SLOVENSKI STANDARD
SIST EN ISO 5167-1:1997/A1:2001

01-julij-2001

Merjenje pretoka fluida na osnovi razlike tlakov - 1. del: Zaslonke, šobe in Venturijeve cevi, vstavljene v polno zapolnjen vod s krožnim prerezom (ISO 5167-1:1995/AM1:1998)

Measurement of fluid flow by means of pressure differential devices - Part 1: Orifice plates, nozzles and Venturi tubes inserted in circular cross-section conduits running full (ISO 5167-1:1995/AM1:1998)

Durchflußmessung von Fluiden mit Drosselgeräten - Teil 1: Blenden, Düsen und Venturirohre in voll durchströmten Leitungen mit Kreisquerschnitt (ISO 5167 -:1995/AM1:1998)

Mesure de débit des fluides au moyen d'appareils déprimogenes - Partie 1: Diaphragmes, tuyeres et tubes de Venturi insérés dans des conduites en charge de section circulaire (ISO 5167-1:1995/AM1:1998)

Ta slovenski standard je istoveten z: EN ISO 5167-1:1995/A1:1998

ICS:

17.120.10	Pretok v zaprtih vodih	Flow in closed conduits

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EUROPEAN STANDARD

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EN ISO 5167-1:1995/A1

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ICS

Descriptors: see ISO document

English version

Measurement of fluid flow by means of pressure differential devices - Part 1: Orifice plates, nozzles and Venturi tubes inserted in circular cross-section conduits running full (ISO 5167-1:1995/AM1:1998)

Mesure de débit des fluides au moyen d'appareils déprimogènes - Partie 1: Diaphragmes, tuyères et tubes de Venturi insérés dans des conduites en charge de section circulaire (ISO 5167-1:1995/AM1:1998)

This amendment A1 modifies the European Standard EN ISO 5167-1:1995; it was approved by CEN on 15 February 1998.

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This amendment exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

Ref. No. EN ISO 5167-1:1995/A1:1998 E

Foreword

The text of the Amendment ISO 5167-1:1995/AM1:1998 to the EN ISO 5167-1:1995 has been prepared by Technical Committee ISO/TC 30 "Measurement of fluid flow in closed conduits" in collaboration with CEN/CS.

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 October 1998, and conflicting national standards shall be withdrawn at the latest by October 1998.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Endorsement notice

The text of the International Standard ISO 5167-1:1995/AM1:1998 has been approved by CEN as a European Standard without any modifications.

INTERNATIONAL STANDARD

ISO 5167-1

First edition
1991-12-15

AMENDMENT 1
1998-04-01

Measurement of fluid flow by means of pressure differential devices —

Part 1:
Orifice plates, nozzles and Venturi tubes inserted in circular cross-section conduits running full

AMENDMENT 1

Mesure de débit des fluides au moyen d'appareils déprimogènes — Partie 1: Diaphragmes, tuyères et tubes de Venturi insérés dans des conduites en charge de section circulaire

AMENDEMENT 1

Reference number
ISO 5167-1:1991/Amd.1:1998(E)

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.

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.

Amendment 1 to International Standard ISO 5167-1:1991 was prepared by Technical Committee ISO/TC 30, *Measurement of fluid flow in closed conduits,* Subcommittee SC 2, *Differential pressure methods.*

This amendment introduces a new, improved equation for the discharge coefficient, *C*. In order to accommodate this changed equation, several other changes are necessary in the text, and also Tables A.1 to A.11 are amended accordingly.

In addition, a correction is made to one expression which is shown in Table D.1.

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Measurement of fluid flow by means of pressure differential devices —

Part 1:
Orifice plates, nozzles and Venturi tubes inserted in circular cross-section conduits running full

AMENDMENT 1

Page 1, clause 1, paragraph 2, last-line

Delete "3 150" and substitute "4 000".

Page 10, Table 1

Add a new row at the top of table1, with the following figures inserted under the columns specified:

Column	Insert figures	
1	0,10	
2	10	(6)
3	14	(7)
4	34	(17)
5	5	
6	16	(8)
7	18	(9)
8	12	(6)
9	blank	
10	blank	
11	blank	
12	4	(2)

Page 10, Table 1

Add the following text:

"NOTE 4 For each type of primary device, not all values of β are permissible."

Page 18, subclause 8.1.7.1, line 3

Delete "0,20" and substitute "0,10".

Pages 21, 22 and 23, subclause 8.3

Delete existing subclause 8.3 (8.3.1, 8.3.2 and 8.3.3) and substitute the following:

8.3 Coefficients and corresponding uncertainties of orifice plates

8.3.1 Limits of use

Standard orifice plates shall only be used in accordance with this part of ISO 5167 under the following conditions.

a) For orifice plates with corner or with D and $D/2$ pressure tappings:

$d \geqslant 12{,}5$ mm

$50 \text{ mm} \leqslant D \leqslant 1\,000 \text{ mm}$

$0{,}1 \leqslant \beta \leqslant 0{,}75$

$Re_D \geqslant 4\,000$ for $0{,}1 \leqslant \beta \leqslant 0{,}5$

$Re_D \geqslant 16\,000\,\beta^2$ for $\beta > 0{,}5$

b) For orifice plates with flange tappings:

$d \geqslant 12{,}5$ mm

$50 \text{ mm} \leqslant D \leqslant 1\,000 \text{ mm}$

$0{,}1 \leqslant \beta \leqslant 0{,}75$

$Re_D \geqslant 4\,000$ and $Re_D \geqslant 170\,\beta^2 D$

where D is expressed in millimetres.

In addition, the relative roughness shall conform with the values in table 3.

Table 3 — Upper limits of relative roughness of the upstream pipeline for orifice plates

β	≤0,3	0,32	0,34	0,36	0,38	0,4	0,45	0,5	0,6	0,75
$10^4\ k/D$	25	18,1	12,9	10,0	8,3	7,1	5,6	4,9	4,2	4,0

The value of the uniform equivalent roughness, k, expressed in length units, depends on several factors such as height, distribution, angularity and other geometric aspects of the roughness elements of the pipe wall.

A full-scale pressure loss test of a sample length of the particular pipe should be carried out to determine the value of k.

However, approximate values of k for different materials can be obtained from the various tables given in reference literature, and table E.1 gives values of k for a variety of materials, as derived from the Colebrook formula.

Most of the experiments on which the values of C given in this part of ISO 5167 are based were carried out in pipes with a relative roughness

$k/D \leqslant 3{,}8 \times 10^{-4}$

as regards corner tappings, or

$$k/D \leqslant 10 \times 10^{-4}$$

as regards flange tappings or D and $D/2$ pressure tappings.

Pipes with higher relative roughness may be used if the relative roughness is within the limits given above for at least $10D$ upstream of the orifice plate.

8.3.2 Coefficients

8.3.2.1 Discharge coefficient, *C*

The discharge coefficient, C, is given by the Reader-Harris/Gallagher equation:

$$\begin{aligned}C = {} & 0{,}5961 + 0{,}0261\beta^2 - 0{,}216\beta^8 \\ & + 0{,}000521\left(\frac{10^6\beta}{Re_D}\right)^{0{,}7} + (0{,}0188 + 0{,}0063A)\beta^{3{,}5}\left(\frac{10^6}{Re_D}\right)^{0{,}3} \\ & + (0{,}043 + 0{,}080\mathrm{e}^{-10L_1} - 0{,}123\mathrm{e}^{-7L_1})(1 - 0{,}11A)\frac{\beta^4}{1-\beta^4} \\ & - 0{,}031(M'_2 - 0{,}8M'^{1{,}1}_2)\beta^{1{,}3}\end{aligned}$$

In the case where $D < 71{,}12$ mm (2,8 in), the following term should be added to the above equation:

$$+0{,}011(0{,}75 - \beta)\left(2{,}8 - \frac{D}{25{,}4}\right) \quad (D \text{ is expressed in millimetres})$$

where

$\beta = d/D$ is the diameter ratio;

Re_D is the Reynolds number related to D;

$$A = \left(\frac{19\,000\beta}{Re_D}\right)^{0{,}8};$$

$$M'_2 = \frac{2L'_2}{1-\beta};$$

$L_1 = l_1/D$ is the quotient of the distance of the upstream tapping from the **upstream** face of the plate and the pipe diameter;

$L'_2 = l'_2/D$ is the quotient of the distance of the downstream tapping from the **downstream** face of the plate, and the pipe diameter (L'_2 denotes the reference of the downstream spacing from the **downstream** face, while L_2 would denote the reference of the downstream spacing from the **upstream** face).

The values of L_1 and L'_2 to be used in this equation, when the spacings are in accordance with the requirements of 8.2.1.2, 8.2.1.3. or 8.2.2, are as follows:

— for corner tappings:

$$L_1 = L'_2 = 0$$

— for D and $D/2$ tappings:

$$L_1 = 1$$

$$L'_2 = 0{,}47$$

— for flange tappings:

$$L_1 = L'_2 = \frac{25{,}4}{D}$$

where D is expressed in millimetres.

The Reader-Harris/Gallagher equation is only valid for the tapping arrangements defined in 8.2.1 or 8.2.2. In particular, it is not permitted to enter into the equation pairs of values of L_1 and L'_2 which do not match one of the three standardized tapping arrangements.

This formula, as well as the uncertainties given in 8.3.3, is only valid when the measurement meets all the limits of use specified in 8.3.1 and the general installation requirements specified in clause 7.

Values of C as a function of β, Re_D and D are given for convenience in tables A.1 to A.11. These values are not intended for precise interpolation. Extrapolation is not permitted.

8.3.2.2 Expansibility [expansion] factor, ε_1

For the three types of tapping arrangement, the empirical formula for computing the expansibility [expansion] factor, ε_1, is as follows:

$$\varepsilon_1 = 1 - (0{,}41 + 0{,}35\beta^4)\frac{\Delta p}{\kappa p_1}$$

This formula is applicable only within the range of the limits of use specified in 8.3.1.

Test results for the determination of ε_1 are only known for air, steam and natural gas. However, there is no known objection to using the same formula for other gases and vapours the isentropic exponent of which is known.

Meanwhile, the formula is applicable only if $p_2/p_1 \geqslant 0{,}75$.

Values of the expansibility [expansion] factor as a function of the isentropic exponent, the pressure ratio and the diameter ratio are given for convenience in table A.14. These values are not intended for precise interpolation. Extrapolation is not permitted.

Note that

$$\varepsilon_2 = \varepsilon_1\sqrt{1 + \frac{\Delta p}{p_2}}$$

8.3.3 Uncertainties

8.3.3.1 Uncertainty of discharge coefficient *C*

For all three types of tapping, when β, D, Re_D and k/D are assumed to be known without error, the relative uncertainty of the value of C is equal to

0,5 % for $\beta \leqslant 0{,}6$

$(1{,}667\ \beta - 0{,}5)$ % for $0{,}6 < \beta \leqslant 0{,}75$

8.3.3.2 Uncertainty of expansibility [expansion] factor ε_1

When β, $\Delta p/p_1$ and κ are assumed to be known without error, the relative uncertainty, in percent, of the value of ε_1 is equal to

$$4\frac{\Delta p}{p_1}$$

Pages 39 to 49, Annex A, Tables A.1 to A.11

Delete existing Tables A.1 to A.11 and substitute the following new versions.

Page 60, Annex D, Table D.1

In the 3rd column headed "$d=$", in the 7th row headed "Precision criterion (where n is chosen by the user) ", delete the expression

$$\left|\frac{A_2 - \dfrac{X}{C\varepsilon_1}}{A_2}\right| < 1\times 10^{-n}$$

and substitute

$$\left|\frac{A_2 - XC\varepsilon_1}{A_2}\right| < 1\times 10^{-n}$$