having a service company come and calibrate the meter onsite.
- Pulling the flowmeter out of service and sending it to a flowmeter calibration facility to be recalibrated.

Preliminary results from the FRWG can be expected in 2016.

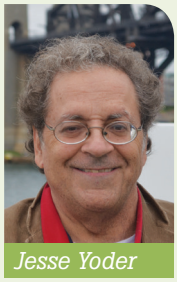
The Growing Need for Recalibration Facilities

Flowmeter market data from Flow Research shows an increasingly expanding flowmeter market. This especially applies to ultrasonic and Coriolis flowmeters, as well as turbine and other types of flowmeters. Some markets are expanding at an annual rate in the 10 percent range. This means that the installed flowmeter base is growing every year, and many of the flowmeters sold this year will need recalibration in the next three to five years.

At the same time, the growth in recalibration facilities does not seem to be matching the growth of the flowmeter market. In addition, some regions, such as the Middle East, still do not have a natural gas flow calibration facility. End-users in this region generally ship their flowmeters to facilities in Europe or North America for recalibration. There are also a number of flowmeter labs in Asia, although many of these tend to mainly serve their own regional areas.

There are also specific applications that are growing but that are not currently served by any or an adequate number of facilities. These include multiphase and LNG flow calibration facilities. Other applications will no doubt emerge as flow measurement expands into new and uncharted areas. These needs will have to be filled either by adding on to existing facilities, or by building new ones. FC

Flow Research is currently conducting two worldwide flowmeter calibration studies — one on gas calibration and one on liquid calibration. For more information, please visit www.flowcalibration.org.


Jesse Yoder

Jesse Yoder, Ph.D., *is president of Flow Research Inc. in Wakefield, Massachusetts, a company he founded in 1998. He has 27 years of experience as an analyst and writer in process control. Dr. Yoder specializes in flowmeters and other field devices, including pressure and temperature products. Dr. Yoder can be reached at jesse@flowresearch.com.*

www.flowresearch.com

FLOWSTREAM *Find related content @ flowcontrolnetwork.com…Search on:*
Flowmeter Calibration | Flowmeter Recalibration | Flow Research