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Measurement of fluid flow in closed conduits — Velocity area method using Pitot static tubes

Mesurage du débit des fluides dans les conduites fermées — Méthode d'exploration du champ des vitesses au moyen de tubes de Pitot doubles

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Foreword

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This document was prepared by Technical Committee ISO/TC 30, *Measurement of fluid flow in closed conduits*, Subcommittee SC 5, *Velocity and mass methods*.

This fourth edition cancels and replaces the third edition (ISO 3966:2020), which has been technically revised.

The main changes are as follows:

— in Bibliography, new references were added;

— in 3.1.9 the wrong word “length” was corrected by “length”;

— in 3.2 the “cross-sectional area of the conduit” was replaced by “inner cross-sectional area of the conduit”;

— in 3.2 the “pipe diameter” was replaced by “inner pipe diameter”;

— in 3.2 the “rectangular conduit height” was replaced by “rectangular conduit inner height”;

— in 3.2 the “rectangular conduit width” was replaced by “rectangular conduit inner width”;

— in 3.2 the “pipe radius” was replaced by “inner pipe radius”;

— in 6.1.2 devices for improving flow conditions were mentioned;

— in 4.1 the “±” in the sentence “……not greater than ±2 %” was deleted;

— in 4.1.1, term “peripheral flow rate” was added and description was revised;

— in 6.1.2, sentence “The length of straight pipe……” was replaced by “The straight length (see 3.1.9) of pipe……”;

— two new subclauses 6.1.4 and 6.1.5 were added;

— the sentence in 6.1.6 “…… be remedied using one of the devices ……” was replaced by “…… be remedied using one or more of the devices ……”

— figures were added into 6.2.1 and 6.2.2 and effects of anti-swirl devices and profile developers were added likewise;

— two new subclauses 6.2.3 and 6.2.4 were added and the related 6.2.5 was modified likewise;

— the sentence in 6.2.5 "……and in any case at a distance……" was replaced by "……and generally at a distance……";

— in 6.4.3 the "±" in the sentence "……does not exceed ±0,5 %" was deleted;

— in 8.2, the "……at Reynolds numbers, *v*, based on……" was replaced by "……at Reynolds numbers, *Re*, based on……";

— the essential Formula (8) has been corrected;

— the values in the essential Formula (9) has been updated;

— Formula (11) for the density of moist air was added and the related Formulae (12) to (14) were added likewise;

— the essential Formula (20) has been corrected from $\sum_{i=2}^{i=n-2} u_i$ to $\sum_{i=2}^{n-2} u_i$ and in the NOTE, "Formula (1)" was corrected by "Formula (20)";

— the essential Formula (22) has been corrected from $\sum_{i=3}^{i=n-2} u_i$ to $\sum_{i=3}^{n-2} u_i$;

— in 11.1.1 and 11.2.1 the "r/R_i" was replaced by "r_i/R" and the "y/D_i" was replaced by "y_i/D";

— in Figure 12 and in 12.4 "distance of the total pressure tapping to the plane of static pressure tappings" was replaced by "distance from the axis of stem to the plane of static pressure holes";

— in 12.2.2 and B.1 k was replaced by k_g;

— in 13.6.1 the "±" in the sentence "……is $\pm v_{max.}/2$" was deleted;

— in Clause 13, phrases "standard deviation" were replaced by phrases "standard uncertainty" and symbols "σ" of "standard deviation" were replaced by "u" of "standard uncertainty" accordingly.

— the 8th footnote for "standard deviation" was revised;

— in Clause 13, words "tolerance" were replaced by phrases "expanded uncertainty" and symbols "δ" of "tolerance" were replaced by "U" of "expanded uncertainty" accordingly.

— in 13.5.3, the "±" in the Formula (40) was deleted;

— Figure A.4 was shifted before A.2;

— in Formula (C.7), "$\frac{1}{2}\rho v^{-2} = \ldots$" was revised as "$\frac{1}{2}\rho \bar{v}^{2} = \ldots$";

— the essential Formula (E.6) has been corrected;

— in Annex G introduction, "errors" were replaced by "uncertainties";

— in G.1, word "Error" in the title was replaced by "Uncertainty" and phrases "standard deviation of error" were replaced by phrases "relative standard uncertainty" and symbols "σ" were replaced by "u" accordingly;

— in G.2, word "Error" in the title was replaced by "Uncertainty" and phrases "standard deviation of error" were replaced by phrases "relative standard uncertainty" and symbols "σ" were replaced by "u" accordingly; Words "tolerance" were replaced by phrases "expanded uncertainty" and symbols "δ" of "tolerance" were replaced by "U" of "expanded uncertainty" accordingly; The "±" in the last sentence of G.2 "……less than ±2 %" was deleted;

— all the sections, mathematical formulae and figures have been renumbered.

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.

Measurement of fluid flow in closed conduits — Velocity area method using Pitot static tubes

1 Scope

This document specifies a method for the determination in a closed conduit of the volume rate of flow of a regular flow

a) of a fluid of substantially constant density or corresponding to a Mach number not exceeding 0,25,

b) with substantially uniform stagnation temperature across the measuring cross-section,

c) running full in the conduit, and

d) under steady flow conditions.

In particular, it deals with the technology and maintenance of Pitot static tubes, with the calculation of local velocities from measured differential pressures and with the computation of the flow rate by velocity integration.

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 2186, *Fluid flow in closed conduits — Connections for pressure signal transmissions between primary and secondary elements*

3 Terms, definitions and symbols

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions 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/

3.1.1
Pitot static tube
"Pitot tube"
tubular device consisting of a cylindrical head attached perpendicularly to a stem allowing measurement of a differential pressure from which the flow rate of the fluid in which it is inserted can be determined, and which is provided with static pressure tapping holes (drilled all around the circumference of the head at one or more cross-sections) and with a total pressure hole (facing the flow direction at the tip of the axially symmetrical nose of the head)

3.1.2
static pressure tapping
group of holes for the measurement of fluid static pressure