THE FIRST REVISION OF ISO 5167

by

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S U M M A R Y

ISO 5167 is an international standard for the measurement of fluid flow by means of orifice plates, nozzles and venturi tubes inserted in circular cross-section conduits running full.

It was published in 1980. The sub-committee ISO/TC30/SC2 has decided a number of editorial and technical changes. The present paper lists, without comments, all the technical ones.

Each item will refer to the clause number of the existing document. The revised standard is entirely renumbered.

2 SYMBOLS AND DEFINITIONS

2.4.2 Reynolds number

The expression:

$$ReD = \frac{4q_m}{\pi\mu_1 D}$$

is added.

2.4.4 Acoustic ratio

The definition and the symbol are deleted.

2.4.5 Velocity of approach factor

The symbol is deleted. The definition is simply recalled in 2.4.6.

2.4.6 Flow and discharge coefficients

The concept of flow coefficient is no longer used in the standard. The symbol is deleted and the definition is simply recalled in a note of the clause. All references to 'α' are deleted in all places were it appeared and all texts deal now only with the discharge coefficient 'C'.

2.4.7 Expansion factor

Subscript 1 is added to the symbol ϵ when it is associated with ρ_1.

3.1 Principle of the Method of Measurement and Computation

The clause gives now the expression of q_m in terms of ϵ_1, ρ_1 as well as with ϵ_2, ρ_2 and the relationship between ϵ_1 and ϵ_2.

3.2 Method of Detemination of the Diameter Ratio of the Selected Standard Primary Device

The clause refers now to a new annex which deals with iterative computation.

3.4.2 (Fluid temperature)

For a gas, the thermometer well must be now at a distance of at most 15D downstream from the plate.

The clause no longer specifies isentropic expansion of gas, and suggests to assume no change in temperature between upstream and downstream conditions.

4 SELECTION OF THE PRIMARY DEVICE

This section is deleted from the body of the standard and assigned to the 'Code of Practice' (which is a companion document intended to facilitate the practical use of the standard).

5.3.2 (Flow conditions)

It is now suggested that increasing β might avoid a change of phase at the orifice.

6.1.6 (Installation requirements)

The clause now admits explicitly the use of seamed pipe, under some conditions.

6.3 Straightening Devices

Two other types of flow conditioners are added to the three previous ones. They are: the 'AMCA' which is a square mesh honeycomb, the 'etoile' which shows eight radial vanes.

6.3.2 (Pressure loss)

The newly accepted conditioners create a pressure loss considerably smaller than those obtained with the three other types.

6.5.3.3 (Eccentricity)

The maximum value of the offset of the orifice or throat axis of primary devices from the axes of upstream and downstream pipes is changed from: $0.0005D/(0.1 + 2.3\beta^4)$ to the less severe value $0.0025D/(0.1 + 2.3\beta^4)$.

7 ORIFICE PLATES

7.1.1.3 (Flatness of the plate)

A maximum slope of one per cent is required at operating conditions (such a one per cent limit was quoted in the next clause 7.1.2.1).

7.1.2.1 Upstream face

Flatness: A maximum slope of 0.5 per cent is now required under shop conditions, before on-site installation, provided that it can be shown that the method of mounting does not distort the plate.

7.1.2.2 Upstream face smoothness

The diameter for which a stated smoothness is required is now extended from 1.5d to 1D and, if not the case, the upstream face must be repolished or cleaned.

7.1.4.3 Thickness of the plate

A thickness of 3.2 mm is now permitted, even if exceeding the 0.05D limit.

7.1.5.2 Bevel angle

This angle is now specified as $45 \pm 15°$.

7.1.6.1 Edges

The downstream edges are now treated in a new clause, and do not require the high quality of the upstream edge.

7.1.6.2 Upstream edge sharpness

The cut-off value of D for the adequacy of visual inspection is now 25 mm, instead of 125 mm.

The text - finished by a very fine radial cut from the centre outwards - is deleted.

7.1.7.1 Orifice diameter

The β range is now the same for the three tapping systems, that is:

$$0.20 \leq \beta \leq 0.75.$$

7.1.7.3 Orifice cylindricity

A new requirement is that the roughness of the orifice bore cylindrical section shall not be such that it affects the edge sharpness measurement.

7.1.8.1 Symmetrical plates

Since the plate has to be especially thin, attention is now called to the value of the differential pressure, which may have to be limited, to prevent plate distortion.

7.2.1.4 Tap diameter

The maximum diameter of individual tappings is now specified as 0.13D or 13 mm (which is the lowest), instead of 0.08D or 12 mm. Note that the 13 mm limit is now compulsory, while the 12 mm limit was 'preferably'.

7.2.3.5 Flange tappings

The tolerances on the positions of tappings are now simple:

$$25.4 \pm 0.5 \text{ mm}$$

when simultaneously: $\beta > 0.6$ and $D < 150$ mm and 25.4 ± 1 mm in all other cases.

7.3.1 Limits of use

Those limits are now the same for all three tapping systems, except as regards ReD.

When d and D are in millimetres, they read as:

$$d \leq 12.5$$

$$50 \leq D \leq 1000$$

$$0.20 \leq \beta \leq 0.75$$

for corner taps:

$$5000 \leq \text{ReD at } \beta \leq 0.45$$

$$10\,000 \leq \text{ReD at } \beta > 0.45$$

for flange and D, D/2:

$1260\beta^2\ D \leq ReD$

and the upper limit for ReD is deleted.

The maximum accepted pipe roughness is also now unified, keeping the most severe values of the criterion k/D (and the table of usual values of k is now shown in an Annex).

7.4 Pressure Loss $\Delta\bar{\omega}$

The text now precises that this loss is considered between sections situated approximately 1D upstream and 6D downstream of the primary device.

It also proposes another simpler expression of this loss:

$$\Delta\bar{\omega}/\Delta P = 1 - \beta^{1.9} \text{ (orifice plates only).}$$

8 NOZZLES

9 VENTURI TUBES

There are no technical changes in those texts, except that, since their individual pressure tappings are referred to the orifice plate ones, their diameter is now governed by the new 0.13D and 13 mm values.

ANNEX A

All tables quoting α are deleted.

Columns at $ReD = 10^8$ and $ReD = \infty$ are added in tabulation of C and values directly printed by a computer-connected printing machine are supplied to the ISO Print Office in Geneva.

ANNEX D

A new annex about iterative computation with fast convergence.

ANNEX E

Usual values of k.

References

[1] Paper presented at the North Sea Flow Measurement Workshop, a workshop arranged by NFOGM & TUV-NEL

Note that this reference was not part of the original paper, but has been added subsequently to make the paper searchable in Google Scholar.