Orifice Metering of Natural Gas and Other Related Hydrocarbon Fluids—Concentric, Square-edged Orifice Meters

Part 2: Specification and Installation Requirements

American Gas Association

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Errata 2

Page 32, Section 6.5:

The equation (in SI units) should read:

$$L = \left(\frac{F_m \times 4.38 \times OD \times 10}{S \times V} \sqrt{\frac{E}{\rho}\left(OD^2 + ID^2\right)} \right)^{\frac{1}{2}}$$

where

L is the probe length (mm);

F_m is the virtual mass factor—a constant to take account of the extra mass of the cylinder due to the fluid surrounding it and vibrating with it. For a gas, F_m = 1.0 and for water and other liquids, F_m = 0.9;

OD is the outside diameter of probe (mm);

ID is the inside diameter of probe (mm);

S is the Strouhal number, dependent on the Reynolds No. and shape of the cylinder, but can be taken as 0.4 for worst case or 0.2 as suggested by API *MPMS* Ch. 8.

V is the velocity of fluid (m/sec);

E is the modulus of elasticity of probe material (kg/cm^2);

ρ is the density of probe material (kg/m^3).

The equation (in USC units) should read:

$$L = \left(\frac{F_m \times 1.205 \times OD}{S \times V} \sqrt{\frac{E}{\rho}\left(OD^2 + ID^2\right)} \right)^{\frac{1}{2}}$$

where

L is the probe length (inches);

F_m is the virtual mass factor—a constant to take account of the extra mass of the cylinder due to the fluid surrounding it and vibrating with it. For a gas, $F_m = 1.0$ and for water and other liquids, $F_m = 0.9$;

OD is the outside diameter of probe (inches);

ID is the inside diameter of probe (inches);

S is the Strouhal number, dependent on the Reynolds No. and shape of the cylinder, but can be taken as 0.4 for worst case or 0.2 as suggested by API *MPMS* Ch. 8.

V is the velocity of fluid (ft/sec);

E is the modulus of elasticity of probe material (psi);

ρ is the density of probe material (g/cc).

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1 Scope

1.1 General

This document establishes design and installation parameters for measurement of fluid flow using concentric, square-edged, flanged tapped orifice meters.

1.2 Construction and Installation Requirements

This document outlines the various design parameters that shall be considered when designing metering facilities using orifice meters. The mechanical tolerances found in this document encompass a wide range of orifice diameter ratios for which experimental results are available.

For all existing installations, the decision to upgrade to meet the requirements of this standard shall be at the discretion of the parties involved. The parties should be cognizant that if a meter installation is not upgraded to meet this standard, measurement bias errors may exist due to inadequate flow conditioning and upstream straight pipe lengths.

Use of the calculation procedures and techniques shown in the API *MPMS* Ch.14.3.1/AGA Report No. 3, Part 1 and API *MPMS* Ch.14.3.3/AGA Report No. 3, Part 3, with existing equipment is recommended, since these represent significant improvements over the previous methods. The uncertainty levels for flow measurement using existing equipment may be different from those quoted in API *MPMS* Chapter 14.3.1/AGA Report No. 3, Part 1.

Use of orifice meters at the extremes of their diameter ratio (β_r) ranges should be avoided whenever possible. Good metering design and practice tend to be somewhat conservative. This means that the use of the tightest tolerances in the mid-diameter ratio (β_r) ranges would have the highest probability of producing the best measurement. An indication of this is found in the section on uncertainty in API *MPMS* Chapter 14.3.1/AGA Report No. 3, Part 1.

This standard is based on β_r between 0.10 and 0.75. Minimum uncertainty of the orifice plate coefficient of discharge (C_d) is achieved with β_r between 0.2 and 0.6 and orifice bore diameters greater than or equal to 0.45 inch. Diameter ratios and orifice bore diameters outside of this range may be used; the user should consult the uncertainty section in API *MPMS* Chapter 14.3.1/AGA Report No. 3, Part 1 for limitations.

Achieving the best level of measurement uncertainty begins with, but is not limited to, proper design. Two other aspects of the measurement process have to accompany the design effort; otherwise it is of little value. These aspects are the application of the metering system and the maintenance of the meters, neither of which is considered directly in this standard. These aspects cannot be governed by a single standard as they cover metering applications that can differ widely in flow rate, fluid type, and operational requirements. The user shall determine the best meter selection for the application and the level of maintenance for the measurement system under consideration.

2 Normative References

No other document is identified as indispensable or required for the application of this standard.