
**Measurement of fluid flow — Procedures
for the evaluation of uncertainties**

Mesure de débit des fluides — Procédures pour le calcul de l'incertitude



PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

This document is a preview generated by EVS

© ISO 2005

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword.....	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions.....	1
4 Symbols and abbreviated terms	3
4.1 Symbols	3
4.2 Subscripts	7
5 Evaluation of the uncertainty in a measurement process.....	8
6 Type A evaluations of uncertainty	9
6.1 General considerations.....	9
6.2 Calculation procedure.....	9
7 Type B evaluation of uncertainties	10
7.1 General considerations.....	10
7.2 Calculation procedure.....	10
7.3 Rectangular probability distribution.....	10
7.4 Normal probability distribution	11
7.5 Triangular probability distribution	11
7.6 Bimodal probability distribution	11
7.7 Assigning a probability distribution	11
7.8 Asymmetric probability distributions	11
8 Sensitivity coefficients	12
8.1 General.....	12
8.2 Analytical solution	12
8.3 Numerical solution.....	12
9 Combination of uncertainties	13
10 Expression of results	14
10.1 Expanded uncertainty	14
10.2 Uncertainty budget	15
Annex A (normative) Step-by-step procedure for calculating uncertainty.....	17
Annex B (normative) Probability distributions	20
Annex C (normative) Coverage factors.....	22
Annex D (informative) Basic statistical concepts for use in Type A assessments of uncertainty	24
Annex E (informative) Measurement uncertainty sources.....	36
Annex F (informative) Correlated input variables	38
Annex G (informative) Examples	40
Annex H (informative) The calibration of a flow meter on a calibration rig.....	58
Annex I (informative) Type A and Type B uncertainties in relation to contributions to uncertainty from “random” and “systematic” sources of uncertainty.....	61
Annex J (informative) Special situations using two or more meters in parallel	62
Annex K (informative) Alternative technique for uncertainty analysis.....	64
Bibliography	65

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 5168 was prepared by Technical Committee ISO/TC 30, *Measurement of fluid flow in closed conduits*, Subcommittee SC 9, *General topics*.

This second edition of ISO 5168 cancels and replaces ISO/TR 5168:1998, which has been technically revised (see Annex I).

Introduction

Whenever a measurement of fluid flow (discharge) is made, the value obtained is simply the best estimate that can be obtained of the flow-rate or quantity. In practice, the flow-rate or quantity could be slightly greater or less than this value, the uncertainty characterizing the range of values within which the flow-rate or quantity is expected to lie, with a specified confidence level.

GUM is the authoritative document on all aspects of terminology and evaluation of uncertainty and should be referred to in any situation where this International Standard does not provide enough depth or detail. In particular, GUM (1995) Annex F, gives guidance on evaluating uncertainty components.

This document is a preview generated by EVS

Measurement of fluid flow — Procedures for the evaluation of uncertainties

1 Scope

This International Standard establishes general principles and describes procedures for evaluating the uncertainty of a fluid flow rate or quantity.

A step-by-step procedure for calculating uncertainty is given in Annex A.

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 9300, *Measurement of gas flow by means of critical flow Venturi nozzles*

ISO Guide to the expression of uncertainty in measurement (GUM), 1995

International vocabulary of basic and general terms in metrology (VIM), 1993

3 Terms and definitions

For the purposes of this document, the terms and definitions given in VIM (1993), GUM (1995) and the following apply.

3.1

uncertainty

parameter, associated with the results of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand

NOTE Uncertainties are expressed as an absolute value and do not take a positive or negative sign.

3.2

standard uncertainty

$u(x)$

uncertainty of the result of a measurement expressed as a standard deviation

3.3

relative uncertainty

$u^*(x)$

standard uncertainty divided by the best estimate

NOTE 1 $u^*(x) = u(x)/x$.

NOTE 2 $u^*(x)$ can be expressed either as a percentage or in parts per million.

NOTE 3 Relative uncertainty is sometimes referred to as dimensionless uncertainty.

NOTE 4 The best estimate is in most cases the arithmetic mean of the related uncertainty interval.