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Measurement of Fluid Flow in Pipes Using Vortex Flowmeters

AN AMERICAN NATIONAL STANDARD

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The American Society of Mechanical Engineers
Two Park Avenue • New York, NY • 10016 USA

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FOREWORD

This Standard has been prepared by Subcommittee 6, Vortex Shedding Flowmeters, of the ASME Standards Committee for Measurement of Fluid Flow in Closed Conduits (MFC). It is one of a series of standards covering a variety of devices that measure the flow of fluids in closed conduits. The vortex shedding principle has become an accepted basis for fluid flow measurement. Flowmeters based on this principle are available for measuring the flow of fluids ranging from cryogenic liquids to steam and high-pressure gases. Vortex shedding flowmeters are also referred to as vortex meters. Their designs are proprietary, and therefore, their design details and associated uncertainty bands cannot be covered in this Standard. However, these devices have in common the shedding of alternating pairs of vortices from some obstruction in the meter.

This Standard contains the relevant terminology, test procedures, list of specifications, application notes, and equations with which to determine the expected performance characteristics.

This revision was approved by the American National Standards Institute on February 19, 2013.

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Measurement of Fluid Flow in Closed Conduits

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Secretary, MFC Standards Committee
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The Committee welcomes proposals for revisions to this Standard. Such proposals should be as specific as possible, citing the paragraph number(s), the proposed wording, and a detailed description of the reasons for the proposal, including any pertinent documentation.

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Subject:	Cite the applicable paragraph number(s) and the topic of the inquiry.
Edition:	Cite the applicable edition of the Standard for which the interpretation is being requested.
Question:	Phrase the question as a request for an interpretation of a specific requirement suitable for general understanding and use, not as a request for an approval of a proprietary design or situation. The inquirer may also include any plans or drawings that are necessary to explain the question; however, they should not contain proprietary names or information.

Requests that are not in this format will be rewritten in this format by the Committee prior to being answered, which may inadvertently change the intent of the original request.

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MEASUREMENT OF FLUID FLOW IN PIPES USING VORTEX FLOWMETERS

1 SCOPE

This Standard

(a) describes the use of vortex flowmeters, including their physical components, principle of operation, installation, performance, influence factors, and calibration in a closed conduit running full for the measurement of volumetric flow rate and volume flow total of single-phase liquids or gases, including vapors such as steam

(b) describes the use of vortex flowmeters in combination with one or more other process measurements for the inferential measurement of mass flow rate, mass flow total, base volumetric flow rate, base volume total, and heat flow metering

(c) is limited to full-bore flowmeters and does not include the special case of insertion-type flowmeters

2 REFERENCES AND RELATED DOCUMENTS

Unless otherwise indicated, the latest issue of a referenced standard shall apply.

ASME MFC-1M, Glossary of Terms Used in the Measurement of Fluid Flow in Pipes

Publisher: The American Society of Mechanical Engineers (ASME), Two Park Avenue, New York, NY 10016-5990; Order Department: 22 Law Drive, P.O. Box 2900, Fairfield, NJ 07007-2900 (www.asme.org)

IEC 60529, Degrees of Protection Provided by Enclosures (IP Code)

Publisher: International Electrotechnical Commission (IEC), 3, rue de Varembé, Case Postale 131, CH-1211 Genève 20, Switzerland/Suisse (www.iec.ch)

3 TERMINOLOGY AND SYMBOLS

3.1 Definitions From ASME MFC-1M Used in This Standard

For the purposes of this Standard, the following definitions are particularly useful in describing the characteristics of vortex shedding flowmeters. ASME MFC-1M provides a more extensive collection of definitions and symbols pertaining to the measurement of fluid flow in closed conduits.

cavitation: the implosion of vapor bubbles formed after flashing when the local pressure rises above the vapor pressure of the liquid.

flashing: the formation of vapor bubbles in a liquid when the local pressure falls to or below the vapor pressure of the liquid, often due to local lowering of pressure because of an increase in the liquid velocity.

K factor: in pulses per unit volume, the ratio of the meter output in number of pulses to the corresponding total volume of fluid passing through the meter during a measured period. Variations in the *K* factor may be presented as a function of either the meter bore Reynolds number or the flow rate of a specific fluid at a specific set of thermodynamic conditions (see Fig. 9.2-1).

lowest local pressure: the lowest pressure found in the meter. This is the pressure of concern regarding flashing and cavitation. Some of the pressure is recovered downstream of the meter.

meter bore Reynolds number: a dimensionless ratio of inertial to viscous forces that is used as a correlating parameter that combines the effects of viscosity, density, and pipeline velocity. It is defined as

$$Re_D = \frac{DU\rho}{\mu}$$

meter factor: the reciprocal of the mean *K* factor.

pressure loss: the difference between the upstream pressure and the pressure downstream of the meter after recovery.

random error: a component of the error of measurement that, in the course of a number of measurements of the same measurand, varies in an unpredictable way.

NOTE: It is not possible to correct for random error.

random uncertainty: a component of uncertainty associated with a random error. Its effect on mean values can be reduced by taking many measurements.

rangeability: flowmeter rangeability is the ratio of the maximum to minimum flow rates or Reynolds number in the range over which the meter meets a specified uncertainty.

response time: for a step change in flow rate, response time is the time needed for the indicated flow rate to