



BSI Standards Publication

Accuracy (trueness and precision) of measurement methods and results

Part 1: General principles and definitions

National foreword

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Accuracy (trueness and precision) of measurement methods and results —

Part 1: General principles and definitions

*Exactitude (justesse et fidélité) des résultats et méthodes de mesure —
Partie 1: Principes généraux et définitions*



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Contents

Page

Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 General principles and practices of accuracy experiments	6
4.1 Accuracy experiment	6
4.2 Standard measurement method	7
4.3 Requirements concerning test items	7
4.4 Conditions for evaluation of repeatability (short intervals of time)	7
4.5 Conditions for evaluation of trueness	8
4.6 Participating laboratories	8
4.7 Influential factors (observation conditions)	8
5 Statistical model	9
5.1 Basic model	9
5.1.1 General mean, m	9
5.1.2 Laboratory component of bias: term B	10
5.1.3 Error term e	10
5.2 Relationship between the basic model and the precision	11
5.3 Bias of the measurement method	11
5.4 Alternative models	11
6 Experimental design of an accuracy experiment	12
6.1 Planning of an accuracy experiment	12
6.2 Standard measurement methods	12
6.3 Selection of laboratories for the accuracy experiment	12
6.4 Selection of test items to be used for an accuracy experiment	13
7 Utilization of accuracy data	14
7.1 Publication values of trueness and precision	14
7.2 Practical applications of trueness and precision values	15
7.2.1 General	15
7.2.2 Checking the acceptability of test results	15
7.2.3 Stability of test results within a laboratory	16
7.2.4 Assessing the performance of a laboratory	16
7.2.5 Comparing alternative measurement methods	16
7.2.6 Uncertainty evaluation	16
Annex A (informative) Symbols and abbreviations used in ISO 5725 (all parts)	17
Bibliography	19

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 69, *Applications of statistical methods*, Subcommittee SC 6, *Measurement methods and results*.

This second edition of ISO 5725-1 cancels and replaces the first edition (ISO 5725-1:1994) which has been technically revised. It also incorporates the Technical Corrigendum ISO 5725-1:1994/Cor.1:1998.

The main changes are as follows:

- normative references have been revisited;
- some definitions have been deleted (observed value, cell in a precision experiment, collaborative assessment experiment) and others have been added (repeatability critical difference, reproducibility critical difference, intermediate precision conditions, intermediate precision standard deviation, intermediate precision critical difference, intermediate precision limit);
- the number of laboratories required for a precision study and Annex B presenting charts of uncertainties for precision measures have been moved in ISO 5725-2;
- guidance on the practical use of trueness and precision to evaluate uncertainty and the use of ISO 21748 was added.

A list of all parts in the ISO 5725 series can be found on the ISO website.

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.

Introduction

0.1 The general term accuracy is used in ISO 5725 (all parts) to refer to both trueness and precision.

The term accuracy was at one time used to cover only the one component now named trueness, but it became clear that to many persons it should imply the total displacement of a result from a reference value, due to random as well as systematic effects.

The term bias has been in use for statistical matters for a very long time, but because it caused certain philosophical objections among members of some professions (such as medical and legal practitioners), the positive aspect has been emphasized by the invention of the term trueness.

0.2 ISO 5725 (all parts) uses two terms "trueness" and "precision" to describe the accuracy of a measurement method. "Trueness" refers to the closeness of agreement between the arithmetic mean of a large number of test results and the true or accepted reference value. "Precision" refers to the closeness of agreement between test results obtained under stipulated conditions.

0.3 The need to consider "precision" arises because tests or measures performed on presumably identical test items in presumably identical circumstances do not, in general, yield identical results. This is attributed to unavoidable random errors inherent in every measurement procedure; the factors that influence the outcome of a measurement cannot all be completely controlled. In the practical interpretation of measurement data, this variability should be taken into account. For instance, the difference between a test result and some specified value may be within the scope of unavoidable random errors, in which case a real deviation from such a specified value has not been established. Similarly, comparing test results from two batches of product will not indicate a fundamental quality difference if the difference between them can be attributed to the inherent variation in the measurement procedure.

0.4 The general term for variability between replicate measurements is precision. Two conditions of precision, termed repeatability and reproducibility conditions, have been found necessary and, for many practical cases, useful for describing the variability of a measurement method. Under repeatability conditions, all factors that influence the measurement are considered constant and do not contribute to the variability, while under reproducibility conditions, some or all influential factors vary and do contribute to the variability of the test results. Thus repeatability and reproducibility are the two extremes of precision, the first describing the minimum and the second the maximum variability in results. Other intermediate conditions between these two extreme conditions also occur when one or more of the factors that influence the measurement are allowed to vary, and are used in certain specified circumstances. Precision is normally expressed in terms of standard deviations.

0.5 The purpose of ISO 5725 (all parts) is as follows:

- a) to outline the general principles to be understood when assessing accuracy (trueness and precision) of measurement methods and results, and in applications, and to establish practical estimations of the various measures by experiment (ISO 5725-1);
- b) to provide basic methods for estimating the two extreme measures of the precision of measurement methods by experiment, giving the circumstances in which they apply (ISO 5725-2);
- c) to provide designs for obtaining intermediate measures of precision, giving the circumstances in which they apply and methods for estimating them and to provide some alternative designs to those given in ISO 5725-2, for determining the precision and trueness of measurement methods for use under certain circumstances (ISO 5725-3);
- d) to provide basic methods for the determination of the trueness of a measurement method (ISO 5725-4);
- e) to provide some alternatives to the methods, given in ISO 5725-2 to ISO 5725-4, for determining the precision and trueness of measurement methods for use under certain circumstances (ISO 5725-5);

- f) to present some practical applications and use of these measures of trueness and precision (ISO 5725-6).

Accuracy (trueness and precision) of measurement methods and results —

Part 1: General principles and definitions

1 Scope

1.1 This document

- introduces conditions, constraints and resources necessary to evaluate a measurement method or a result;
- defines an organizational scheme for the acquisition of trueness and precision data by study;
- provides the necessary definitions, statistical model and principles for ISO 5725 (all parts).
- is not applicable to proficiency testing or production of the reference item that has their own standards (ISO 13528, respectively and ISO Guide 35).

1.2 This document is concerned exclusively with measurement methods which yield results on a continuous scale and give a single value as the test result, although this single value may be the outcome of a calculation from a set of observations.

It defines values which describe, in quantitative terms, the ability of a measurement method to give a true result (trueness) or to replicate a given result (precision). Thus, there is an implication that exactly the identical item is being measured, in exactly the same way, and that the measurement process is under control.

This document may be applied to a very wide range of test items, including gas, liquids, powders and solid objects, manufactured or naturally occurring, provided that due consideration is given to any heterogeneity of the test item.

This document does not include methods of calculation that are described in the other parts.

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 undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3534-1, *Statistics — Vocabulary and symbols — Part 1: General statistical terms and terms used in probability*

ISO 3534-2, *Statistics — Vocabulary and symbols — Part 2: Applied statistics*

3 Terms and definitions

For the purpose of this document, the terms and definitions given in ISO 3534-1, ISO 3534-2 and the following apply.

The symbols used in ISO 5725 (all parts) are given in [Annex A](#).