

full steam ahead



Clamp-on flow measurement no longer just for liquids.

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When plant engineers look for a non-intrusive flow measurement solution, clamp-on ultrasonic flowmeters are typically the first technology considered. Users traditionally have considered clamp-on technology only for liquid applications.

For years flowmeter manufacturers have been asked, “Do you have a clamp-on solution for steam?” Until recently the answer has been no, but new technology now makes clamp-on steam flow measurement a reality for many common types of steam flows.

Clamp-on steam flow measurement derives from technology developed to provide solutions for clamp-on gas flow measurement. GE Infrastructure, Sensing introduced its first ultrasonic flowmeters for gas in late 2001, designed primarily for use in natural gas or compressed air. These clamp-on gas flowmeters leverage highly efficient ultrasonic transducer

technology that provides ultrasonic signal orders of magnitude stronger than previous transducers. New signal processing capability, high-temperature transducer capability and external noise dampening allow meters to provide more reliable measurements over a broader application range.

Practical application

A clamp-on steam ultrasonic flowmeter consists of the following system components:

- Ultrasonic flowmeter electronics. Both fixed installation and portable electronics platforms are available.
- Clamp-on ultrasonic transducers. Various frequencies for pipe sizes 3” (76.2mm) and larger. Various wedge materials for temperatures up to 446 degrees F (230 degrees C).
- Couplant. A putty-like material applied to the



Clamp-on steam ultrasonic flowmeter installation on 4-inch CS Sch 40 steam supply line at the Living and Learning Building at the University of Vermont.

face of the transducer, acoustically “coupling” the transducer face to the outside pipe wall to ensure the best possible transmission of the transducer signal into the pipe.

- Clamping fixture. Made of anodized aluminum and stainless steel. Provides a fixture for mounting the transducers on the pipe. No problem handling elevated temperatures found in steam applications.

- Pre-amplifier and transducer cables. Pre-amplifiers located close to the transducers to boost the ultrasonic signal receive gain and cables to connect the transducers, pre-amplifier and ultrasonic flowmeter electronics.

- Pipe dampening jacket. An aluminum jacket sized for the diameter of the pipe with patented dampening material applied to the internal surface. The material cures on the pipe over a period of approximately 24 hours. It effectively dampens acoustic “noise” in the system, allowing the ultrasonic flowmeter system to detect the transit-time signals necessary for flow measurement without interference from other noise sources in the piping system.

Steam flow survey at University of Vermont (UVM)

Under the leadership of new president Daniel Fogel, the University of Vermont (www.uvm.edu) in Burlington, Vermont, launched a progressive campaign in late 2003 to improve the university infrastructure. The plan called for renovations of several existing buildings and dormitories, new parking structures and a new 800-bed dormitory. The campus has its own central plant that supports heating in the cold Vermont winters as well as air conditioning in summer months for all campus buildings. Planners questioned whether the existing underground network of steam pipelines around the 450-acre campus had enough capacity to support the locations where new buildings were proposed. A “no” answer might mean the need for new steam

pipelines, additional boilers and control systems that would significantly factor into the development cost of the campus expansion plan.

The UVM Energy Management Office of the Physical Plant Department decided to take a look at its steam plan for three, five and 10 years for both the North and South campuses. Part of the analysis involved making steam flow measurements at points in the distribution system where no flowmeters were previously installed. In February 2004, GE Infrastructure, Sensing was contacted about its ability to make these flow measurements in a non-intrusive manner. A non-intrusive flow measurement was needed because engineers at the university could not shut down the steam system for installation of wetted flow technology on a system still in use for building heating. GE offered to perform a steam flow survey using clamp-on gas flowmeters for a period of approximately two weeks at four different measurement locations. Application details for the four measurement points are shown in the table below.

Building Name/Measurement Point Location

	Christie	Givens	Living and Learning	HSRF
Pipe size OD (inches)	4.500	5.536	4.500	10.750
Pipe wall thickness (inches)	0.237	0.285	0.237	0.365
Nominal temperature (°F)	353	377	360	382
Nominal flow range measured over test period (lb/hr)	1840 – 5185	3160 – 11310	1770 – 4945	146 – 4735

Application details and installation locations were verified between UVM engineers and GE Infrastructure, Sensing Field Services as being suitable for clamp-on steam ultrasonic flow measurement. UVM technicians prepared the installation sites by erecting staging where necessary to reach overhead steam pipes and by stripping back pipe insulation materials. GE's field service engineers installed the clamp-on transducers, pipe dampening jackets and flowmeter electronics.

After two weeks of operation, GE engineers returned to the university, downloaded data logs from each flowmeter and removed the systems. The data was subsequently presented to engineers at the Energy Management Office for analysis. University engineers were hoping for a cold spell during the flow survey to better understand and quantify the typical maximum steam usage during a cold Vermont winter. Unfortunately, Mother Nature did not cooperate, but university engineers were pleased to get real flow data in a quick and simple manner without shutting down the steam service to install intrusive flow measurement equipment.

At the end of the flow survey, GE field service engineers removed the flowmeter electronics, but left the clamping fixtures, dampening jackets and clamp-on transducers in place, with a plan to return during the following winter with electronics to perform another short-term survey.



The GC868 clamp-on gas ultrasonic flowmeter is capable of use in steam applications.

In January 2005 GE field service engineers returned to perform a 10-day flow survey. Re-installation of the flowmeter electronics and validation of the system showed that the dampening material held up to long-term installation on hot steam pipes. Indeed, the dampening material's ability to dampen pipe noise actually improves after initial installation as the material cures to an almost cork-like consistency. However, in some cases the ultrasonic couplant had to be re-applied to maximize flowmeter performance — a typical recommendation for most clamp-on ultrasonic flowmeter installations for almost any application.

Subsequently the University of Vermont elected to purchase outright the four flowmeter systems used for the flow survey. The systems were left in-place by GE field service engineers at the end of the flow survey.

The field results at UVM highlight the growing application reach of ultrasonic flowmeters, which now includes steam flow measurement.

About the Author



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