ASME MFC-3M–1989
(REVISION OF ASME MFC-3M-1985)
REAFFIRMED 1995

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# Measurement of Fluid Flow in Pipes Using Orifice, Nozzle, and Venturi

AN AMERICAN NATIONAL STANDARD

The American Society of
Mechanical Engineers

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# Measurement of Fluid Flow in Pipes Using Orifice, Nozzle, and Venturi

## ASME MFC-3M-1989

(REVISION OF ASME MFC-3M-1985)

The American Society of Mechanical Engineers

345 East 47th Street, New York, N.Y. 10017

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**This Standard will be revised when the Society approves the issuance of a new edition. There will be no addenda or written interpretations of the requirements of this Standard issued to this Edition.**

# FOREWORD

(This Foreword is not part of ASME MFC-3M–1989.)

Prior to the publication of the first edition of this Standard, ASME MFC-3M–1984, there was no U.S. standard covering all of the measurements of fluid flows through closed conduits and pipes and using differential pressure devices (primary elements). Most people have used for guidance the ASME Fluid Meters. The International Organization for Standardization (ISO) developed a general use standard, ISO 5167, but incorporating expressions for discharge coefficients that the ASME Fluid Meters Research Committee determined covers a considerably broader span of fluids and flowing conditions, and reduced the uncertainty in the prediction of the discharge coefficient.

This Standard has been prepared by the ASME Standards Committee on the Measurement of Fluid Flow in Closed Conduits (MFC) and incorporates the ASME-ISO orifice coefficient equations in both U.S. customary and SI (metric) units. It is intended to:

*(a)* cover the broader requirements of flow measurements found throughout industry using differential producing flowmeters; and

*(b)* be a practical working document, with representative calculations for some of the equations given in Appendix B.

In order to promote U.S. competitiveness in international trade, this Standard has been made as consistent and technically equivalent as practical with ISO 5167. There have been some technical and many editorial changes made in consideration of U.S. practice and some new technical insights.

This revision includes extensive editorial, stylistic, and format changes to the 1985 edition. There have been no substantive changes to the text of the Standard.

Suggestions for improvement of this Standard will be welcome. They should be sent to Secretary, ASME MFC Main Committee, 345 East 47th Street, New York, NY 10017.

This revision was approved as an ASME National Standard on November 11, 1989.

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# MEASUREMENT OF FLUID FLOW IN PIPES USING ORIFICE, NOZZLE, AND VENTURI

## 1 SCOPE AND FIELD OF APPLICATION

This Standard specifies the geometry and method of use (installation and flowing conditions) for orifice plates, nozzles, and Venturi tubes when they are inserted in a conduit running full, to determine the rate of the fluid flowing. It also gives necessary information for calculating flow rate and its associated uncertainty.

It applies only to pressure difference devices in which the flow remains turbulent and subsonic throughout the measuring section, is steady or varies only slowly with time and the fluid is considered single-phased. In addition, the uncertainties are given in the appropriate sections of this Standard for each of these devices, within the pipe size and Reynolds number limits which are specified.

It deals with devices for which sufficient calibrations have been made to enable the specification of coherent systems of application and to enable calculations to be made with certain predictable limits of uncertainty.

The devices introduced into the pipe are called primary devices. The term *primary device* also includes the pressure taps and the associated upstream and downstream piping. All other instruments or devices required for the measurement or transmission of the differential pressures are known as *secondary elements*, and in combination are referred to as the secondary devices. This Standard covers the primary devices; secondary devices[1] will be mentioned only occasionally.

The following primary devices are covered in this Standard:

*(a)* orifice plates, which can be used with the following arrangements of pressure taps:
  *(1)* flange pressure taps
  *(2)* $D$ and $D/2$ pressure taps[2]
  *(3)* corner pressure taps

*(b)* nozzles:
  *(1)* ASME long radius nozzles

*(c)* Venturi tubes:
  *(1)* classical Venturi tubes.[3]

This Standard does not cover pipe or conduit sizes under 50 mm [2 in.] nominal.

This Standard does not apply to ASME Performance Test Code measurements.

This Standard is applicable to measurement of flow of any fluid, (liquid, vapor, or gas).

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[1]See ASME/ANSI MFC-8M.

[2]Orifice plates with *vena contracta* taps are not considered in this Standard.

[3]In the U.S. the classical Venturi tube is sometimes called the Herschel Venturi tube.