ASME MFC-22–2007

# Measurement of Liquid by Turbine Flowmeters

**REAFFIRMED 2014**

FOR CURRENT COMMITTEE PERSONNEL
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**AN AMERICAN NATIONAL STANDARD**

The American Society of Mechanical Engineers

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AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

Three Park Avenue • New York, NY 10016

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This Standard will be revised when the Society approves the issuance of a new edition. There will be no addenda issued to this edition.

ASME issues written replies to inquiries concerning interpretations of technical aspects of this document. Periodically certain actions of the ASME MFC Committee may be published as Cases. Cases and interpretations are published on the ASME Web site under the Committee Pages at http://cstools.asme.org as they are issued.



The American Society of Mechanical Engineers
Three Park Avenue, New York, NY 10016-5990

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# FOREWORD

Turbine flowmeters cover a family of devices with varying designs that depend on rotating blades for the measurement of fluid velocity. This Standard is for liquid turbine meters and is not intended for gas turbine meters. The primary purpose of the liquid turbine flowmeter is to measure flowing volume. The flowing volume can be recalculated as volume at a specific set of conditions or as mass flow with the proper addition of additional measurements that can include temperature, pressure, and analytical devices.

The liquid flow turbine meters can be used for process monitoring, control, and custody transfer applications.

Suggestions for improvement of this Standard are welcome. They should be sent to The American Society of Mechanical Engineers, Attn: Secretary, MFC Standards Committee, Three Park Avenue, New York, NY 10016-5990.

Following approval by the Standards Committee and the ASME Board, this Standard was approved as an American National Standard on June 8, 2007, with the designation ASME MFC-22–2007.

# ASME MFC COMMITTEE
# Measurement of Fluid Flow in Closed Conduits

(The following is the roster of the Committee at the time of approval of this Standard.)

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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
The American Society of Mechanical Engineers
Three Park Avenue
New York, NY 10016-5990

**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.

**Proposing a Case.** Cases may be issued for the purpose of providing alternative rules when justified, to permit early implementation of an approved revision when the need is urgent, or to provide rules not covered by existing provisions. Cases are effective immediately upon ASME approval and shall be posted on the ASME Committee Web page.

Requests for Cases shall provide a Statement of Need and Background Information. The request should identify the standard, the paragraph, figure or table number(s), and be written as a Question and Reply in the same format as existing Cases. Requests for Cases should also indicate the applicable edition(s) of the standard to which the proposed Case applies.

**Interpretations.** Upon request, the MFC 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/her 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 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.

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 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.

# MEASUREMENT OF LIQUID BY TURBINE FLOWMETERS

## 1 SCOPE

This Standard describes the criteria for the application of a turbine flowmeter with a rotating blade for the measurement of liquid flows through closed conduit running full.

The standard discusses the following:

*(a)* considerations regarding the liquids to be measured

*(b)* turbine flowmeter system

*(c)* installation requirements

*(d)* design specifications

*(e)* the maintenance, operation, and performance

*(f)* measurement uncertainties

This Standard does not address the details of the installation of accessory equipment used to measure pressure, temperature, and/or density for the accurate determination of mass or base volumes, or those accessories used to automatically compute mass or base volumes.

## 2 REFERENCES

The following is a list of publications referenced in this Standard. Unless otherwise specified, the latest edition shall apply.

ANSI/NCSL Z540.2-1997 (R2002), U.S. Guide to Expression of Uncertainty in Measurement

Publisher: NCSL International, 2995 Wilderness Place, Suite 107, Boulder, CO 80301-5404

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

Publisher: The American Society of Mechanical Engineers (ASME), Three Park Avenue, New York, NY 10016-5990; Order Department: 22 Law Drive, P.O. Box 2300, Fairfield, NJ 07007-2300

ISO Guide to the expression of uncertainty in measurement

Publisher: International Organization for Standardization (ISO), 1 ch. de la Voie-Creuse, Case postale 56, CH-1211, Genève 20, Switzerland/Suisse

NIST Technical Note 1297 (TN 1297), Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results

Publisher: United States Department of Commerce, Technology Administration, National Institute of Standards and Technology (NIST), 100 Bureau Drive, Gaithersburg, MD 20899; http://physics.nist.gov/Pubs/guidelines/TN1297/tn1297s.pdf

## 3 DEFINITIONS AND SYMBOLS

Much of the vocabulary and many of the symbols used in this Standard are defined in ASME MFC-1M. Others that are unique in the field under consideration, or with special technical meanings are given in para. 3.1. Where a term has been adequately defined in the main text, reference is made to the appropriate paragraph.

### 3.1 Definitions

*base flow rate:* flow rate converted from flowing conditions to base conditions of pressure and temperature, generally expressed in units of base volume per unit time (e.g., gpm, $m^3/h$, etc.).

*base pressure:* a specified reference pressure to which a fluid volume at flowing conditions is reduced for the purpose of billing and transfer accounting. It is generally taken as 14.73 psia (101.560 kPa) by the gas industry in the U.S.

*base temperature:* a specified reference temperature to which a fluid volume at flowing conditions is reduced for the purpose of billing and transfer accounting. It is generally taken as 60°F (15.56°C) by the gas industry in the U.S.

*base volume:* volume of the fluid at base pressure and temperature.

*flowing pressure:* static pressure of the fluid at the flowing condition.

*flowing temperature:* the temperature of the fluid at the flowing condition.

*linearity:* linearity refers to the constancy of $K$ factor over a specified range, defined by either the pipe Reynolds number or the flow rate. A typical liquid turbine meter performance curve is shown in Fig. 1. The linear range of the turbine meter is usually specified by a band defined by maximum and minimum $K$ factors, within which the $K$ factor for the meter is assumed to be $K_{mean}$. The upper and lower limits of this range can be specified by the manufacturer as a function of maximum and minimum Reynolds number ranges, a flow rate range of a specified fluid, or other meter design limitations such as pressure, temperature, or installation effects.

*pipe Reynolds number:* expressed by the equation

$$Re_p = \frac{v_p D}{\nu} = \frac{\rho v_p D}{\mu} \quad (1)$$