by Jesse Yoder, Ph.D.

Ultrasonic Flowmeters for Custody Transfer

Multipath Systems Offer Accuracy for Critical Measurement Applications

IN JUNE 1998, THE AMERICAN GAS ASSOCIATION PUBLISHED A STANDARD CALLED AGA-9. THIS STANDARD LAYS OUT CRITERIA FOR THE USE OF ULTRASONIC FLOWMETERS, SPECIFICALLY MULTIPATH SYSTEMS, FOR CUSTODY TRANSFER OF NATURAL GAS.

In today's fast-paced flowmeter market, user demand for higher accuracy and reliability is causing a shift towards new-technology flowmeters, especially ultrasonic and Coriolis. And in the case of ultrasonic flowmeters, this shift is helped by the number of new products entering the market, particularly for custody-transfer applications where industry approvals have paved the way for ultrasonic flow measurement.

The history of ultrasonic flowmeters goes back to 1963, when Tokyo Keiki (now Tokimec) first introduced ultrasonic flowmeters to commercial markets. In 1972, Controlotron (now part of Siemens Energy & Automation) was the first company to introduce clamp-on ultrasonic flowmeters in the United States. In the late 1970s and early 1980s, Doppler ultrasonic flowmeters came to prominence. However, they were not well understood, and as a result oft misapplied. This gave ultrasonic flowmeters a bad reputation with some end-users, but by the 1990s ultrasonic flowmeters were being widely used for industrial applications.

Much of the history and success of ultrasonic flowmeters is tied to approvals granted by industry associations. For most custody-transfer applications, end-users select a type of flowmeter for which an industry-approved standard exists. In June 1998, the American Gas Association (*www.aga.org*) published a standard called AGA-9. This standard lays out criteria for the use of ultrasonic flowmeters, specifically multipath systems, for custody transfer of natural gas. It was updated and reissued in 2007. The publication of this standard gave a boost to the sale of ultrasonic flowmeters, especially those of the multipath variety.

Single Path vs. Multipath

Transit-time ultrasonic flowmeters in closed pipes work by shooting an ultrasonic beam from one side of the pipe to the other and back again. They track the transit time of the wave. If the wave is going with the flow, its transit time is shorter than when it goes against the flow. The difference between the transit times of the two beams is proportional to flowrate.

Some ultrasonic flowmeters rely on one pair of transducers that send only one wave back and forth across the pipe. These are called single-path ultrasonic meters. Other ultrasonic flowmeters shoot two, three, four, or more beams across the pipe and back. While ultrasonic meters with two beams could be considered multipath, the term multipath is usually reserved for ultrasonic meters with three or more beams. The best-known ultrasonic flowmeters for custody transfer of natural gas have four, five, or six beams.

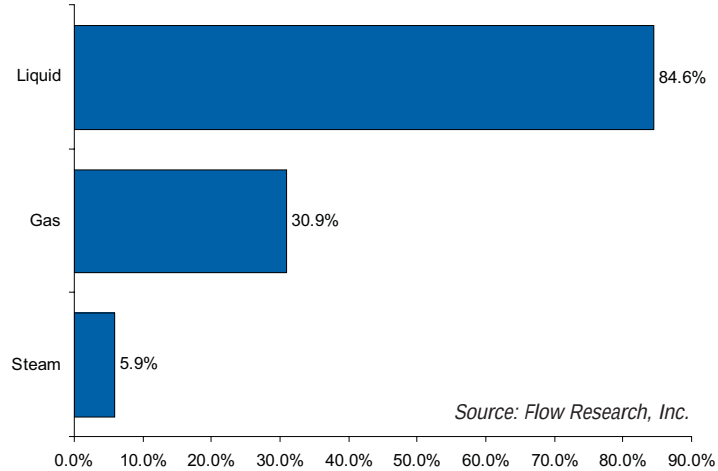
Multipath ultrasonic flowmeters measure flow at multiple points, and as a result are more accurate than single-path meters. The jury is still out on what is the optimal number of paths, or the extent to which adding more paths than six offers improved performance. What is clear is that multipath ultrasonic flowmeters, regardless of the number of paths, typically outperform single or dual-path meters.

Measurement of Liquids

Ultrasonic flowmeters are used to measure both gas and liquid flows. In 1995, the International Organization of Legal Metrology (OIML, *www.oiml.org*) developed R 117, "Measuring Systems for Liquids Other than Water." While this is a standard that applies to ultrasonic flowmeters, it applies to other types of flowmeters as well.

While the AGA adopted AGA-9 in 1998, it was not until seven years later that a standard was approved in the United States that was specific to the use of ultrasonic flowmeters for liquid applications. In February 2005, the American Petroleum Institute (API, *www.api.org*) published a standard for the use of ultrasonic flowme-

Figure 1
Are or Will the Ultrasonic Flowmeters You Have Purchased or Will Purchase Be Used in Gas, Liquid, or Steam Applications?



Total respondents = 136

Note: Percentages sum to over 100 due to multiple responses

ters for measuring liquid hydrocarbons. Since that time, suppliers have brought out flowmeters that conform to both OIML 117 and the API standard.

Ultrasonic Suppliers

KROHNE (*www.krohne-mar.com*), for example, has released several multipath flowmeters designed for custody transfer of liquids. The ALTOSONIC V is a five-path meter designed for use in the oil & gas, refining, and petrochemical industries. The ALTOSONIC III is a three-path meter designed as a more cost-effective alternative that still can be used for custody transfer of light liquid hydrocarbons.

Another company with products in this space is Faure Herman (*www.faure herman.com*). Faure Herman, based near Paris, France, manufactures an 18-path ultrasonic flowmeter designed for liquid applications. In February 2007, Idex Corporation acquired Faure Herman.

While Caldon has traditionally sold into the nuclear industry, the company has also developed ultrasonic flowmeters for petroleum applications. Included in this group are two-path, four-path, and eight-path ultrasonic meters. In January 2006, Caldon was purchased by Cameron (*www.c-a-m.com*) and is now a division of Caldon Measurement Systems.

Thermo Scientific M-PULSe

One of the most recent entries into this market is the M-PULSe by Thermo Fisher Scientific (*www.thermofisher.com*). Thermo Fisher Scientific is the result of a merger between Thermo Electron and Fisher Scientific, a deal that was completed in November 2006. The recently formed company is now branding products as Thermo Scientific and has long been a player in the ultrasonic flowmeter market, offering both Doppler and transit-time ultrasonic meters.

The M- PULSe is a transit-time ultrasonic flow measurement system comprised of a spoolpiece and flow computer. It is designed for the custody-transfer of petroleum products. One unique feature of the system is the integrated flow computer, which incorporates the necessary API algorithms for custody-transfer applications. The flow computer can be mounted in a safe area, as much as 500 feet from the meter's spoolpiece.

With the M-PULSe, Thermo Fisher is making a bid to be a major player in an increasingly crowded transit-time ultrasonic flowmeter field. The M-PULSe is one of few multipath ultrasonic flowmeters for liquid applications with four paths. It offers accuracy levels of 0.15 percent. The M-PULSe spoolpiece is available in sizes from four to 16 inches.

Facing the Competition

Transit-time ultrasonic flowmeters for petroleum applications face competition from Coriolis, positive-displacement, turbine, and differential-pressure (DP) meters. However, Coriolis meters perform best in line sizes of less than four inches, while ultrasonic meters do best in line sizes of four inches and up. This makes ultrasonic meters more complementary than competitive with Coriolis flowmeters. Even so, companies such as Rheonik (*www.rheonik.com*), Endress+Hauser (*www.endress.com*), and Micro Motion (*www.micromotion.com*) are now offering Coriolis meters for lines above six inches.

Ultrasonic flowmeters have several advantages over positive-displacement (PD) and turbine flowmeters. Unlike PD and turbine meters, they have no moving parts and create little-to-no pressure drop. This gives them an advantage in terms of long-term reliability. And while DP flowmeters have a cost advantage, they have the disadvantage of creating pressure loss. In addition, their primary elements, especially orifice plates, are subject to wear. It is due to these advantages that many end-users are now selecting ultrasonic flowmeters, especially for new applications.

Thermo Fisher Scientific's M- PULSe is a transit-time ultrasonic flow measurement system comprised of a spoolpiece and flow computer. It is designed for the custody transfer of petroleum products.

Ultrasonic Technologies Abound

Just five years ago the ultrasonic flowmeter market was dominated by companies that offered only one kind of flowmeter. This made ultrasonic a less desirable choice for large projects that required multiple types of flowmeters and instrumentation. Now, however, the new companies that dominate the field offer a broad range of flowmeters and other instrumentation. Companies such as Thermo Fisher Scientific, KROHNE, Cameron Measurement Systems, and Siemens offer a broad range of flowmeters and process instrumentation. In addition, these companies are continuing to offer newer breeds of ultrasonic products. Ultrasonic flowmeters have finally matured to the point where they can take their place as one of the leading types of flowmeters. FC

***Jesse Yoder**, Ph.D., is the president of Flow Research Inc. (Wakefield, Mass.), a company he founded in 1998. He has 20 years of experience as an analyst and writer in process control. Dr. Yoder specializes in flowmeters and other field devices, including pressure, level, and temperature products. He has written over 70 market research studies in industrial automation and control and has published numerous journal articles. Dr. Yoder can be reached at jesse@flowresearch.com or 781 245-3200.*

www.flowresearch.com

For more information on the ultrasonic flowmeter market, visit Flow Research's Web portal www.FlowUltrasonic.com. Also, look for an article on trends in the worldwide ultrasonic flowmeter market in the February issue of Flow Control.