
International Standard 7145

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Determination of flowrate of fluids in closed conduits of circular cross-section — Method of velocity measurement at one point of the cross-section

Détermination du débit des fluides dans les conduites fermées de section circulaire — Méthode par mesure de la vitesse en un seul point

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 7145 was developed by Technical Committee ISO/TC 30, *Measurement of fluid flow in closed conduits*, and was circulated to the member bodies in April 1981.

It has been approved by the member bodies of the following countries :

Australia	Italy	Portugal
Belgium	Japan	Romania
Czechoslovakia	Korea, Dem. P. Rep. of	South Africa, Rep. of
Egypt, Arab Rep. of	Korea, Rep. of	United Kingdom
France	Netherlands	USSR
India	Norway	

The member bodies of the following countries expressed disapproval of the document on technical grounds :

Germany, F. R.
USA

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Determination of flowrate of fluids in closed conduits of circular cross-section — Method of velocity measurement at one point of the cross-section

1 Scope and field of application

1.1 Scope

This International Standard specifies a method for the determination of the volume rate of flow of a single phase fluid of a substantially constant density (Mach number $\leq 0,25$) under steady fully developed flow conditions in a closed conduit of circular cross-section running full by measurement of the flow velocity in a single point.

The method provides for the possibility of placing the primary velocity measuring device either at the point where it is assumed the mean axial velocity prevails, i.e. at a distance of $0,242 R$ from the wall of the conduit (R being the radius of the conduit), or on the axis of the conduit.

If there are doubts about the symmetry of the flow it is advisable to use at least two measuring points located symmetrically on one circumference at the distance from the wall specified above.

1.2 Field of application

The method specified in this International Standard does not apply unless the following conditions have been fulfilled :

- a) The conduit shall have a straight length sufficiently long so that, in the measuring section, a distribution of velocities corresponding to fully developed turbulent flow can be observed (see 2.3.5).

Hydraulic resistance coefficient λ of the conduit should not exceed 0,06.

- b) The flow must be turbulent and the Reynolds number, Re_D , should exceed or be equal to the following values :

λ	$> 0,03$	0,025	0,02	0,01
Re_D	10^4	3×10^4	10^5	10^6

When the velocity is measured on the conduit axis, the flow should be in fully rough turbulent regime (see 2.3.6). The Reynolds number, Re_D , should then exceed or be equal to :

λ	0,06	0,05	0,04	0,03	0,025	0,02	0,01
Re_D	3×10^4	5×10^4	10^5	3×10^5	5×10^5	10^6	5×10^7

- c) The experimental data on which this International Standard is based principally relate to conduits of diameter equal to or greater than 300 mm, but there is every reason to believe that the method can be applied to conduits of smaller diameter.

- d) In any point of the measuring cross-section, the angle between the direction of local velocity and the axis should not exceed 5° .

This condition can be verified either with the probe used for the measurements, if the design permits this, or with a different type of probe. It can be assumed that if the condition required is verified for a given flow q , then this condition is also met within the range $q/3$ to $3q$.

1.3 Accuracy of the method

As a guide, it can be considered that determination of flow from velocity measurement at a single point, carried out in accordance with the requirements of this International Standard, will lead to an uncertainty (at a confidence level of 95 %) not exceeding ± 3 %. However, the uncertainty on the flow shall be calculated for each individual application of this International Standard depending on the type of primary device, on the method of use and if necessary, on the method of calibration as well as on the measuring conditions.

2 Symbols and definitions

2.1 References

The vocabulary and symbols used in this International Standard are defined in the following International Standards :

ISO 3354, *Measurement of clean water flow in closed conduits — Velocity-area method using current-meters.*

ISO 3966, *Measurement of fluid flow in closed conduits — Velocity-area method using pitot-static tubes.*

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

ISO 5168, *Measurement of fluid flow — Estimation of uncertainty of a flow-rate measurement.*

The definitions appearing in 2.3 are given only for terms used in a special sense for which it would seem useful to repeat the definition of meaning.