PD IEC TR 63250:2021

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Household and similar electrical appliances — Method of measuring performance — Assessment of repeatability, reproducibility and uncertainty

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A list of organizations represented on this committee can be obtained on request to its committee manager.

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Household and similar electrical appliances – Method of measuring performance – Assessment of repeatability, reproducibility and uncertainty

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FOREWORD

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IEC 63250 has been prepared IEC technical committee 59: Performance of household and similar electrical appliances. It is a Technical Report.

The text of this Technical Report is based on the following documents

Draft	Report on voting
59/752/DTR	59/765/RVDTR

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this Technical Report is English.

Words **in bold** in the text are defined in Clause 3.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

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INTRODUCTION

To encourage the efficient use of energy and other resources, national governments and regional authorities have issued regulations that mandate the provision of information to consumers regarding the energy and water consumption of household appliances and associated performance characteristics.

Therefore, methods for measuring performance characteristics must be of sufficient **accuracy** to provide confidence to governments, consumers and manufacturers.

The **accuracy** of a test method is expressed in terms of **bias** and **precision**. **Precision**, when evaluating test methods, is expressed in terms of two measurement concepts: **repeatability** (intra-laboratory variability) and **reproducibility** (inter-laboratory variability). Therefore, standard procedures are required for determining the **repeatability** and the **reproducibility** of test methods. The determination of levels of **repeatability** and **reproducibility** is frequently done by carrying out **round robin tests** (RRT). The **repeatability** of a test method must be sufficiently accurate for comparative testing. The **reproducibility** of a test method must be sufficiently accurate for the determination of values that are declared, and for checking these declared values. Other ways to assess the uncertainty are possible.

Uncertainty reporting is essential to ensure measured data are interpreted correctly. Especially when data of measurements are to be compared between laboratories or when normative requirements are set up, it is necessary to know the uncertainty with which data can be measured.

In conformity assessment using a binary decision rule, a property of an item is measured, and the item is accepted as conforming if the measured value of the property lies within a defined acceptance interval. A measured value outside the acceptance interval leads to rejection of the item as non-conforming.

The objective of this technical report is to give guidelines for household and similar electrical appliances within TC 59, but it can also be used for assessing other types of appliances outside the technical committee 59 and its subcommittees' environment.

It is intended to collate and summarise the information needed for assessing the **repeatability**, **reproducibility** and uncertainty of measurements of performance of household and similar electrical appliances present in previous IEC publications[1].

[1] IEC TR 61923, IEC TR 62617 and IEC TR 62970

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HOUSEHOLD AND SIMILAR ELECTRICAL APPLIANCES – METHOD OF MEASURING PERFORMANCE – ASSESSMENT OF REPEATABILITY, REPRODUCIBILITY AND UNCERTAINTY

1 Scope

This Technical Report deals with the determination of **repeatability** and **reproducibility** of test methods used for assessing the performance characteristics of household and similar electrical appliances. It also provides guidance for carrying out **round robin tests** (RRT).

It also specifies the uncertainty reporting of measurements of household and similar electrical appliances.

It describes methods to estimate the uncertainty of a measured result and to predict the range of measured values when the same appliance is measured in another laboratory applying the same measurement method.

It does not cover the development of measurement methods. It also does not deal with:

– the production variability of the appliance;

– how closely the measurement method reflects the normal use of appliances in households.

NOTE 1 Although this technical report does not cover the development of test methods, it can be taken into consideration for this purpose.

NOTE 2 For the purpose of this technical report production variability includes the variation of the individual appliances of the same type and model manufactured on the same production line.

NOTE 3 For noise standardisation, some deviating definitions are used (see. IEC 60704-3:2019).

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

ISO 5725-2:2019, *Accuracy (trueness and precision) of measurement methods and results – Part 2: Basic method for the determination of repeatability and reproducibility of a standard measurement method*

ISO 80000-1:2009, *Quantities and units – Part 1: General*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
accuracy
closeness of agreement between a test result or measurement result and the true value

Note 1 to entry: In practice, the accepted reference value is substituted for the true value.

Note 2 to entry: The term "**accuracy**", when applied to a set of test or measurement results, involves a combination of random components and a common systematic error or **bias** component.

Note 3 to entry: **Accuracy** refers to a combination of trueness and **precision**.

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[SOURCE: ISO 3534-2:2006, 3.3.1, modified – Cross-references have been deleted]

3.2
precision
closeness of agreement between independent test/measurement results obtained under stipulated conditions

Note 1 to entry: **Precision** depends only on the distribution of random errors and does not relate to the true value or the specified value.

Note 2 to entry: The measure of **precision** is usually expressed in terms of imprecision and computed as a standard deviation of the test results or measurement. Less **precision** is reflected by a larger standard deviation.

Note 3 to entry: Quantitative measures of **precision** depend critically on the stipulated conditions. **Repeatability conditions** and **reproducibility conditions** are particular sets of extreme stipulated conditions.

[SOURCE: ISO 3534-2:2006, 3.3.4, modified – Cross-references have been deleted]

3.3
repeatability
precision under **repeatability conditions**.

Note 1 to entry: **Repeatability** can be expressed quantitatively in terms of the dispersion characteristics of the results.

[SOURCE: ISO 3534-2:2006, 3.3.5, modified – Cross-references have been deleted]

3.4
repeatability conditions
observation conditions where independent test/measurement results are obtained with the same method on identical test/measurement items in the same test or measuring facility by the same operator using the same equipment within short intervals of time

Note 1 to entry: **Repeatability** conditions include:

- the same measurement procedure or test procedure;
- the same operator;
- the same measuring or test equipment used under
- the same conditions;
- the same location;
- repetition over a short period of time.

[SOURCE: ISO 3534-2:2006, 3.3.6, modified – Cross-references have been deleted]

3.5
repeatability standard deviation
standard deviation of test results or measurement results obtained under **repeatability conditions**

Note 1 to entry: It is a measure of the dispersion of the distribution of test results or measurement results under **repeatability conditions**.

Note 2 to entry: Similarly, "repeatability variance" and "repeatability coefficient of variation" can be defined and used as measures of the dispersion of test or measurement results under **repeatability conditions**.

[SOURCE: ISO 3534-2:2006, 3.3.7, modified – Cross-references have been deleted]

3.6
reproducibility
precision under **reproducibility conditions**

Note 1 to entry: **Reproducibility** can be expressed quantitatively in terms of the dispersion characteristics of the results.

Note 2 to entry: Results are usually understood to be corrected results

[SOURCE: ISO 3534-2:2006, 3.3.10, modified – Cross-references have been deleted]

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3.7
reproducibility conditions
observation conditions where independent test/measurement results are obtained with the same method on identical test/measurement items in different test or measurement facilities with different operators using different equipment

[SOURCE: ISO 3534-2:2006, 3.3.11, modified – Cross-references have been deleted]

3.8
reproducibility standard deviation:
standard deviation of test results or measurement results obtained under **reproducibility conditions**

Note 1 to entry: It is a measure of the dispersion of the distribution of test or measurement results under **reproducibility conditions**.

Note 2 to entry: Similarly, "reproducibility variance" and "reproducibility coefficient of variation" can be defined and used as measures of the dispersion of test or measurement results under **reproducibility conditions**.

[SOURCE: ISO 3534-2:2006, 3.3.12 modified – Cross-references have been deleted]

3.9
outlier
member of a small subset of observations that appears to be inconsistent with the remainder of a given sample

Note 1 to entry: The classification of an observation or a subset of observations as **outlier(s)** is relative to the chosen model for the population from which the data set originates. This or these observations are not to be considered as genuine members of the main population.

Note 2 to entry: An **outlier** may originate from a different underlying population, or be the result of incorrect recording or gross measurement error.

Note 3 to entry: The subset may contain one or more observations.

[SOURCE: ISO 16269-4:2010, 2.2 modified – Cross-references have been deleted]

3.10
statistical uncertainty
repeatability standard deviation obtained in one laboratory under **repeatability conditions**

3.11
expanded uncertainty
quantity defining an interval about the result of a measurement that may be expected to encompass a large fraction of the distribution of values that could reasonably be attributed to the measurand

Note 1 to entry: The fraction may be viewed as the coverage probability or level of confidence of the interval.

Note 2 to entry: To associate a specific level of confidence with the interval defined by the expanded uncertainty requires explicit or implicit assumptions regarding the probability distribution characterized by the measurement result and its combined standard uncertainty. The level of confidence that may be attributed to this interval can be known only to the extent to which such assumptions may be justified.

Note 3 to entry: **Expanded uncertainty** is termed *overall uncertainty* in paragraph 5 of Recommendation INC-1 (1980)

[SOURCE: ISO/IEC Guide 98-3:2008, 2.3.5]

3.12
bias
difference between the expectation of a test result or measurement result and a true value

[SOURCE: ISO 3534-2:2006, 3.3.2, modified – Cross-references and Notes have been deleted]

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3.13
round robin testing
RRT
ringtest
process in which one or more items are tested according to a specific protocol by a number of different laboratories.

4 Determination of standard deviations

4.1 General

Repeatability and **reproducibility standard deviations** serve as parameters for assessing:

– the suitability of a measurement method;

– the **accuracy** of a measurement result;

– conformance of measured values to acceptance interval.

Rounding is only applied to reported values in Clause 7. If numbers are rounded, they are rounded to the nearest number in accordance with ISO 80000-1:2009, Annex B, Rule B. If the rounding takes place to the right of the comma, the omitted places are not filled with zeros.

4.2 Repeatability standard deviation

The **repeatability standard deviation** $s_{L,i}$ of a measurement method within laboratory i is calculated from Equation (1):

$$s_{L,i} = \sqrt{\frac{1}{n_i - 1} \sum_{k_i=1}^{n_i} \left(x_{ki} - \overline{x}_i\right)^2} \tag{1}$$

where

n_i is the number of measurement results;

x_{ki} is the particular measurement result;

$\overline{x}_i$ is the arithmetic mean value of n_i measurement results x_k of laboratory i.

The average **repeatability standard deviation** s_r of a measurement method within p laboratories is calculated from Equation (2):

$$s_r = \sqrt{\frac{1}{p} \sum_{i=1}^{p} s_{L,i}^2} \tag{2}$$

where

$s_{L,i}$ is the **repeatability standard deviation** within laboratory i;

p is the number of laboratories participating in the inter-laboratory test.

4.3 Reproducibility standard deviation

The **reproducibility standard deviation** s_R of a measurement method is calculated from Equations (3), (4), and (5):

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