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Q&A - All You Ever Wanted to Know about Thermal Mass Flow Meters

By Wayne Shannon

Flow Control Network recently sat down with Wayne Shannon, Sage Metering's resident expert on thermal mass flow measurement. They discussed a variety of topics, including the advantages and disadvantages of thermal mass flow technology, typical end-user pitfalls, application suitability, and installation best practices. We developed a Q&A to answer all you ever wanted to know about thermal mass flow meters.

Q: What are the primary limitations of thermal mass flow meters?

The end user must utilize the thermal mass flow meter on the gas for which the meter was calibrated, as changing the gas composition will degrade the accuracy. The flow meter should not measure wet gas, as condensed drops of liquid contacting the sensor may cause spiking and reduce the accuracy. Also, rapid changes in gas temperature may result in some instability during these transitional periods, as the gas flow measurement with thermal mass flow meters is based on the temperature difference between the sensors.

Q: What applications are best suited for thermal mass flow meters, and why?

Thermal mass flowmeters are successful in numerous gas flow applications. A common use is measuring natural gas flow to combustion sources (e.g., boilers, furnaces, heaters) for energy management and environmental reporting. Also, submetering of natural gas for cost accounting, process efficiency, as well as tenant billing, are frequent uses. Air flow measurement for combustion air or compressed air is also very common. The primary benefits for selecting this technology in these applications are that the meter obtains mass flow measurement, is easy to install, has excellent turndown capabilities, low pressure drop, and low installation cost.

Q: When specifying a thermal mass flow technology, what are some of the key considerations end users must be mindful of to ensure the meter best matches the needs of the application?

The end user must have a complete understanding of the flowmeter's use. They should provide the flow meter manufacturer the range of flow rates, temperature ranges, pressure, gas composition (and gas composition changes if applicable), along with a description of the piping system, including the length of the pipe's straight run and upstream disturbances.

Q: In your experience, what are some of the common pitfalls end-users encounter when specifying and using thermal mass flow meters?

Often the end user overlooks installation considerations, especially the length of the pipe's straight run. The flow profile in the actual installation must be the same as the profile during calibration. During calibration, the flow profile is usually a fully developed flow profile, which occurs after sufficient straight run (typically 15 pipe diameters after a single elbow and longer distances for other flow disturbances). Keep in mind that if these distances are not available, then a flow conditioner is an option.

Q: What are the key challenges for using thermal mass flow meters in flare gas measurement applications? How can these challenges be overcome?

Thermal mass flow meters are successful in flare gas applications in the gas and oil fields where the source of the gas is relatively consistent. Challenges in these applications include rapid changes in flow rates and carry-over of material, which can damage the sensor. Damaging the sensor can be avoided by using a heavy-duty probe and sensor.

Flare applications at an oil refinery or petrochemical plant may have varying gas composition depending on what section of the refinery is releasing gas to the flare. For this reason, when accurate gas measurement is needed, we do not recommend using thermal mass flow meters in the main flare headers. The ultrasonic gas flow meter works well in this application. While thermal mass flow meters are not suitable for the main flare header, they work well in the branch manifolds and indicate the source of a release, which is helpful to operations and maintenance departments.

Thermal mass flowmeters have proven to be advantageous in certain flare gas measurement applications.

Q: Looking ahead over the next 5-10 years, how do you see thermal mass flow measurement technology evolving? How will the thermal flow meters of tomorrow be better than those of today?

Future thermal mass flow meters will permit the user to enter or change a gas or gas mixture while the flowmeter is in operation. Additionally, real-time adjustment using an external gas chromatograph will be possible. Other operational improvements will include internal on-line diagnostics to verify that the instrument is operating properly and remains in calibration. A greater selection of communication protocols will be available. Sensor technology will improve, permitting accurate gas flow measurement at higher velocities than currently obtainable.

About the Author

Wayne Shannon is product marketing manager for Sage Metering. Wayne has over 20 years' experience with applications, product marketing, and sales of thermal dispersion mass flow meters. He has been directly involved with recommending and applying thermal mass flowmeters in a wide variety of industries. Wayne has a bachelor's degree in Chemical Engineering and an MBA in Marketing.

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