Primary Flow Signal, Inc.
PFS
THE LEADER IN RELIABLE FLOW MEASUREMENT

ISO 9001-2000 CERTIFIED

THE PFS ELBOW FLOWMETER

PFS-ASME-EM

PRODUCT BULLETIN

DOCUMENT NUMBER: 2022

An Innovative Solution for Installation Conditions Where There is No Space Available for a Standardized Flow Meter!

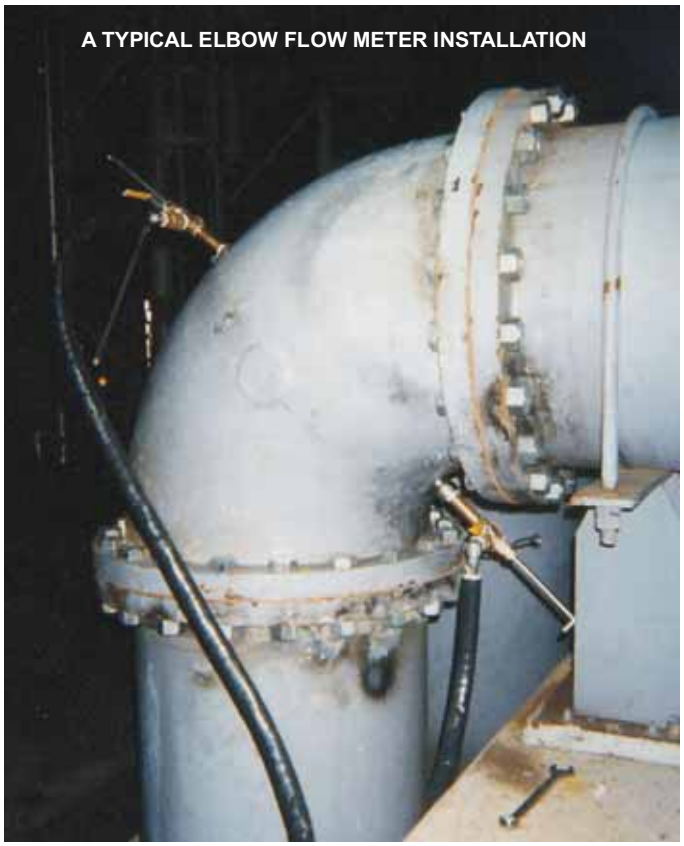
WHY CONSIDER AN ELBOW FLOW METER?

In the practice of flow measurement, cases emerge wherein the existing installation conditions preclude the use of conventional primary flow elements due to dimensional constraints, financial obstacles relative to acquisition costs, or other limitations exist that call for innovative solutions for otherwise seemingly unsolvable problems.

In the limited instances where, in the opinion of Primary Flow Signal, Inc., superior flow meter solutions are impractical or impossible, the "Elbow Flow Meter" as defined by the ASME in paper number 63-WA-17, as well as other applicable reference works including Miller, is considered and recommended, after careful review of application requirements.

An example of a typical elbow meter installation would be metering off a header with multiple legs ending in elbows which do not have adequate laying length availability to install an HVT-Halmi Venturi(or other standardized) primary element. A properly designed and calibrated elbow flow meter will serve as a effective flow meter with high repeatability, and accuracy as good as the capabilities of the calibration laboratory permit.

An elbow flow meter will never fully substitute for a venturi primary flow element, and its application must be determined and ascertained by a competent expert. Without properly executed model tests and flow



A TYPICAL ELBOW FLOW METER INSTALLATION

FEATURES AND BENEFITS

- **No limitations on line size.**
- **Uncalibrated accuracy approx. +/-4.0%. Calibrated accuracy depends on accuracy of the lab.**
- **Good repeatability (on the order of +/-0.20%.)**
- **No additional head loss (attributable to meter.)**
- **Relatively low acquisition cost.**
- **Suitable for flow measurement in either direction.**
- **Minimum required pipe Reynolds number 50,000 with no maximum limit.**

LIMITATIONS AND CONSTRAINTS

- **Discharge coefficient changes with pipe Reynolds number and is non-linear.**
- **Differential produced by the elbow meter is significantly lower than other primary (head type) elements.**
- **Application of ASME design standard is limited to liquid (incompressible) line fluids.**
- **For reliable and higher accuracy applications individual flow calibration for elbow meter including adjacent piping is required.**

NOTICE AND DISCLAIMER: Primary Flow Signal, Inc. makes representations herein based solely upon the guidance and standards published by ASME. Accordingly, Primary Flow Signal, Inc. assumes no liability whatsoever for any third party application of the technology discussed herein, except as may be specifically and expressly stated in the course of a commercial engagement, wherein the representations made are limited to those contained within the Submittal Document that is an integral part of any PFS, Inc. commercial engagement.

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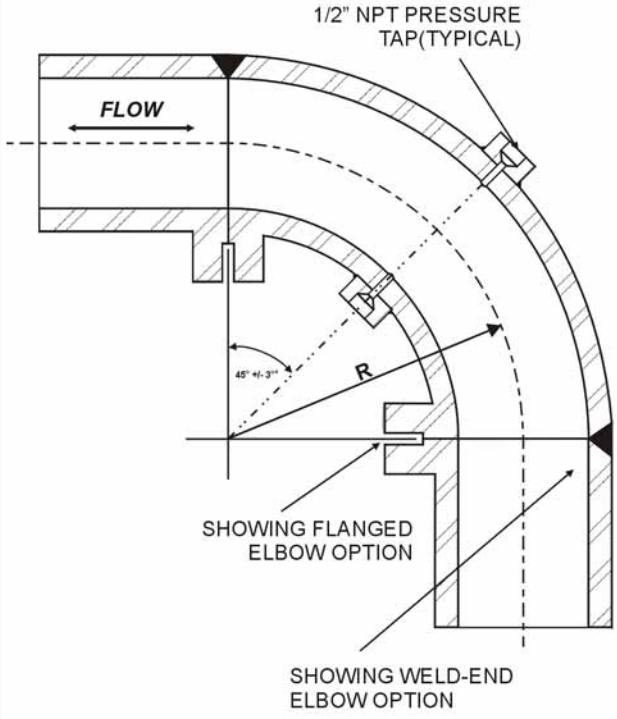
GENERAL DESIGN AND OPERATION INFORMATION

ASME Fluid meters classifies the elbow flow meter in the rate-meters division, head (kinetic) class, centrifugal type. This device utilizes the centrifugal change of velocity pressure across a curved stream, and consists essentially of a curved section of pipe(elbow) with static pressure holes located on the inner and outer circumferential walls of the curved section on the centerline of the two legs of the bend and also in the same radial plane.



TYPICAL 90° PIPE BEND ELBOW FLOW METER CONFIGURATION

As with any head-type primary flow element, the key factors generally influencing the differential producing phenomena and its relationship to rate of flow, or the coefficient of discharge, include the surface roughness and composition of the elbow itself, characteristic dimensions including the ratio between the line size and the elbow radius, and pipe Reynolds number.

The Elbow Flow Meter, as contemplated in ASME, is essentially a liquid (incompressible) line fluid meter and cannot be translated directly to gas flow metering without significant additional calibration work to empirically establish the adiabatic expansion factor specific to a given meter and application.

Performance of the Elbow Flow Meter is largely predicted by empirical work and research reported in ASME, and as such, the design performance is defined together with flow calculation protocols, standards and limitations.

Notwithstanding, to properly satisfy the demands of specific, unique flow metering applications, flow metering expertise and experience is essential. Primary Flow Signal, Inc. provides such expertise and recommends certain parameters governing the utilization of the Elbow Flow Meter.

Since the coefficient of this meter type is essentially unpredictable over pipe Reynolds number and velocity profile, meaningful use of the meter is not practical without proper model test and hydraulic calibration.

Any tests must be properly designed and organized to correctly incorporate all critical installation conditions in the calibration plan. Proper analysis and interpretation of the results is then required to permit design of an elbow flow metering scheme that will consistently produce accurate and reliable results.

Over wide flow range applications, especially, the non-linear nature of the elbow flow meter demands a secondary instrumentation system that includes characterization capabilities.

Primary Flow Signal, Inc. provides such secondary equipment in its PFS-FlowMaster product line. Therefore, an entire flow metering system can be provided with single source responsibility for system accuracy and performance.

In order to further explore the possibilities inherent in the PFS Elbow Flow Meter related to your flow metering application, please contact the company for more information.

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