ASME MFC-18M–2001

MEASUREMENT OF FLUID FLOW USING VARIABLE AREA METERS

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The next edition of this Standard is scheduled for publication in 2006. There will be no addenda issued to this edition.

ASME will issue written replies to inquiries concerning interpretation of technical aspects of this Standard.

The American Society of Mechanical Engineers
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FOREWORD

This Standard is based on current industrial and research practices. It was prepared by the ASME MFC Subcommittee 10 on Variable Area Meters and approved by the ASME MFC Standards Committee on Measurement of Fluid Flow In Closed Conduits with an emphasis of definitions and specifications of variable area meters.

This Standard was approved as an American National Standard on May 25, 2001.

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Measurement of Fluid Flow In Closed Conduits

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General. ASME Standards are developed and maintained with the intent to represent the consensus of concerned interests. As such, users of this Standard may interact with the Committee by requesting interpretations, proposing revisions, and attending committee meetings. Correspondence should be addressed to:

Secretary, MFC Standards Committee
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Proposing Revisions. Revisions are made periodically to the Standard to incorporate changes that appear necessary or desirable, as demonstrated by the experience gained from the application of the Standard. Approved revisions will be published periodically.

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.

Interpretations. Upon request, the MFC Standards Committee will render an interpretation of any requirement of the Standard. Interpretations can only be rendered in response to a written request sent to the Secretary of the MFC Standards Committee.

The request for interpretation should be clear and unambiguous. It is further recommended that the inquirer submit his request in the following format:

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 genral understanding and use, not as a request for an approval of a proprietary design or situation. The inquirer may also include plans or drawings which 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.

ASME procedures provide for reconsideration of any interpretation when or if additional information that might affect an interpretation is available. Further, persons aggrieved by an interpretation may appeal to the cognizant ASME Committee or Subcommittee. ASME does not “approve”, “certify”, “rate”, or “endorse” any item, construction, proprietary device, or activity.

Attending Committee Meetings. The MFC Standards Committee regularly holds meetings, which are open to the public. Persons wishing to attend any meeting should contact the Secretary of the MFC Standards Committee.

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MEASUREMENT OF FLUID FLOW USING VARIABLE AREA METERS

1 SCOPE

This Standard describes the common variable area flowmeter. This Standard does not attempt to standardize dimensions because the commercial products differ too widely.

The variable area meter is manufactured in a variety of designs. This Standard addresses only those meters based on a vertical tapered tube of round or a modified round cross section. Specifically not addressed are the various vane type meters, meters with horizontal flow, or meters which use a spring deflection to oppose flow forces.

2 REFERENCES AND RELATED DOCUMENTS

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

ASME MFC-2M Measurement Uncertainty for Fluid Flow in Closed Conduits

ASME Fluid Meters, 6th Ed

Publisher: The American Society of Mechanical Engineers (ASME), Three Park Avenue, New York, NY 10016; Order Department: 22 Law Drive, Box 2300, Fairfield, NJ 07007-2300

3 SYMBOLS AND DEFINITIONS

For symbols and their definitions, see Table 1.

4 FLOW RATE EQUATIONS

The variable area flowmeter is composed of a body containing the fluid and a "float," which is free to move in the body to a position related to the flow rate. The balance of forces positions the float. Gravity pulls the float downward. The buoyancy of the float plus the velocity related dynamic fluid forces lift the float. The float rises to increase the flow area until the fluid forces lifting the float match the downward force. The meter must be oriented with flow vertically up for the analysis to be correct. Orientation substantially off the vertical will cause errors or a failure to respond. (See ASME Fluid Meters for more complete analysis of the variable area meter).

It is not practical to calculate meter capacity from physical principles for commercial variable area meters. The manufacturer's catalogs do not list the tube cross section areas, or float volumes, or weights, or inlet and exit pressure drops; all of this information is proprietary. The manufacturer supplies all of the capacity data in the form of tables. This reduces the equation for each meter flow to:

$$Q_v = C_r * \%Scale/100 \tag{1}$$

The full scale meter flow, C_r is defined and tabulated in the manufacturer's catalogs for each specific metering tube and float. Separate tables are used for liquids and compressible fluids. The industry often uses the term "normal" [typical 1.013 bar and 20°C (14.7 psia and 70°F)] conditions for compressible fluid sizing rather than "standard". The user is cautioned to define the reference conditions used. (See the manufacturer's literature for guidance on sizing and calibration.) Equation 2 shows how to correct for a float material density differing from the basis density and for a flowing fluid density differing from the basis density:

$$Q_v = C_r \bullet (\%Scale/100) \bullet \sqrt{\frac{(SG_f - SG_l) \bullet SG_{lc}}{(SG_{fc} - SG_{lc}) \bullet SG_l}} \tag{2}$$

NOTE: Use a consistent basis for SG. For compressible fluids, the negative terms above become very small and are not significant. Calculate Mass flow as the product of volumetric flow and upstream mass density.

$$Q_m = Q_v \bullet \rho_l \tag{3}$$