IMPROVE FLOWMETER ACCURACY IN CRAMPED QUARTERS

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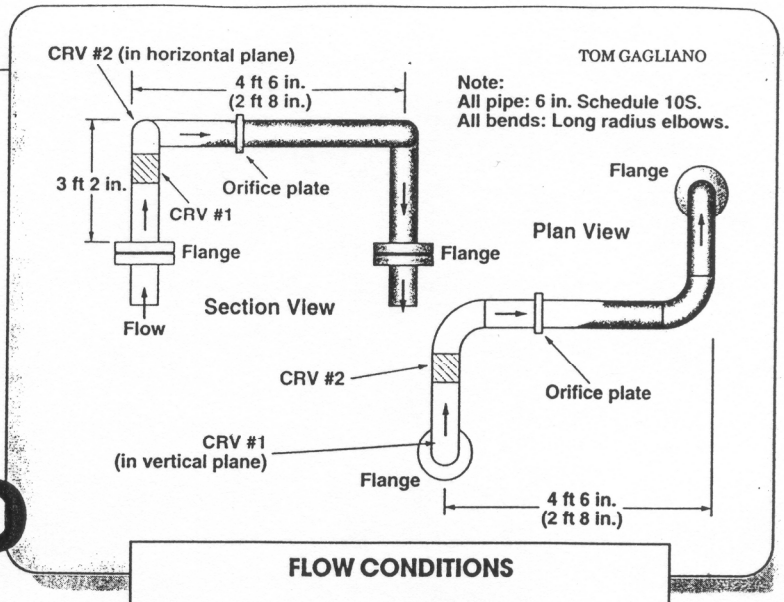

FLOW CONDITIONS

Fluid	Combustion gas
Temperature	50°F
Upstream pressure	30 in. water column
Normal flow	2,200 lb/h
Maximum flow	2,500 lb/h
Allowable pressure drop for flow sensor	10 in. water column

Rotation vanes can straighten fluid flow in curved or complex pipe segments, improving flowmeter accuracy

Getting accurate pipeline flow measurements with an orifice meter requires that the flow be streamlined and stable upstream of the orifice. A long, straight section of pipe usually provides the required stability. However, in many cases, a complex piping configuration or cramped site conditions make such long, straight piping runs more of a luxury than the norm.

Straightening devices such as honeycombs and vanes inserted upstream of the orifice can reduce the length of straight pipe required. But they provide only marginal improvements in measurement accuracy, and may still require significant straight pipe.

A new flow-conditioning device developed by Cheng Fluid Systems, Inc. (Sunnyvale, Calif.) solves this problem. Combining rotation vanes with a 90-deg elbow, the Cheng Rotational Vane (CRV) produces stable flow immediately downstream of the elbow.

A complex gas piping system at Bechtel Savannah River, Inc.'s Defense Waste Processing Facility (DWPF; Aiken, S.C.) contains several 90-deg, long-radius elbows. Located in a high-radiation zone, the pipe carries offgas from a glass melter.

The two sections of 6-in. pipe that required flowmeters had straight runs of only two and four feet, respectively, between fittings. Because of radiation in the area, the only viable flowmeter was an orifice plate with impulse tubing connected to a differential-pressure (dP) cell outside the radiation zone.

For such a complex piping configuration — two elbows in perpendicular planes — the general rule of thumb for installing an orifice meter calls for a section of straight pipe, at least 15 to 40 pipe diameters in length, upstream of the meter. Even with the help of traditional straightening vanes, such a configuration would have required a straight section at least nine pipe diameters ahead of the orifice, and a straight section at least four pipe-diameters long downstream of the orifice.

At DWPF, these two gas piping systems provided a total straight pipe length of just four and eight pipe diameters, respectively. And, even if straightening vanes were used, the flowmeter vendors could not estimate the flow measurement error that would occur.

For pipe layouts that have no elbow room, this flow-straightening device improves sensor accuracy downstream

To solve the problem, Cheng's CRV technology was considered, as it had been previously used to increase the capacity of a water pump at DWPF. In that liquid application, turbulence created by an elbow at the pump suction was hindering pump capacity. By installing a CRV upstream of the elbow, unstable, turbulent flow was eliminated, allowing the pump to meet its design capacity.

Building on this liquid experience, Cheng Fluid Systems designed a similar CRV for the gas piping system at DWPF. Vanes were installed upstream of each elbow and an orifice plate was inserted at the midpoint of the short pipe run below the second elbow.

During operation, impulse lines transmit the pressure drop signal outside the radiation area, where a microprocessor converts it to a 4- to 20-mA signal. That signal is then sent to a remote monitoring and control system.

With the new Cheng elbow vanes in place, the orifice flowmeter has performed to design capacity. And, to date, the system has shown no random fluctuations and no lack of repeatability, even at the low end of the dP cell's range (i.e., 0- to 10-in. water column), where turbulence typically has the most adverse impact. **467** ■

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