Second edition
2017-04

Guidance for the use of repeatability, reproducibility and trueness estimates in measurement uncertainty evaluation

Lignes directrices relatives à l'utilisation d'estimations de la répétabilité, de la reproductibilité et de la justesse dans l'évaluation de l'incertitude de mesure

Reference number
ISO 21748:2017(E)

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

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 documents 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).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

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

This second edition cancels and replaces the first edition (ISO 21748:2010), of which it constitutes a minor revision.

The changes compared to the previous edition are as follows:

— minor change in the title (estimation to evaluation) to reflect preferred use of terms (see third list item);

— minor changes in wording and format to conform to current ISO Directives, which included the addition of Clause 2 and renumbering of subsequent clauses;

— the phrases "estimation of measurement uncertainty" (and similar usage of "estimate") and "evaluation of measurement uncertainty" (and similar usage of "evaluate") have been amended to distinguish quantitative estimates of the components of uncertainty from the process of evaluations of measurement uncertainty, which can include additional relevant considerations;

— the word "standard" has been added before "uncertainty" where appropriate, for clarity;

— redundant definitions of terms defined as squared quantities, where the standard deviation was also defined [s^2_b, s^2_{inh}, s^2_L, s^2_r, s^2_W, $u^2(y)$, σ^2_L, σ^2_r] have been removed;

— in the definition of r_{ij}, "in the interval -1 to +1" was removed;

— in the definition of the term s_{inh}, "uncertainty" was changed to "standard deviation";

— in the definitions for $u(y)$, $u_i(y)$ and $u(Y)$, $U(y)$, equations were removed (not necessary for standard terms);

— the symbols from all definitions of terms where they had been included (combined standard uncertainty, coverage factor, expanded uncertainty, standard uncertainty) have been removed;

— the definition of y_0 has been removed because the term is not used in the document;

— in 7.4, first dash, “quality control charts” has been replaced with “control charts”;

— a note has been added to Clause 10 (previously Clause 9);

— in 13.1, 14.1 and 14.3 (previously 12.1, 13.1 and 13.3), “combined” has been added before “standard uncertainty”;

— in 13.2.1 and 13.2.2 (previously 12.2.1 and 12.2.2), the word “combined” has been removed before “expanded uncertainty”;

— in A.1, changed italics “standard uncertainties” to standard text;

— in A.1, 7th paragraph (3rd from end), “combined standard uncertainties [$u(x_i)$]” has been changed to “additional standard uncertainties $u(y)$”;

— in C.3, title, “Uncertainty for AOAC method 990.12” has been replaced with “Uncertainty for measurements obtained by AOAC method 990.12”;

— in C.3.2, “eight laboratories” has been replaced with “twelve laboratories “;

— in C.4.4, “0,07 g/kg (0,7 % as mass fraction)” has been changed to “7 g/kg (0,7 % as mass fraction)”;

— References [27] and [28] have been updated.

Introduction

Knowledge of the uncertainty associated with measurement results is essential to the interpretation of the results. Without quantitative evaluations of uncertainty, it is impossible to decide whether observed differences between results reflect more than experimental variability, whether test items comply with specifications, or whether laws based on limits have been broken. Without information on uncertainty, there is a risk of misinterpretation of results. Incorrect decisions taken on such a basis can result in unnecessary expenditure in industry, incorrect prosecution in law, or adverse health or social consequences.

Laboratories operating under ISO/IEC 17025 accreditation and related systems are accordingly required to evaluate measurement uncertainty for measurement and test results and report the uncertainty where relevant. ISO/IEC Guide 98-3 is a widely adopted standard approach. However, it applies to situations where a model of the measurement process is available. A very wide range of standard test methods is, however, subjected to collaborative study in accordance with ISO 5725-2. This document provides an appropriate and economic methodology for estimating uncertainty associated with the results of these methods, which complies fully with the relevant principles of the GUM, while taking account of method performance data obtained by collaborative study.

The general approach used in this document requires the following.

— Estimates of the repeatability, reproducibility and trueness of the method in use, obtained by collaborative study as described in ISO 5725-2, be available from published information about the test method in use. These provide estimates of the intra-laboratory and inter-laboratory components of variance, together with an estimate of uncertainty associated with the trueness of the method.

— The laboratory confirms that its implementation of the test method is consistent with the established performance of the test method by checking its own bias and precision. This confirms that the published data are applicable to the results obtained by the laboratory.

— Any influences on the measurement results that were not adequately covered by the collaborative study be identified and the variance associated with the results that could arise from these effects be quantified.

An uncertainty estimate is made by combining the relevant variance estimates in the manner prescribed by the GUM. This estimate can serve, with other contributions, in the evaluation of uncertainty, or in some cases can be the final, stated, uncertainty.

The general principle of using reproducibility data in uncertainty evaluation is sometimes called a “top-down” approach.

The dispersion of results obtained in a collaborative study is often also usefully compared with measurement uncertainty evaluated using GUM procedures as a test of full understanding of the method. Such comparisons will be more effective given a consistent methodology for estimating the same parameter using collaborative study data.