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**Measurement of fluid flow in closed  
conduits — Velocity-area methods of flow  
measurement in swirling or asymmetric  
flow conditions in circular ducts by  
means of current-meters or Pitot static  
tubes**

*Mesurage de débit des fluides dans les conduites fermées — Mesurage  
de débit dans les conduites circulaires dans le cas d'un écoulement  
giratoire ou dissymétrique par exploration du champ des vitesses au  
moyen de moulinets ou de tubes de Pitot doubles*



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Published in Switzerland

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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 7194 was prepared by Technical Committee ISO/TC 30, *Measurement of fluid flow in closed conduits*, Subcommittee SC 5, *Velocity and mass methods*.

This second edition results from the reinstatement of ISO 7194:1983 which was withdrawn in 2003 and with which it is technically identical.

## Introduction

In order to carry out measurements of the flow-rate of single phase fluids in closed pipes by velocity-area methods, using either current-meters or Pitot static tubes, with satisfactory accuracy (e.g. of the order of  $\pm 2\%$ ), it is usually necessary to choose a measuring plane where the velocity distribution approaches that of fully developed flow (see ISO 3354 and ISO 3966).

There are, however, some cases where it is practically impossible to obtain such a flow distribution, but where as good as possible a measurement of the flow-rate is desirable.

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# Measurement of fluid flow in closed conduits — Velocity-area methods of flow measurement in swirling or asymmetric flow conditions in circular ducts by means of current-meters or Pitot static tubes

## 1 Scope

This International Standard specifies velocity-area methods for measuring flow in swirling or asymmetric flow conditions in circular ducts by means of current-meters or Pitot static tubes.

It specifies the measurements required, the precautions to be taken, the corrections to apply, and describes the additional uncertainties which are introduced when a measurement in asymmetric or swirling flow has to be made.

Only flows with a negligible radial component are considered, however. Furthermore, it is not possible to make a measurement in accordance with this International Standard if, at any point in the measuring cross-section, the local velocity makes an angle of greater than  $40^\circ$  with the axis of the duct, or where the index of asymmetry  $Y$  (defined in Annex F) is greater than 0,15.

This International Standard deals only with instruments for measuring local velocity as defined in ISO 3354 and ISO 3966. If Pitot static tubes are used, this International Standard applies only to flows where the Mach number corresponding to local velocities does not exceed 0,25.

## 2 Normative references

The following referenced documents are indispensable for the application 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/TR 3313, *Measurement of fluid flow in closed conduits — Guidelines on the effects of flow pulsations on flow-measurement instruments*

ISO 3354:2008, *Measurement of clean water flow in closed conduits — Velocity-area method using current-meters in full conduits and under regular flow conditions*

ISO 3455:2007, *Hydrometry — Calibration of current-meters in straight open tanks*

ISO 3966:2008, *Measurement of fluid flow in closed conduits — Velocity area method using Pitot static tubes*

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

ISO 5168, *Measurement of fluid flow — Procedures for the evaluation of uncertainties*