INTERNATIONAL STANDARD

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

Part 4: Venturi tubes

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

Partie 4: Tubes de Venturi

Reference number
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ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 5167-4 was prepared by Technical Committee ISO/TC 30, *Measurement of fluid flow in closed conduits*, Subcommittee SC 2, *Pressure differential devices*.

This first edition of ISO 5167-4, together with the second edition of ISO 5167-1 and the first editions of ISO 5167-2 and ISO 5167-3, cancels and replaces the first edition of ISO 5167-1:1991, which has been technically revised, and ISO 5167-1:1991/Amd.1:1998.

ISO 5167 consists of the following parts, under the general title *Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full*:

— *Part 1: General principles and requirements*

— *Part 2: Orifice plates*

— *Part 3: Nozzles and Venturi nozzles*

— *Part 4: Venturi tubes*

Introduction

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

ISO 5167 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 within specified limits of pipe size and Reynolds number.

ISO 5167 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.

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 for the measurement are known as “secondary devices”. ISO 5167 covers primary devices; secondary devices[1)] will be mentioned only occasionally.

ISO 5167 is divided into the following four parts.

a) Part 1 of ISO 5167 gives general terms and definitions, symbols, principles and requirements as well as methods of measurement and uncertainty that are to be used in conjunction with Parts 2 to 4 of ISO 5167.

b) Part 2 of ISO 5167 specifies orifice plates, which can be used with corner pressure tappings, D and $D/2$ pressure tappings[2)], and flange pressure tappings.

c) Part 3 of ISO 5167 specifies ISA 1932 nozzles[3)], long radius nozzles and Venturi nozzles, which differ in shape and in the position of the pressure tappings.

d) This part of ISO 5167 specifies classical Venturi tubes[4)].

Aspects of safety are not dealt with in Parts 1 to 4 of ISO 5167. It is the responsibility of the user to ensure that the system meets applicable safety regulations.

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1) See ISO 2186:1973, *Fluid flow in closed conduits — Connections for pressure signal transmissions between primary and secondary elements*.

2) Orifice plates with “vena contracta” pressure tappings are not considered in ISO 5167.

3) ISA is the abbreviation for the International Federation of the National Standardizing Associations, which was succeeded by ISO in 1946.

4) In the USA the classical Venturi tube is sometimes called the Herschel Venturi tube.

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

Part 4: Venturi tubes

1 Scope

This part of ISO 5167 specifies the geometry and method of use (installation and operating conditions) of Venturi tubes when they are inserted in a conduit running full to determine the flowrate of the fluid flowing in the conduit.

This part of ISO 5167 also provides background information for calculating the flowrate and is applicable in conjunction with the requirements given in ISO 5167-1.

This part of ISO 5167 is applicable only to Venturi tubes in which the flow remains subsonic throughout the measuring section and where the fluid can be considered as single-phase. In addition, each of these devices can only be used within specified limits of pipe size, roughness, diameter ratio and Reynolds number. This part of ISO 5167 is not applicable to the measurement of pulsating flow. It does not cover the use of Venturi tubes in pipes sized less than 50 mm or more than 1 200 mm, or where the pipe Reynolds numbers are below 2×10^5.

This part of ISO 5167 deals with the three types of classical Venturi tubes:

a) cast;

b) machined;

c) rough welded sheet-iron.

A Venturi tube is a device which consists of a convergent inlet connected to a cylindrical throat which is in turn connected to a conical expanding section called the “divergent”. The differences between the values of the uncertainty of the discharge coefficient for the three types of classical Venturi tube show, on the one hand, the number of results available for each type of classical Venturi tube and, on the other hand, the more or less precise definition of the geometric profile. The values are based on data collected many years ago. Venturi nozzles (and other nozzles) are dealt with in ISO 5167-3.

NOTE 1 Research into the use of Venturi tubes in high-pressure gas [$\geqslant$ 1 MPa ($\geqslant$ 10 bar)] is being carried out at present (see References [1], [2], [3] in the Bibliography). In many cases for Venturi tubes with machined convergent sections discharge coefficients which lie outside the range predicted by this part of ISO 5167 by 2 % or more have been found. For optimum accuracy Venturi tubes for use in gas should be calibrated over the required flowrate range. In high-pressure gas the use of single tappings (or at most two tappings in each plane) is not uncommon.

NOTE 2 In the USA the classical Venturi tube is sometimes called the Herschel Venturi tube.