



BSI Standards Publication

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

National foreword

This Published Document is the UK implementation of IEC TR 63250:2021.

The UK participation in its preparation was entrusted to Technical Committee CPL/59, Performance of household electrical appliances.

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

Contractual and legal considerations

This publication has been prepared in good faith, however no representation, warranty, assurance or undertaking (express or implied) is or will be made, and no responsibility or liability is or will be accepted by BSI in relation to the adequacy, accuracy, completeness or reasonableness of this publication. All and any such responsibility and liability is expressly disclaimed to the full extent permitted by the law.

This publication is provided as is, and is to be used at the recipient's own risk.

The recipient is advised to consider seeking professional guidance with respect to its use of this publication.

This publication is not intended to constitute a contract. Users are responsible for its correct application.

This publication is not to be regarded as a British Standard.

© The British Standards Institution 2021
Published by BSI Standards Limited 2021

ISBN 978 0 55 05119 3

ICS 97.030

Compliance with a Published Document cannot confer immunity from legal obligations.

This Published Document was published under the authority of the Standards Policy and Strategy Committee on 31 July 2021.

Amendments/corrigenda issued since publication

Date	Text affected
------	---------------



TECHNICAL REPORT

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

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 97.030

ISBN 978-2-8322-9939-5

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	7
2 Normative references	7
3 Terms and definitions	7
4 Determination of standard deviations.....	10
4.1 General.....	10
4.2 Repeatability standard deviation	10
4.3 Reproducibility standard deviation	11
5 Assessment of repeatability, reproducibility, and uncertainty of a measurement method.....	11
5.1 Purpose.....	11
5.2 Requirements	11
5.3 Expression of repeatability and reproducibility	12
5.4.1 The importance of the uncertainty.....	12
5.4.2 Methods to estimate uncertainty	12
5.4.3 Expanded uncertainty calculation	13
6 Scrutiny of results for consistency and outliers	14
6.1 Purpose	14
6.2 Graphical consistency technique (Mandel's b and k statistics).....	14
6.2.1 Inter-laboratory consistency statistic.....	14
6.2.2 Intra-laboratory consistency statistic.....	14
6.2.3 Evaluation	14
6.3 Numerical outlier technique.....	15
6.3.1 Cochran's C test.....	15
6.3.2 Grubbs' test.....	15
6.3.3 Evaluation	15
7 Data to be reported for assessing the repeatability, reproducibility and uncertainty of a test method.....	16
Annex A (informative) Example of bottom-up analysis.....	17
A.1 General.....	17
A.2 Temperature measurement system	17
A.2.1 General.....	17
A.2.2 Calibration of thermocouples	17
A.2.3 Calibration of the DAQ system.....	17
A.3 Uncertainty temperature measurement.....	17
A.4 Analysis of each component in the uncertainty formulation, example thermocouple simulator.....	19
Annex B (informative) Guidance on how to conduct round robin tests for household and similar electrical appliances	21
B.1 General.....	21
B.2 Scope	21
B.3 Process and responsibilities.....	22
B.3.1 Process	22
B.3.2 Responsibilities	23
B.4 Testing laboratories	23

B.4.1	Potential laboratories.....	23
B.4.2	Announcement.....	23
B.4.3	Selection of laboratories.....	24
B.4.4	Final list of laboratories.....	24
B.5	Transportation of the product.....	24
B.5.1	Logistics.....	24
B.5.2	Packaging.....	24
B.6	Test.....	24
B.6.1	Performance of test.....	24
B.6.2	Laboratory visit.....	25
B.6.3	Transmission of result.....	25
B.7	Analysis, report and termination.....	25
B.7.1	Analysis.....	25
B.7.2	Report.....	25
B.7.3	Termination and publication of final external report.....	26
Annex C (informative)	Example of a round robin test and its analysis.....	27
C.1	General.....	27
C.2	Standard deviations and assessment of repeatability and reproducibility.....	27
C.3	Scrutiny of results for consistency and outliers.....	29
C.3.1	Example of Mandel's h and k statistics.....	29
C.3.2	Example of numerical outlier test.....	29
Annex D (informative)	Example of expression of results.....	32
Bibliography	33
Figure 1	– Visualisation of straggler and outlier of Cochran value.....	16
Figure C.1	– Mandel's h statistics.....	30
Figure C.2	– Mandel's k statistics.....	31
Table A.1	– Description of uncertainty parameters.....	18
Table A.2	– Measuring a temperature of -23 °C at a climate room temperature between 16 °C to 32 °C	19
Table A.3	– Expanded uncertainty in measured temperature ($U(T)$, $k = 2$) at a room temperature in the range of 16 °C to 32 °C and a lab temperature between 14 °C and 32 °C	19
Table A.4	– Calibration results of the simulator.....	20
Table C.1	– Measurement results.....	27
Table C.2	– Standard deviations, repeatability and reproducibility.....	28
Table C.3	– Mandel's h and k statistics.....	29
Table C.4	– Cochran's test C and Grubbs' test G	29
Table C.5	– Cochran's test C and Grubbs' test G summary.....	30

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publications"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 63250 has been prepared by 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.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

Currently in preview, click buy full version

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 publications¹.

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

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**.