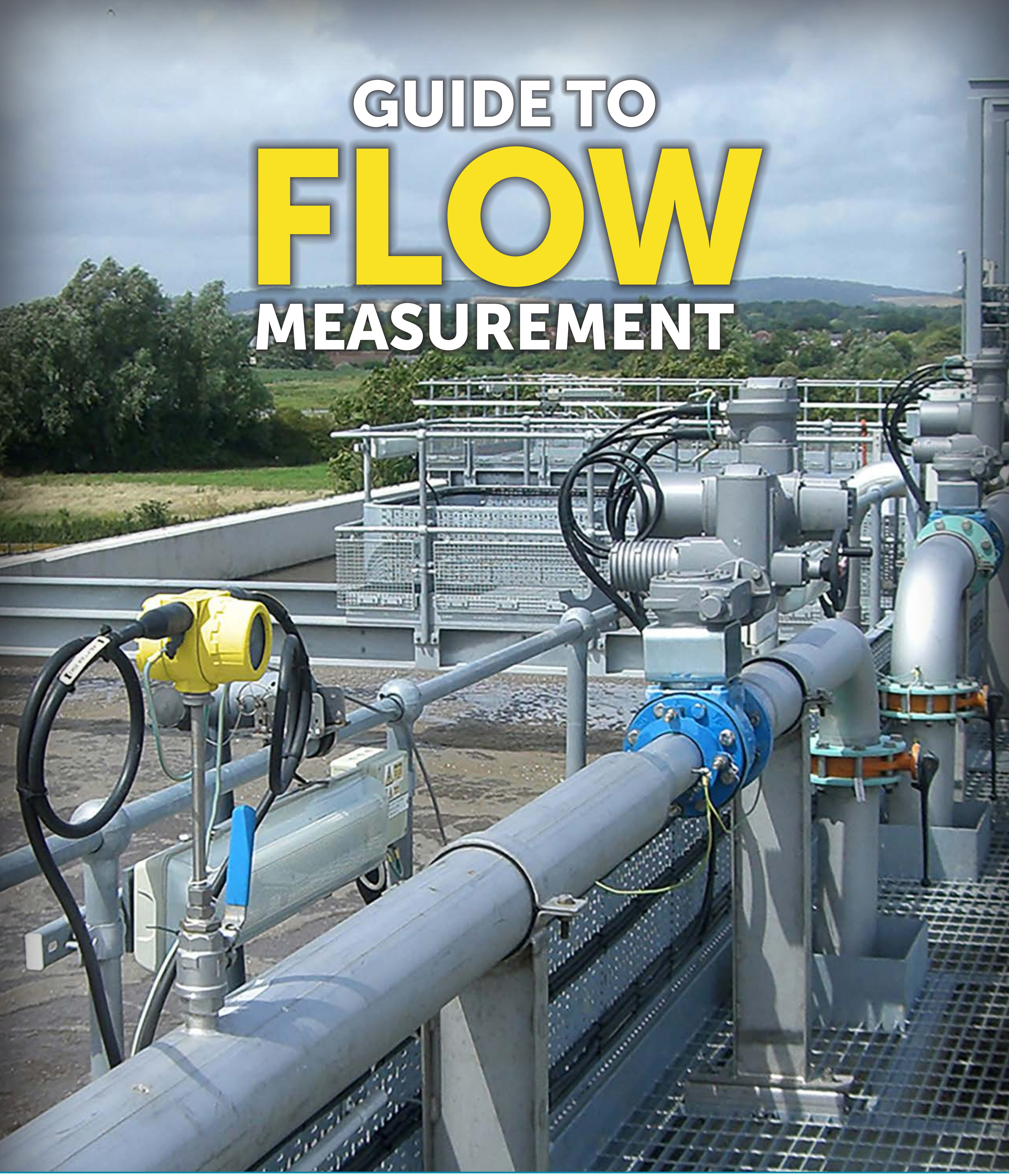
GUIDE TO FLOW MEASUREMENT



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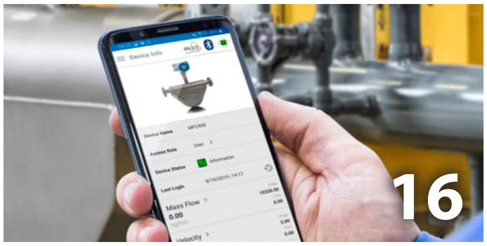
Building on the success of last year's ebook, the second edition of IPP/T's Flow Measurement Handbook once again brings engineers and process professionals the latest insights on flow measuring techniques and instruments. This insightful compilation of articles provides new information and a wealth of practical advice on the design, operation, and performance of a broad range of flowmeters.

In the pages of the handbook, you'll find expert advice and applications that work best for a number of real-life situations, and tips on how to choose the best system for your flow challenges.



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FLOW MEASUREMENT

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IPP/T INDUSTRIAL PROCESS PRODUCTS & TECHNOLOGY

CANADA'S PROCESS NETWORK

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10 ESSENTIALS
TO SPECIFY A THERMAL MASS GAS FLOW METER SUCCESSFULLY

By Randy Brown
Fluid Components International

Mom and dad always said to do your homework. That was true then for school and true now for process measurement and control professionals responsible for specifying flow instrumentation.

Whether you are working on a plant upgrade, a process improvement or an expansion project, doing your homework on the application and installation will save you time and expense, and ensure success.

To specify a thermal mass flow meter correctly, there are 10 key questions you will want to understand, consider and then be able to answer. Being ready with the answers to these 10 questions will help you communicate effectively with consulting engineers, manufacturers and/or their local sales engineering team.

Figure 1. Knowing gas type is required to specify a thermal flow meter.

1. What installed accuracy is needed?

Reviewing the general accuracy statement in the manufacturer's product literature is not enough. The installed accuracy must take into consideration the instrument's basic accuracy capability, plus calibration, plus flow profile disturbances, and both the gas and installation temperatures and the instrument's ability to compensate for it.

Is an actual gas calibration needed or is equivalency acceptable?

In all cases, an actual gas calibration performed at process temperature and pressure conditions will always result in best possible accuracy for thermal mass flow meters.[1] When best possible accuracy and repeatability is required, then an actual gas calibration is the solution.

In some situations, however, an actual gas calibration might not be practical, achievable or economical, and then an equivalency calibration is the only practical answer. These situations might include, but are not limited to, complex gas mixtures or for various safety reasons.

Furthermore, in applications where less accuracy and repeatability are acceptable, an equivalency calibration, using a surrogate gas (typically air), might be an acceptable, lower-cost alternative. Equivalency calibrations are theoretical, and their accuracy is the subject of much debate. When done only for purchase price savings, buyers should beware of equivalency methods. Reputable manufacturers will provide you with an expected accuracy per your specific installation conditions and the calibration process they will apply before you commit to purchase.

2. What is the gas type to be measured?

Is the gas type air, inert gas or hydrocarbon-based gas (Figure 1)? Is it a single gas or a mixture? If it is a mixture, what are the proportions of which gases? Could the gas mixture change, and, if so, by what proportions? Is the gas clean or dirty? If dirty, can you qualify and/or quantify it? Is the gas dry, moist or wet? Can you quantify the amount of moisture? Is the fluid corrosive? Dry, clean gases can be processed by all manufacturers. If it is a moist gas, then constant power technology has been proven to be superior. If liquid droplets or condensation conditions exist within the flow stream, then two manufacturers currently have solutions. One offers a super-heated, 300°C [572°F] flow element to flash-off the droplets, while another manufacturer provides a mechanical shunt which prevents liquid droplets or condensate from reaching the sensors.

The measuring principle of thermal mass flow meters involves heat transfer caused by gas flow. Any moisture or condensate in the gas stream that contacts the heated sensor can cause a sudden, momentary change in the heat transfer that can result in a spiked or fluctuating reading, creating inaccurate or unstable flow measurement. Thermal flow meters using the constant ΔT (CT) method are particularly reactive to moisture droplets, while constant power (CP) method meters, because their slightly heated sensor's temperature is elevated above the dew point of the gas are resistant to moisture's effects.

3. What is the required flow range?

Figure 2. Know your flow range.

One of the compelling features of thermal flow meters is their wide turndown capability (Figure 2). Typical turndown for most manufacturers is 100:1. Flow range capabilities are a big differentiator between suppliers and technology. Typical CT-type technology meters have less range than CP-type devices due to sensor power limitations. However, some manufacturers have special techniques to extend their measuring ranges up to 1000 fps [300 mps].

4. What is the needed response time?

While it might seem like "the faster the response the better" is the correct choice, in flow metering this might not be true at all. If the thermal flow meters will be part of a PID control loop, too fast of a response can create excessive valve responses (chatter) resulting in an inability to achieve stable flow control or premature valve failure. Conversely, if the response is too slow, the control valve action might lag by too much and desired control is not achieved. Furthermore, if the air/gas flow stream has any entrained moisture (e.g., condensation droplets), a fast-responding thermal flow meter will produce erratic, unstable readings as water droplets hit the sensors.

5. In what type and size pipe will the meter be installed?

Will the installation be in a round pipe or a rectangular duct? What is the diameter — both OD and ID — of the pipe or dimensions of the duct? If an insertion-style meter, what is the dimension of the socket (e.g. thread-o-let), and will it be installed through a ball valve? These are important considerations for three reasons:

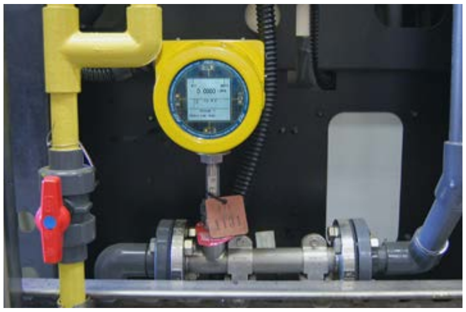

Figure 3A Top: Small diameter piping situations can require a different type of connection configuration.

Figure 3B Bottom: Extreme example of very large diameter pipe, high temperature insulation, dusty, outdoor, above ground installation point, and in Div.1/Zone 1 type Ex location that were made clear at the beginning to ensure first-time right success.

Smaller diameter pipes require use of an inline or spool-piece design, rather than an insertion type.

If an insertion-type, whether a single-point or multi-point averaging solution is recommended.

To ensure the probe length is correct to achieve the proper insertion depth into the pipe. (In single-point types, the center of the pipe is the required installation depth) (Figure 3).

6. How much straight run is available?

Figure 4. Consider meter flow straight-run requirements and flow disturbers.

To meet their laboratory-calibrated performance specifications in their actual field installation, thermal mass flow meters require a repeatable flow profile (Figure. 4). This will naturally occur with 15d to 20d of upstream straight run and 5d to 10d of downstream straight run. These are laws of flow dynamics physics, not subject to debate. If you do not have enough straight run available, reputable manufacturers will provide information and quantification of the accuracy degradation you could expect. Furthermore, all reputable manufacturers offer some type of flow conditioning technology to produce an accurate, repeatable measurement in installations with inadequate straight run.

7. What are the ambient conditions and requirements of the meter's installation area?

Will the instrument be installed indoors, outdoors under a protective roof, or out-

Figure 5. In outdoor, harsh desert sunlight, know the ambient conditions of your installation location.

doors completely exposed to all weather conditions (Figure 5)? Would the installation benefit by remotely locating the electronics from the sensor element? Would a sun shield help shade the transmitter and readout? Does the instrument enclosure's IP or NEMA-type rating meet or exceed the installation condition requirements?

Will the instrument be exposed to corrosive elements (e.g. seawater) or erosive (e.g. high-pressure or steam washdowns) conditions? Will a plastic enclosure survive? Will the paint come off or will the aluminum enclosure exhibit a patina? Will a carbon steel enclosure rust? Would service life be worth the extra investment in a stainless-steel enclosure?

Is the process itself running at high temperature where the instrument could be exposed to radiated heat, or does the pipe have a layer of insulation to consider? Should electronics be remotely located from the sensor element to avoid exposure to excessive heat radiating from the process? If insulated, be sure to add its depth in determining the length of the probe and the process connection. Is the installation subject to explosive gases such that Ex class/zone approvals are required? If yes, what levels? Is the location a Div.1/Zone 1, Class I, Div.2/Zone 2, etc.? If yes, what country's approval standards are required (e.g. FM, ATEX). Does the full instrument (sensor, electronics and enclosure) carry the matching required approval?

8. What type outputs are needed and how many?

Is a single analog output (e.g. 4-20 mA) of the flow rate adequate? If an output of the temperature is also desired, many manufacturers also provide a second analog output channel for this. Some manufacturers also offer pulse or frequency outputs to send to remote readouts or totalizers. Or is your process tied to a bus communications-based control network requiring HART, Modbus, Foundation Fieldbus, Profibus, BACnet, EtherNetIP or other protocol? Do you require evidence of these bus comms being registered and certified to better ensure successful integration?

Is there a chance your output needs could change in the future? For example, is the plant considering migrating from traditional analog 4-20 mA signals to a digital bus? If yes, ask the flow meter manufacturer if its meter can be upgraded and, if yes, how. For the few manufacturers who offer some migration path, the means will be much different. For some it might mean returning the meter to the factory, while others might have a field upgrade kit available. Others will have both analog and digital buses already embedded and selectable by the user in the field.

9. What type of process connection will be used?

How will the flow meter be installed into the pipe and held in place (Figure 6)? Will

Figure 6. What is the required mechanical connection to pipe?

the meter be installed in or ever need to be retracted under pressure? And if so, how much? Some manufacturers offer only a limited choice while others offer an extensive selection. What type of fitting is required: threaded, flanged, compression type, NPT or metric? What about the required ratings? Will you need a packing gland or need to hot tap the line for installation? Would adding a ball valve be helpful for maintenance? Consider also that non-standard or special order process connections will increase the cost and extend delivery times.

10. Are specific pedigrees, certifications and/or documentation required?

Often overlooked during initial considerations and application suitability are requirements for certifications and qualifications beyond the basic meter performance. This might include such things as pressure tests, certified materials and traceability, positive material identification report, and/or welding pedigree and certificates. If the thermal flow meter is to be used in a safety instrumented system (SIS), is there proof, and preferably independent verification, of SIL compliance (Figure 7). If the flow meter will be used in emissions monitoring (CEMS), does it need to have special functions or features added (e.g. calibration check routines) to comply with local regulations (e.g. U.S. EPA, European QAL1, etc.)?

Figure 7. What certification requirements need to be met?

Conclusion

The proper selection of any flow meter requires the specifying engineer to consider several variables. Thermal mass gas flow meters are no different. Thermal mass gas flow meters are a mainstream technology growing in popularity due to continued improvements in the technology, cost effectiveness and education on best practices. Specifying engineers prepared with answers to the 10 variables presented here will take less time to identify the best-suited product, as well as ensure first-time right installation success (Table 1).

Footnote

1 Reference ISO 14511:2019, section 8,2 measurement of fluid flow in closed conduits-thermal mass flowmeters

Thermal Flow Meter Success Checklist

- ☐ Accuracy needed
- ☐ Gas type(s) and composition mix %
- ☐ Flow range
- ☐ Response time
- ☐ Size and type of pipe (or duct)
- ☐ Length of straight-run available, upstream and downstream, from meter's installation point
- ☐ Ambient conditions at installation location
- ☐ Type of electronic output(s) needed
- ☐ Process connection
- ☐ Certifications, tests, documentation

Table 1. Thermal Flow Meter Success Checklist

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More thermal flow meters for more applications in more industries.

For more than five decades, FCI has been precisely where you need us. In pipe sizes from 1/4-inch to the largest of stacks, and everything in-between. Measuring more than 200 gases, pure or mixed. Operating over flow rates from 0.2 to 1000 fps, with turndowns from 100:1 to 1000:1. In temperatures up to 850°F. Generating analog outputs and digital bus I/O to go with your DCS, PLC, or SCADA. For the definitive choice in gas flow measuring solutions—for any industry, anywhere—there's only one way to go.

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TAKING CLAMP-ON FLOW MEASUREMENT TO A NEW LEVEL OF PERFORMANCE WITH A LOW COST OF OWNERSHIP

By Vijay Acharya
M.ENG, P.ENG

Building on decades of experience in manufacturing and supplying clamp-on flow meter technology globally combined with Digital innovation, Siemens SITRANS FS230 clamp-on flow system offers higher performance in demanding applications, improved user-friendliness, easier installation, and diagnostics for continuous reliable operation.

Siemens Ultrasonic clamp-on flow meters operate on "Transit Time" principle to accurately measure volumetric flow of liquids and gases in process industries such as municipal potable water, wastewater including sludge flow, district energy chilled, hot, and condensate water, oil and gas including hydrocarbon liquids, natural gas, hydrogen, LNG, chemical, power, food, and pharma. It is applied for density measurement for product identification and pig detection applications in oil pipelines transferring varieties of crude and finished products like gasoline, diesel, etc. of various producers.

NON-INTRUSIVE & NON-CONTACT

The clamp-on flow meter sensors are clamped on the outside surface of the pipe. When an electromagnetic flow meter cannot be applied, the clamp-on flow meter is the next best choice over other in-line flow technologies like vortex, Coriolis, thermal dispersion, differential pressure, turbine, variable area type flow meters.

- No moving parts, so it offers no obstruction or pressure drop, no wear and tear or fouling of wetted parts like electrodes of electro-magnetic flow meters.
- It is not affected by aggressive, corrosive, or toxic liquids or gases
- Contamination free when measuring the sterile or high-purity media.
- Independent of the pressure, temperature, and other fluid property variations.

EASY & PORTABLE

The clamp-on flow meters are easy to mount on the pipes 15mm to 10M size without modifying or cutting the pipes or shutting down the process, this increases uptime and safety of the process and personnel.

- The portable clamp-on flowmeter is suitable to verify accuracy of other flow meters in the plant.
- Can be temporarily installed for flow survey or when the permanent flow meter has failed in the plant, and operators need flow information for monitoring and control of the processes until they replace/repair the failed flow meter.

DOPPLER OR TRANSIT TIME

Clamp-on ultrasonic flow meters are based on **Doppler** or on **Transit Time** of the liquid or gas. The Doppler effect example is a police car, as it moves closer to us the siren sounds louder and fades as it moves away, we call it a frequency shift. Doppler method is application sensitive and needs particles or bubbles in the fluid and due to various factors beyond scope of this article to discuss its accuracy can be as low as +/-20% or sometimes it ceases to work.

Siemens employs Transit Time principle for its Clamp-on Ultrasonic Flow meter SITANS FS230

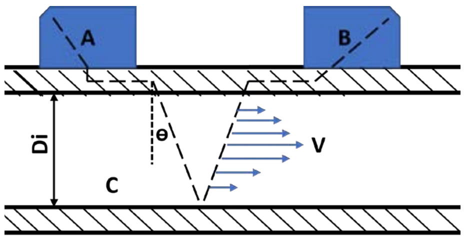

Figure 1: SITRANS FSS200 Sensors mounted in a reflect mode.

SITRANS FSS 200 clamp-on ultrasonic sensor pair A & B simultaneously transmits and receives acoustic signals directly through the pipe walls, where the refraction angle θ through the fluid is governed by Snell's law of refraction.

$\sin\theta = C / V\phi$ (C= speed of sound in fluid and $V\phi$ is phase velocity in pipe wall which is a constant).

The average transit time T_{fluid} of soundwaves in fluid between the sensors A and B is calculated by the meter by subtracting the computed fixed times within the transducers and pipe walls. The meter automatically compensates for the changes in sound velocity in fluid based on the variations in measured average transit time between sensors A and B.

The soundwaves travelling from sensor A to B ($T_{A,B}$) in the direction of the flow arrives earlier than the soundwaves travelling from sensor B to A ($T_{B,A}$) against the flow. This time difference ΔT is used to compute the integrated velocity(V) of the fluid as shown in the equation below.

$$V = (V\phi/2) \times (\Delta T/T_{fluid})\backslash$$

Once the fluid velocity (V) is determined, the fluid Reynolds number is computed to apply correction factor K_{Re} for fully developed profile. This requires entry of inside pipe diameter (Di), fluid dynamic viscosity (μ) and density (p). The volumetric flow rate (Q) is then calculated by using the following equation.

$$Q = (K_{Re}) \times (\pi/4) \times (Di)2 \times V$$

Ultrasonic sensor types:

There are two types of SITRANS FSS200 sensors used with SITRANS FS230 clamp-on flow meter. Universal or Shear mode or narrow beam sensors are used for any sonically conductive pipe and selected based on outside diameter of the pipe. It injects an acoustic signal into the pipe wall, and effectively pushing the signal through the pipe and to the opposite sensor. This technology though is easier and less expensive, but susceptible to aeration and solids in the fluid. It is mainly employed for portable flow survey where accuracy of +/-1% to +/-2% is acceptable.

Siemens is a pioneer in lamb wave (wide beam) sensor technology. They are selected based on pipe wall thickness, it broadcasts a wide range of frequencies through the pipe and locates a frequency that matches close to the pipe wall. This frequency is transmitted through the fluid with pipe is acting as a wave guide this provide wide area of beam to optimize signal to noise ratio and improves measuring accuracy to +/-0.5% to +/-1% and tolerates aeration and solids particles in the fluid much better. Lamb wave or wide beam sensors uses lower energy and are designed for steel pipes but can also be used with Aluminum and Titanium pipes. The signals are more cohesive, prominent, and precise. As a result, we can mark the arrival of the receive signal with greater accuracy. By contrast, a one size fits all approach as does our competitor, it becomes necessary to "crank-up" the transmit amplitude to blast the signal through the pipe and as a result the signal suffers by arriving less pronounced and less precise.

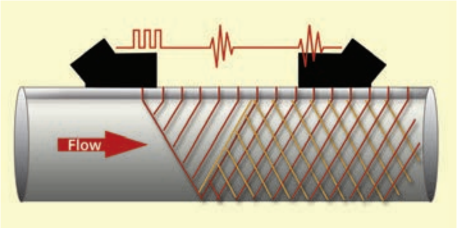

Figure 2: Lamb wave wide beam sensor where pipe is used as a wave guide.

For improved flow profile average in demanding applications, clamp-on flow sensors can be installed with 1, 2, 3 and 4 path on a single pipe in reflect mode or in direct mode shown below in figure 3.

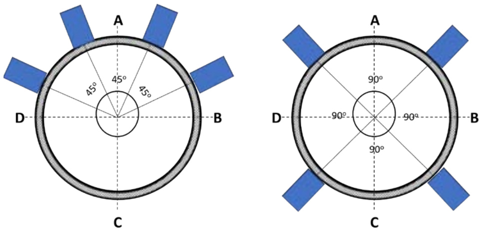

Figure 3: Four path installation in reflect mode (Left) and direct mode (right).

Higher performance with Digital SITRANS FS230

Instant digitalization of the signal, improved signal to noise ratio and reduced susceptibility to noise enhances SITRANS FS230 accuracy up to +/- 0.5% to +/- 1% and repeatability of +/- 0.25% (ISO 11631). It brings the advantage of a wider turn down ratio, which means it can measure very low flow of liquids and very high flow of gases. The fast update rate of 100 Hz from sensor interface to the transmitter and control system enables FS230 to detect and update any minuscule flow changes within 10 mS.

The digital sensor link (DSL) is the crucial link between the sensors FSS200 and the transmitter FST030. The DSL electronics module receives the analogue signals from the sensors and digitizes them to send them on to the transmitter. A SITRANS FS230 flow system comes with two options: an integrated DSL for ordinary area installations, or the external variant in an explosion-proof housing for installation in Zone 1 hazardous area locations.

SITRANS FS230 with digital platform, accurately measures volumetric flow in standard applications, but also in complex applications it can accept pressure and temperature sensor inputs to provide accurate mass flow and volumetric flow at standard (or normal) conditions. I It makes a product identification of hydrocarbons liquids in oil pipelines using a relation between their speed of sound, temperature, viscosity, and density. The process values along with extensive diagnostics parameters are available on local HMI and communicated to control systems via HART or Modbus for the operator to verify whether the flow meter is accurate and healthy or there is any process issue.

Figure 4: The Siemens SITRANS FS230 Flowmeter System combines SITRANS FSS200 sensors and SITRANS FST030 Transmitter.

APPLICATIONS:

SITRANS FS230 is ideal for measuring hydrocarbon liquid applications

The oil industry of Canada engaged in oil exploration, storage & transfer, refining and supplying the finished products to their customers are using Siemens clamp-on flow meters to measure flowrates, density, or interface measurement for identification of different products flowing in the pipeline.

The challenges are the varying flow rates, considering different products in the pipeline, temperature changes, the associated change in viscosity and flow behavior. A temperature measurement, either directly via a sensor or as an external analog input signal, is necessary. Based on the actual measured values of the current speed of sound, the measuring device accesses an internal oil table considering the current temperature. Aided by the table, the transmitter identifies the measured liquid, determines the current density & viscosity, calculates the Reynolds number, and corrects the volume flow accordingly.

Read Oil Table | Write Oil Table | Sort table | Store Table In Flash

End User Password entered
Command executed
Flash successfully updated

	Liquident	Liquident Identifier	MPMS 11.1 Reference Density	Viscosity Values		Liquid Classification Coefficients		
Unit	$[\frac{m}{s}]$	N/A	$[\frac{kg}{m^3}]$	$[\frac{m^2}{s}]$	$[\frac{m^2}{s}]$	$[\frac{kg^2}{m^6 \cdot K}]$	$[\frac{kg}{m^3 \cdot K}]$	$[\frac{1}{K}]$
index	PID_OilTable_Liquident @ T3 & Pref	PID_OilTable_LiquidIdentifier [0;255]	PID_OilTable_MPMSReferenceDensity @ T3 & Pref	PID_OilTable_ReferenceViscosity1 + 2		PID_OilTable_LiquidCoefficientK0 + 1 + 2		
1	1100	1 - MTBE	640	1E-06	6E-07	346,4228	0,4388	0,0000
2	1180	2 - LFB	717	1E-06	6E-07	346,4228	0,4388	0,0000
3	1200	3 - LR	733	1E-06	6E-07	346,4228	0,4388	0,0000
4	1330	4 - Kerosene	775	3,5E-06	2,2E-06	594,5418	0,0000	0,0000
5	1350	5 - AVJET	818	3,5E-06	2,2E-06	594,5418	0,0000	0,0000
6	1380	6 - HS Diesel	819	5,5E-06	3,5E-06	186,9696	0,4862	0,0000
7	1410	7 - LS Diesel	885	5,5E-06	3,5E-06	186,9696	0,4862	0,0000
8	1420	8 - GASOIL	959	2E-05	8,00E-06	186,9696	0,4862	0,0000
9	1490	9 - FO	930	0,000119	3E-05	186,9696	0,4862	0,0000
10	1579	10 - HFO	960	0,001049	0,0003	186,9696	0,4862	0,0000
11								

Figure 5: Oil Table (former Liquident table) stores 30 common products Gasoil, Diesel, Kerosene etc.

The measuring device always shows the currently recognized liquid on the display but is also able to output the current mass or a standard volume calculation. Cleaning pigs briefly interrupt the ultrasonic measuring paths and are thus reliably recognized as a pig run.

SITRANS FS230 in gas flow measurement applications

Typical applications are checking of the permanently installed flow meters, measuring high pressure gas networks, gas power plant compressors, gas inventory balancing, gas production in chemical industry and temporary billing. The pipe sizes it can cater are DN50 to DN1500 sizes with minimum pressure of 8 bars in steel pipes and velocity of gas up to 40 meters/sec.

The SITRANS FS230 flow system for gas measurement consists of two/four pairs of SITRANS FSS200 wide beam clamp-on sensors, internal or external digital sensor link and a SITRANS FST030 transmitter as in figure 7. Temperature changes via external sensor or analogue input and pressure changes via analogue inputs to FST030 are necessary for mass flow and standard volume flow corrections.

Sending ultrasonic signals through a gas is a challenge. At low pressure conditions, the signals are being scattered a lot more, causing a lower signal-to-noise ratio. Using Lamb wave Sensors with Wide Beam Technology can remedy this. Flow speeds of up to 40 m/s and more can cause beam blowing but the angle of incidence is much smaller than in liquid applications and thus the sensor distance is also smaller which mitigates the effect of high flow speeds on the sonic signals.

SITRANS FST030 transmitter has an internal AGA 8 gas table, which was created with the current gas chemical composition, taking pressure and temperature into account. Based on the actual measured values of the current flow rate, the FS230 accesses the AGA 8 gas table and determines the current viscosity, calculates the Reynolds number, and corrects the volume flow accordingly and able to output the current volume or to carry out the mass or a standard volume calculation.

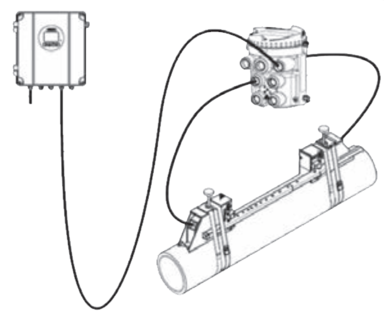

Figure 7: Clamp-on flow meter SITRANS FS230 system components and natural gas flow measurement application with "Soundcoat" to enable operations at low amplitude signals found in gas measurement.

Figure 6: SITRANS FS230 measuring hydrocarbon liquids with 4 path installation of wide-beam SITRANS FSS200 sensors in reflect mode, clamp-on temperature sensor in Zone 0, external DSL in Zone1 and wall mounted SITRANS FS230 about 100 meters away in Zone 2 hazardous area.

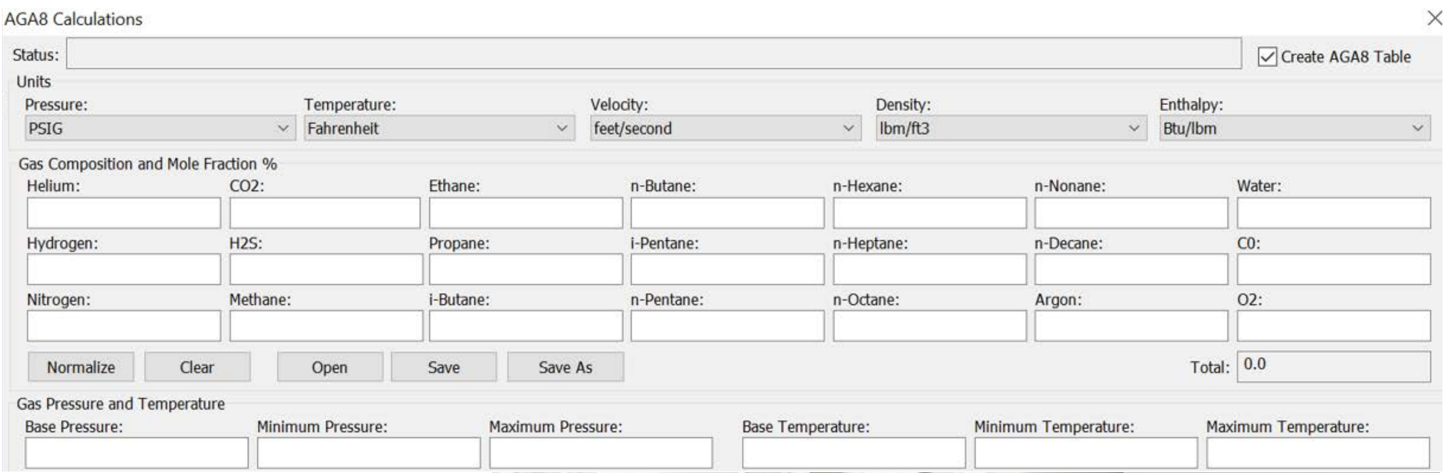

Figure 8: AGA8 gas table to determine speed of sound in natural gas & hydrocarbon gases.

SITRANS FS230 applications in other industries

SITRANS FS230 advancements have made the clamp-on flow technology more accurate, reliable and user friendly. Water and wastewater industry is the classic example as in figure 9, where in the assets like piping network and pumping stations are quite old and needs to measure the discharge flow from the pumping stations or a leak detection in the piping network. Similarly, in the district energy industry that supplies hot and chilled water for heating and cooling applications. Here the customer wants to measure liquid flow, but also wants to measure the energy usage for billing to their customer. The SITRANS FS230 clamp-on flow meter is an ideal solution with its patented pipe configuration algorithm for Reynold number correction to minimize the error under non-ideal installation conditions with excellent signal to noise ratio and fast update rates measure the flow and flow total data with other important information can be logged and viewed. The Energy meter SITRANS FUE950 energy calculator along with two matched pair temperature sensors mounted in supply and return line calculates the energy flow with input of flow rate from SITRANS FS230.

Figure 9: Typical water & wastewater pumping station and hot & chilled water lines in HVAC industry with installation constraints. Energy calculator & matched pair temperature sensors for energy measurement in HVAC industry.

Local manufacturing and Digitalization

Siemens in Peterborough is a local Canadian manufacturing hub of Siemens process instruments including Clamp-on flow meters and delivers quality instruments with the shortest lead time possible.

Also, the clamp-on flow meter SITRANS FS230 are easily integrated into the cloud-based Siemens Mindsphere Platform for leak detection and similar remote applications using Siemens Apps.

Siemens Process Instrumentation products are distributed in Quebec and Ontario exclusively by Franklin Empire.

Links for more information:

1) Technical information, case studies and PIA life cycle portal
2) Siemens SIWA Leak plus
3) Siemens FS230 videos
4) To book a meeting with a Franklin Empire Process Instrumentation Specialist

About the author: Vijay Acharya M.ENG, P.ENG is the Sr. Product Manager (Flow Products), Siemens Process Instruments, Oakville Ont. He has more than 30 years experience in Process Measurement and Control applications support, product management and product marketing.

UNDERSTANDING WHEN AND WHERE TO CALIBRATE YOUR FLOWMETERS

It's a simple enough conundrum: Failure to calibrate flowmeters can negatively impact performance, while calibrating too frequently can result in excessive costs without providing a benefit. So, when and how do you calibrate to best effect? The answer is, with planning and understanding so that you can make informed, proactive decisions rather than being reactive.

With flow measurements, the industry standard is to calibrate annually, even though that might not be necessary. Often, it's a ritual with no scientific basis behind it, other than it being as long as operators are willing to tolerate the risk of a potential problem. Some flowmeters require calibration only once every 3-4 years. In other circumstances, more frequent calibration, possibly even monthly, may be required to maintain a safe, effi-

cient, or regulatory-compliant operation. Calibration intervals might also fluctuate based on usage or historical performance.

New instruments and technologies, combined with careful planning and study, can allow plants to calibrate flowmeters at an optimum frequency, resulting in improved operations and cost savings.

So, when to calibrate? Step 1 is developing a flow calibration plan that follows best practices. Our Endress+Hauser whitepaper, "Best Practices for Flow Calibration Management" covers the issues in developing such a plan, including performing a plant wide assessment of all instrumentation, including flowmeters, ranking the latter according to four levels of interest from highest to lowest – product-critical, process-critical, safety-critical and non-critical – and establishing acceptable tolerances for each device.

Download the Endress+Hauser whitepaper, "Best Practices for Flow Calibration Management". **Click here**

When to Calibrate?

Setting up such a flow calibration plan often requires assistance from the flowmeter manufacturer and/or a qualified service provider to identify the optimal calibration frequency. The end-user must use this advice and apply it based on particular service conditions, functions of the meter and their own experience.

Calibration frequency depends on the criticality and maximum acceptable tolerance, as well as the nature of the product being measured, normal usage pattern (continuous or intermittent), any clean-in-place (CIP) considerations, the severity of process impacts, the type of flowmeter (contact or non-contact), and the unit's accessibility for calibration. In some cases, it may only be possible to access a flowmeter during a complete process shutdown; in other cases, a flowmeter might be readily accessible.

In a new plant, the flowmeter calibration frequency is usually based on expected operational parameters and advice from the flowmeter manufacturer. In an existing plant, the frequency can be based on historical experience and previous documented calibration performance and processes that yield better results. In either case, quality, regulatory or safety requirements may override the manufacturer's advice or historical data.

Once a calibration plan has been in effect for a few years, the instrument management software used in formulating the plan and storing performance data takes on a bigger role. Each time calibration is done, new data is recorded and stored in the database. This data shows the status of the flowmeter before and after calibration, and it may indicate it does not require calibration as often as previously assumed.

Where to Calibrate?

For calibration, flowmeters may be removed from the process and shipped to a calibration lab. Calibration can also be done at the user's site, using a portable flow rig. A portable rig does not provide the same accuracy as a lab, but does offer convenience and speed. Depending on plant topology, many measuring points can be quickly calibrated with minimal process downtime.

Calibration labs typically handle larger size flowmeters with larger flowrates. Portable flow rigs can handle flowmeters up to a maximum of 2" (rig), but larger sizes can be calibrated in-line with master meters. The results of on-site flow calibration are still traceable to recognized national standards and the turnaround time is reduced to hours versus days or weeks. For example, Endress+Hauser's on-site flow calibration is accredited in accordance with ISO/IEC 17025. Endress+Hauser can calibrate up to 2" on site and up to 4" at our Burlington, ON office.

For a comprehensive overview of the capabilities of third party providers of calibration services, download our Endress+Hauser whitepaper, "Instrument Calibration as a service". **Click here**.

These are key considerations in opting for lab versus on-site calibration.

Laboratory calibration

- Best accuracy
- Turnaround in days or weeks
- Suits larger calibration range – 1/24" to 12" and larger
- Usually costs less than on-site calibration

On-site calibration

- Good accuracy

- Faster turnaround than a lab, usually in hours
- Suitable for 2" and smaller, using a calibration rig – or 3" to 4" with in-line calibration with master meters
- Usually costs more than laboratory calibration

Thanks to advances in flowmeter diagnostics and instrument management software, the increasing availability of nearby calibration labs and portable rigs, and the willingness of instrument vendors to assist users with calibration, setting up and implementing a flow calibration plan based on best practices is easier than ever.

For instance, a Wisconsin food and beverage plant was having compliance difficulties after failing an audit. They realized they needed specialized support. Working with the flowmeter manufacturer, they performed an assessment of 300 flowmeters. Next, the calibration plan was established and frequencies determined. After calibrating all devices, all flowmeter data was stored in a calibration management software solution. Now the plant is able to easily access performance information, including calibration data, history and certificates.

Such solutions can help find that Goldilocks balance – calibration intervals that are not too frequent or infrequent, but just right.

100%

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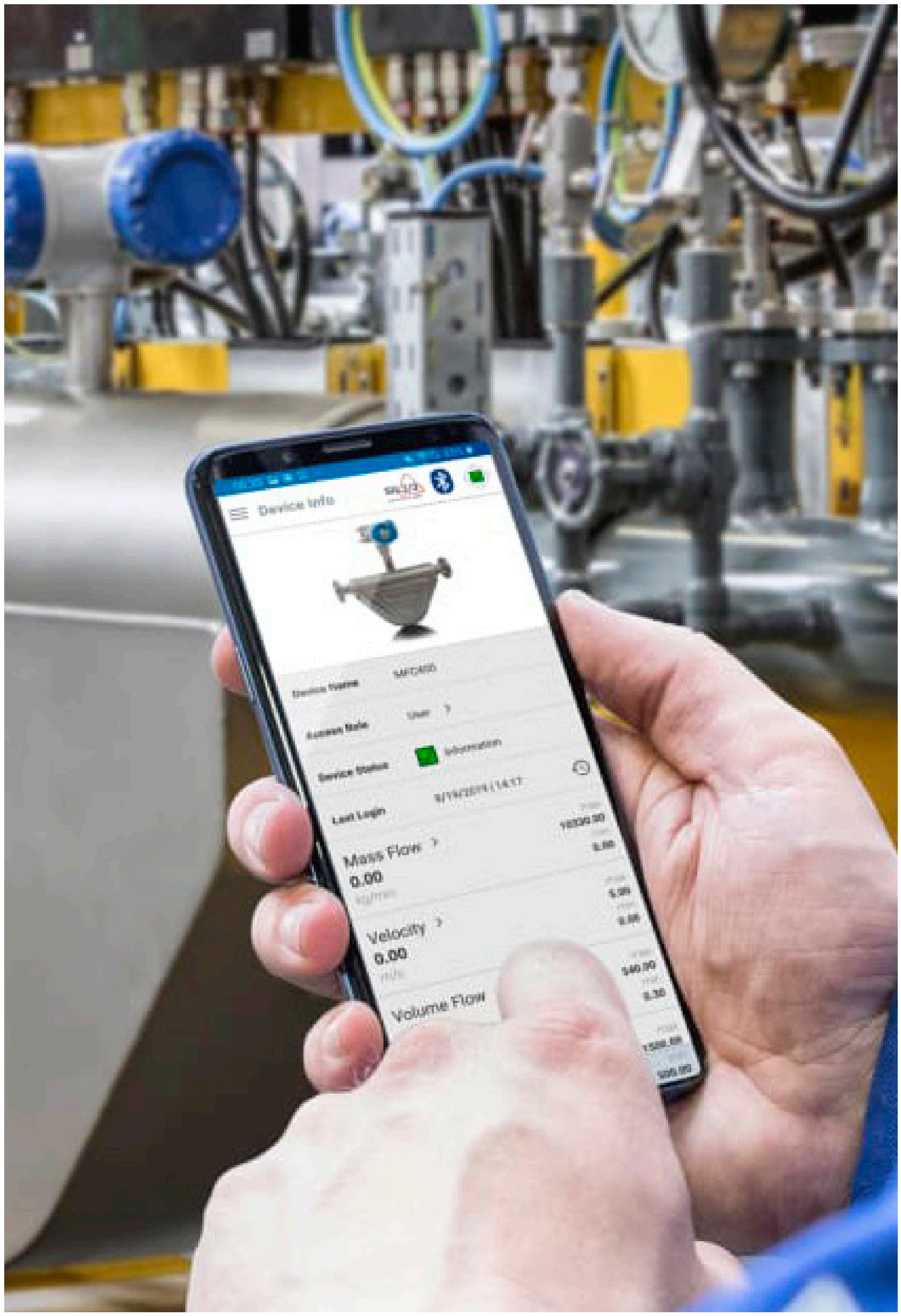
People for Process Automation

A BREAKTHROUGH IN REMOTE MONITORING FOR CORIOLIS FLOW METERS

By Alec O'Keefe
Product Specialist, KROHNE, Inc.



Getting technicians into the field to perform a variety of flow meter requirements can be a tedious and time-consuming process. The convenience of being able to see and interact with the device without having to be directly at the meter or in the control room would save critical time that could be dedicated to other tasks.

To address this need, KROHNE launched its Bluetooth Low Energy (BLE) option in 2020 for all OPTIMASS Coriolis flow meters equipped with an MFC 400 converter. In conjunction with the OPTICHECK Flow Mobile app, which is available for iOS and Android, the BLE solution allows for a wide range of meter interactions that field technicians may require to be performed on a smartphone or tablet.

This includes device commissioning, monitoring of basic and in-depth parameters, diagnostic readings, and meter verification. While attaching Bluetooth technology to more simple process instrumentation devices is not new, KROHNE is touting this development as a first for Coriolis flow meters. Many of these meters being used by the oil and gas industry are in remote locations, so the new BLE solution can have a significant and immediate impact.

Simplicity Is Key

From their vehicles, technicians open the app, which detects every meter within range and works as far as 60 feet away with clear line-of-sight. Meters are identifiable by tag and serial number. From there, the technician can connect to the meter and view everything the device sees, more than 20 variables, and can trend as many as four at once. Along with the most useful measured values — such as raw mass flow, density, or temperature — more in-depth items that may be of concern are available, including drive level, tube frequency, and the presence of two-phase flow.

Real-time diagnostics, where the meter is continuously performing self-checks to ensure it is operating properly, can also be quickly accessed.

BLE also turns device commissioning, typically an inconvenience, into a relatively simple and quick task. Once a meter is installed, technicians may need to perform a zero-flow or density calibration; make minor adjustments, such as setting units or output ranges; or even change or remove the Bluetooth password.

Although KROHNE Coriolis flow meters are calibrated at the factory in a controlled environment, the extra layer of calibration in situ can substantially benefit the instrument's performance.

Additionally, the app allows technicians to remotely perform a verification on meters, which is important as regulations on the industry have been increasing in recent years. This capability makes it easier to provide the traceability needed to satisfy those requirements.

The business case for investing in the BLE solution, especially for oil and gas companies with broad geo-graphical fields, is strong. With technicians constantly under stress to put out fires (figuratively) in the field, the leap in efficiency would free them up to address other pressing issues.

Use Case

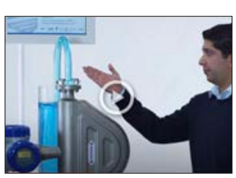
A KROHNE oil and gas industry customer with many Coriolis flow meters in the field has already used BLE to accelerate tasks so technicians can be free to tackle other issues. The customer, who tends to have clusters of six to eight devices within a very tight footprint, now has personnel that pull up to a well pad and connect to every meter without leaving their truck. Not only does this save time, but it also pro-vides cover from the elements, which is especially beneficial for those who work in the blistering heat of Texas or freezing conditions in Canada, for example.

Because BLE is so new, many oil and gas professionals are not aware it is available. The solution can either be ordered as an option with new devices or retrofitted, depending on the hardware revision of the converter. OPTIMASS with BLE are currently the only safety integrity level (SIL) certified mass flow meters on the market allowing Bluetooth communication. Visit our website to get more information: https://krohne.com/safety/#optimass

Watch the OPTICHECK Flow Mobile video

Watch the OPTICHECK DTM video

Watch the OPTICHECK Master video



Watch the demonstration of the EGM™ technology based on a function model