Why We Need More Gas Flow Calibration Facilities

By Jesse Yoder, Ph.D.

This is Part II in a series of articles on flowmeter calibration. Part I in this series appeared in September Flow Control (pages 14–18).

The first time I began to fully appreciate the importance of flowmeter calibration, especially for gas flowmeters, was during three trips I made to the Middle East in 2009. The purpose of these trips was to interview end-users about their use of flowmeters, especially those used to measure gas flow. I visited the United Arab Emirates, Saudi Arabia, Qatar, and Oman. Typical end-user plants include petrochemical, chemical, refining, and oil and gas production companies.

The End-User Perspective

End-users interviewed expressed frustration that there is no major independent flow calibration facility in the Middle East. Since that time, Emerson Process Management (*www.emersonprocess.com*) has built a liquid flow calibration facility in Abu Dhabi. However, this facility is only designed for meters with relatively small line sizes, and it is designed to calibrate liquid rather than gas flowmeters. End-users in the Middle East who wish to have their flowmeters recalibrated generally send them to Europe or the United States. While there are some excellent flow labs in these regions, there are a number of issues that can make this a difficult solution.

One issue is that the end-user company may not have a back-up flowmeter that can readily replace the flowmeter being pulled from service. This can mean having to do without the flowmeter until the recalibrated flowmeter is returned from the calibration facility. While some of the leading calibration facilities promise two- to three-day turnaround, transportation time to and from the calibration facility has to be taken into account. Customs clearance can cause further delays. Air transportation is always an option, but is quite expensive, while travel by ground or by ship is less expensive, but slower. For companies in the Middle East, a fast turnaround time at the calibration facility doesn't necessarily make up for what can be lengthy transportation time to and from the calibration facility.

This situation is very much parallel to the problems some companies have in delivering their products to far-flung regions of the globe. It is why companies such as ABB (*www.abb.com*), Emerson Process Management, and Siemens (*www.siemens.com*) have built manufacturing facilities in China and other countries around the world. Having manufacturing facilities where the customer is located means quicker delivery time, and the ability to more quickly deliver customized products. It also means faster service time for customers. While a number of flowmeter manufacturers have sales offices in the Middle East, end-users there would also like to see flowmeter manufacturing plants built in this region.

To help build in redundancy and also to build in a backup, some end-users run two flowmeters in series, especially for critical measurements. This could be two ultrasonic flowmeters in series, two turbine flowmeters in series, or an ultrasonic and a turbine flowmeter in series. Then if one flowmeter has to be pulled for recalibration, the company still has one flowmeter to rely on. Even though this may not be an ideal situation, it is far better than being left without any flowmeter to measure the flow.

Where to Calibrate Your Flowmeter

End-users have a number of highly qualified and reliable independent laboratories to choose from. These include Colorado Engineering and Experiment Station, Inc. (CEESI, *www.ceesi.com*) in the United States, NMi Euroloop (*nmi-euroloop.nl*) and VSL (*www.vsl.nl*) in the Netherlands, pigsar in Germany, National Engineering Laboratory (NEL, *www.tuvnel.com*) in the United Kingdom, and TransCanada Calibrations (*www.tccalibrations.com*) in Canada. There are also a number of

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CEESI natural gas flow calibration facility in Garner, Iowa.

calibration facilities in China and Asia.

While end-users can select from a large number of independent labs, they can also choose to go back to the manufacturer from which they bought the flowmeter. Nearly all manufacturers have calibration facilities for performing the initial calibration of the flowmeters they sell before they are delivered. Most will also perform recalibration as a service for their customers.

While manufacturers who make recalibration a service are to some extent in competition with the independent flow labs, there may be other considerations that give end-users a reason to go back to the manufacturer. This could be physical location of the manufacturer, a positive relationship with the flowmeter supplier, a service contract already in place, extensive calibration facilities by the manufacturer, or a lack of a relationship with an independent flow lab. For one or more of these reasons, end-users may choose the manufacturer of their flowmeters, or some other flowmeter manufacturer, to calibrate their flowmeters.

Why Gas Flowmeter Calibration Is Unique

When performing a flowmeter calibration, the best calibration is performed when it duplicates the conditions under which the flowmeter measures flow. This includes the fluid being measured, the pressure and temperature conditions, and the upstream and downstream piping. For this reason, end-users sometimes ship not only the flowmeter to be calibrated, but also the flow conditioner and accompanying piping. This is especially common with orifice plate flowmeters, and it is called a meter run.

Large ultrasonic and turbine flowmeters, those 12 inches in diameter and above, present special challenges for flowmeter calibration. The most effective calibration is performed with natural gas flowing through the reference meter and the meter being calibrated. Large ultrasonic and turbine meters flow natural gas at extremely high speed. Facilities that can calibrate these large flowmeters cost millions of dollars to build. This is why most large ultrasonic and turbine meters are both initially calibrated at independent labs and then recalibrated at independent labs.

Two Solutions for High-Speed Gas Flow

There are two main ways to generate the kind of high speed and high pressure flows needed for calibrating large natural gas meters. One way is to build a facility that has equipment capable of flowing natural gas through a master meter and the meter under test using equipment contained within the facility. This is called a closed loop system. The other way is to build a flow calibration facility that leverages an existing natural gas pipeline.

The closed-loop solution is the one chosen by NMi Euroloop. NMi Euroloop

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Natural gas storage balloons at an NMi Euroloop gas flow calibration facility.

was opened in 2010, primarily to address the need for high-speed natural gas flow calibrations. This facility uses a combination of piston compressors, high-speed blowers, and an ammonia cooling system to create the right combination of high speed, high pressure, and the correct temperature to calibrate large natural gas flowmeters. One advantage of this system is that it can run 24/7, and the facility has complete control over the natural gas used in the calibration process. The total capacity of the natural gas available at this facility is 7,000 m^3. NMi Euroloop uses seven turbine meters as master meters, monitored by seven ultrasonic flowmeters.

Building a calibration facility on a high-speed natural gas pipeline that is already flowing natural gas is the solution chosen by CEESI at a facility built in Garner, Iowa. CEESI diverts a sufficient amount of natural gas from a TransCanada pipeline that is already flowing high-speed natural gas to use it for test purposes. The natural gas is used for calibration purposes, and then returned to the natural gas pipeline.

The Need for More Calibration Facilities

Simple math dictates the need for more calibration facilities, especially for gas flow measurement. Even though the market for turbine flowmeters is growing slowly, a large number of new turbine meters are sold every year worldwide. Many of these are for gas flow measurement. The ultrasonic flowmeter market, by contrast, continues to grow, especially multipath ultrasonic flowmeters for custody transfer applications. Many of these are large flowmeters, but the smaller ones also need to be calibrated. Eventually, perhaps within three to five years, many of these flowmeters sold in 2015 will need to be recalibrated. This is in addition to the existing installed base of turbine and ultrasonic meters that were sold three to five years ago that may need recalibration this year.

Some flow calibration facilities report that they have waiting lists for flow calibrations. End-users also report having to wait three months or more for certain flowmeters to be recalibrated, especially large size ultrasonic and turbine meters. The growth in the flowmeter market is relentless, with most flowmeter types showing positive unit growth each year. There appears to be no corresponding growth in flowmeter calibration facilities. If flowmeter growth is outpacing the growth of calibration facilities currently, what will the situation be like in five or 10 years? This problem is so critical that it may need to be addressed by an industry wide task force, rather than being left up to individual flowmeter manufacturers and independent flowlabs.

Flowmeters Measuring New Types of Fluids Require Recalibration

As if measuring existing fluids, such as natural gas and petroleum liquids, is not enough, new fluids are becoming increasingly important, and new types of flowmeters are being created to measure them. Two of the most important new flowmeter types are multiphase flowmeters and liquefied natural gas (LNG) meters.

Multiphase flowmeters measure the relative amount of gas, oil, and water in fluids coming out of oil and gas wells. These flowmeters are very expensive (some cost more than $500,000), though recently costs have come down with innovative technological developments. Multiphase flowmeters are extremely valuable because they provide information about the state of the producing well and the field it is in, and because they make it possible to determine the relative amounts of oil, gas, and water coming out of a well before these fluids are run through a separator.

LNG is a difficult measurement because it has to be made at cryogenic temperatures. The temperature of LNG is at -161 C, which is equivalent to -259 F. Several companies, including GE Measurement and McCrometer, have developed LNG meters. Other companies can perform this measurement using cryogenic meters. LNG is increasingly playing a role in the world's energy story. Because China, Japan, and many other Asian countries were not blessed with an abundance of fossil fuels like countries in Europe, the Middle East, and North America, they are importing LNG on ships from these regions. VSL is building an LNG calibration facility that is expected to open in Rotterdam, the Netherlands, in 2016.

Right now the need for recalibrating multiphase meters is less critical because many of them are new, and they are so expensive that they are relatively small in number. But both multiphase and LNG flowmeters will need to be calibrated in the future, presenting another opportunity for flowmeter calibration facilities. FC

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