SLOVENSKI STANDARD
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Merjenje pretoka fluida na osnovi tlačne razlike, povzročene z napravo, vstavljeno v polno zapolnjen vod s krožnim prerezom - 2. del: Zaslonke (ISO 5167-2:2022)

Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full - Part 2: Orifice plates (ISO 5167-2:2022)

Durchflussmessung von Fluiden mit Drosselgeräten in voll durchströmten Leitungen mit Kreisquerschnitt - Teil 2: Blenden (ISO 5167-2:2022)

Mesurage de débit des fluides au moyen d'appareils déprimogènes insérés dans des conduites en charge de section circulaire - Partie 2: Diaphragmes (ISO 5167-2:2022)

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Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full - Part 2: Orifice plates (ISO 5167-2:2022)

Mesurage de débit des fluides au moyen d'appareils déprimogènes insérés dans des conduites en charge de section circulaire - Partie 2: Diaphragmes (ISO 5167-2:2022)

Durchflussmessung von Fluiden mit Drosselgeräten in voll durchströmten Leitungen mit Kreisquerschnitt - Teil 2: Blenden (ISO 5167-2:2022)

This European Standard was approved by CEN on 17 June 2022.

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European foreword

This document (EN ISO 5167-2:2022) has been prepared by Technical Committee ISO/TC 30 "Measurement of fluid flow in closed conduits" in collaboration with CCMC.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by December 2022, and conflicting national standards shall be withdrawn at the latest by December 2022.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN ISO 5167-2:2003.

Any feedback and questions on this document should be directed to the users' national standards body/national committee. A complete listing of these bodies can be found on the CEN website.

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INTERNATIONAL STANDARD

ISO 5167-2

Second edition
2022-06

Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full —

Part 2: Orifice plates

Mesurage de débit des fluides au moyen d'appareils déprimogènes insérés dans des conduites en charge de section circulaire —

Partie 2: Diaphragmes

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

ISO 5167-2 was prepared by Technical Committee ISO/TC 30, *Measurement of fluid flow in closed conduits*, Subcommittee SC 2, *Pressure differential devices*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/SS F05, *Measuring instruments*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition of ISO 5167-2 cancels and replaces the first edition (ISO 5167-2:2003), which has been technically revised.

The main changes are as follows:

— a revised maximum orifice edge thickness is given for $\beta < 0,2$;

— a correction has been made to the required spacing between two 45° bends for which the straight length upstream of an orifice plate is stated;

— a clearer specification has been given for the tee for which the straight length upstream of an orifice plate is stated;

— flow calibration of orifice plates is included;

— there is improved wording of the rules for spacing of multiple fittings but no change in actual requirements.

A list of all parts in the ISO 5167 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

ISO 5167, consisting of six parts, covers the geometry and method of use (installation and operating conditions) of orifice plates, nozzles, Venturi tubes, cone meters and wedge meters when they are inserted in a conduit running full to determine the flow rate of the fluid flowing in the conduit. It also gives necessary information for calculating the flow rate and its associated uncertainty.

ISO 5167 (all parts) is applicable only to pressure differential devices in which the flow remains subsonic throughout the measuring section and where the fluid can be considered as single-phase, but is not applicable to the measurement of pulsating flow. Furthermore, each of these devices can only be used uncalibrated in accordance with this standard within specified limits of pipe size and Reynolds number, or alternatively they can be used across their calibrated range.

ISO 5167 (all parts) deals with devices for which direct calibration experiments have been made, sufficient in number, spread and quality to enable coherent systems of application to be based on their results and coefficients to be given with certain predictable limits of uncertainty. ISO 5167 also provides methodology for bespoke calibration of differential pressure meters.

The devices introduced into the pipe are called primary devices. The term primary device also includes the pressure tappings. All other instruments or devices required to facilitate the instrument readings are known as secondary devices, and the flow computer that receives these readings and performs the algorithms is known as a tertiary device. ISO 5167 (all parts) covers primary devices; secondary devices (see ISO 2186) and tertiary devices will be mentioned only occasionally.

Aspects of safety are not dealt with in ISO 5167-1 to ISO 5167-6. It is the responsibility of the user to ensure that the system meets applicable safety regulations.

Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full —

Part 2: Orifice plates

1 Scope

This document specifies the geometry and method of use (installation and operating conditions) of orifice plates when they are inserted in a conduit running full to determine the flow rate of the fluid flowing in the conduit.

This document also provides background information for calculating the flow rate and is applicable in conjunction with the requirements given in ISO 5167-1.

This document is applicable to primary devices having an orifice plate used with flange pressure tappings, or with corner pressure tappings, or with D and $D/2$ pressure tappings. Other pressure tappings such as "vena contracta" and pipe tappings are not covered by this document. This document is applicable only to a flow which remains subsonic throughout the measuring section and where the fluid can be considered as single phase. It is not applicable to the measurement of pulsating flow[1]. It does not cover the use of orifice plates in pipe sizes less than 50 mm or more than 1 000 mm, or where the pipe Reynolds numbers are below 5 000.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 4006, *Measurement of fluid flow in closed conduits — Vocabulary and symbols*

ISO 5167-1, *Measurement of fluid flow by means of pressure differential devices inserted in circular-cross section conduits running full — Part 1: General principles and requirements*

ISO 5168, *Measurement of fluid flow — Procedures for the evaluation of uncertainties*

ISO/IEC Guide 98-3, *Uncertainty of measurement — Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

3 Terms, definitions and symbols

For the purposes of this document, the terms, definitions and symbols given in ISO 4006 and ISO 5167-1 apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

4 Principles of the method of measurement and computation

The principle of the method of measurement is based on the installation of an orifice meter into a pipeline in which a fluid is running full. The presence of the orifice plate causes a static pressure difference between the upstream and downstream sides of the plate. The mass flow rate, q_m, can be determined using Formula (1):

$$q_m = \frac{C}{\sqrt{1-\beta^4}} \varepsilon \frac{\pi}{4} d^2 \sqrt{2\Delta p \rho_1} \tag{1}$$

The uncertainty limits can be calculated using the procedure given in ISO 5167-1:2022, Clause 8.

Computation of the mass flow rate, which is an arithmetic process, can be performed by replacing the different terms on the right-hand side of the basic Formula (1) by their numerical values.

Similarly, the value of volume flow rate, q_V, is calculated from Formula (2):

$$q_V = \frac{q_m}{\rho} \tag{2}$$

where ρ is the fluid density at the temperature and pressure for which the volume is stated.

As will be seen later in this document, the discharge coefficient, C, is dependent on the Reynolds number, Re, (see ISO 5167-1:2022, 3.3.2), which is itself dependent on q_m, and has to be obtained by iteration (see ISO 5167-1:2022, Annex A, for guidance regarding the choice of the iteration procedure and initial estimates).

The diameters d and D used in Formula (1) (since D is required to calculate β) are the values of the diameters at working conditions. Measurements taken at any other conditions should be corrected for any possible expansion or contraction of the orifice plate and the pipe due to the values of the temperature and pressure of the fluid during the measurement.

It is necessary to know the density and the viscosity of the fluid at the working conditions. In the case of a compressible fluid, it is also necessary to know the isentropic exponent of the fluid at working conditions.

5 Orifice plates

5.1 Description

5.1.1 General

The various types of standard orifice meter designs are similar and therefore only a single description is needed. Each type of standard orifice meter design is characterized by the arrangement of the pressure tappings.

'Orifice plate' can refer just to the plate or to the whole meter; where it is important to be clear that the plate and pipework are meant, 'orifice meter' can be used.

NOTE Limits of use are given in 5.3.1.

The axial plane cross-section of a standard orifice plate is shown in Figure 1.

The letters given in the following text refer to the corresponding references in Figure 1.

5.1.2 General shape

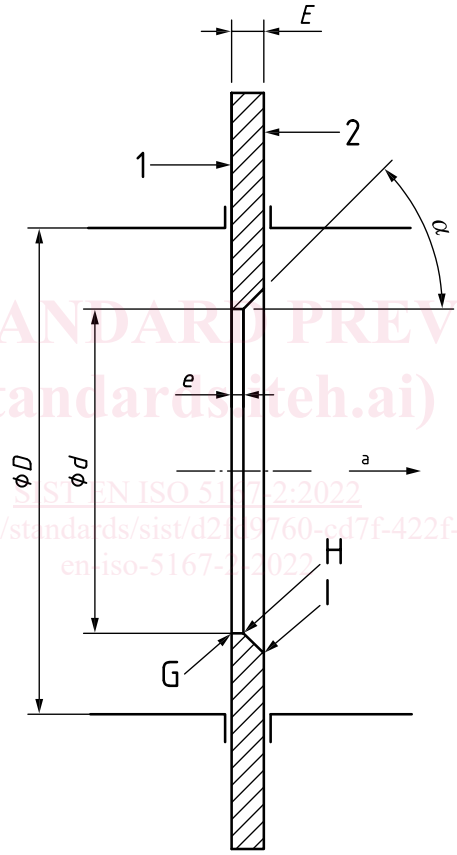
5.1.2.1 The part of the plate inside the pipe shall be circular and concentric with the pipe centreline. The faces of the plate shall always be flat and parallel.

5.1.2.2 Unless otherwise stated, the following requirements apply only to that part of the plate located within the pipe.

5.1.2.3 Care shall be taken in the design of the orifice plate and its installation to ensure that plastic buckling and elastic deformation of the plate, due to the magnitude of the differential pressure or of any other stress, do not cause the slope of the straight line specified in 5.1.3.1 to exceed 1 % under working conditions.

Traditionally, many differential pressure systems had a maximum differential pressure limit of 50 kPa (500 mbar). With modern digital differential pressure instrumentation, a higher maximum differential pressure is possible, provided that the plate material, plate thickness, and method of support are sufficient to prevent bending or buckling.

NOTE Further information is given in ISO/TR 9464:2008, 5.2.5.1.2.3.



Key

1 upstream face A

2 downstream face B

a Direction of flow.

Figure 1 — Standard orifice plate

5.1.3 Upstream face A

5.1.3.1 The upstream face A of the plate shall be flat when the plate is installed in the pipe with zero differential pressure across it. Provided that it can be shown that the method of mounting does not distort the plate, this flatness may be measured with the plate removed from the pipe. Under these circumstances, the plate may be considered to be flat when the maximum gap between the plate and a straight edge of length D laid across any diameter of the plate (see Figure 2) is less than $0{,}005(D - d)/2$,