IEC 62059-32-1

Edition 1.0 2011-12

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Electricity metering equipment – Dependability –
Part 32-1: Durability – Testing of the stability of metrological characteristics by applying elevated temperature

Appareils de comptage de l'électricité – Sûreté de fonctionnement –
Partie 32-1: Durabilité – Contrôle de stabilité des caractéristiques métrologiques en appliquant une température élevée

IEC 62059-32-1:2011

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

- Catalogue of IEC publications: www.iec.ch/searchpub

The IEC on-line Catalogue enables you to search by a variety of criteria (reference number, text, technical committee,…). It also gives information on projects, withdrawn and replaced publications.

- IEC Just Published: www.iec.ch/online_news/justpub

Stay up to date on all new IEC publications. Just Published details twice a month all new publications released. Available on-line and also by email.

- Electropedia: www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 20 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary online.

- Customer Service Centre: www.iec.ch/webstore/custserv

If you wish to give us your feedback on this publication or need further assistance, please visit the Customer Service Centre FAQ or contact us:
Email: csc@iec.ch
Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00

A propos de la CEI

La Commission Electrotechnique Internationale (CEI) est la première organisation mondiale qui élabore et publie des normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications CEI

Le contenu technique des publications de la CEI est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

- Catalogue des publications de la CEI: www.iec.ch/searchpub/cur_fut-f.htm

Le Catalogue en-ligne de la CEI vous permet d'effectuer des recherches en utilisant différents critères (numéro de référence, texte, comité d'études,…). Il donne aussi des informations sur les projets et les publications retirées ou remplacées.

- Just Published CEI: www.iec.ch/online_news/justpub

Restez informé sur les nouvelles publications de la CEI. Just Published détaille deux fois par mois les nouvelles publications parues. Disponible en-ligne et aussi par email.

- Electropedia: www.electropedia.org

Le premier dictionnaire en ligne au monde de termes électroniques et électriques. Il contient plus de 20 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans les langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International en ligne.

- Service Clients: www.iec.ch/webstore/custserv/custserv_entry-f.htm

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions, visitez le FAQ du Service clients ou contactez-nous:
Email: csc@iec.ch
Tél.: +41 22 919 02 11
Fax: +41 22 919 03 00

IEC 62059-32-1

Edition 1.0 2011-12

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Electricity metering equipment – Dependability – Part 32-1: Durability – Testing of the stability of metrological characteristics by applying elevated temperature

Appareils de comptage de l'électricité – Sûreté de fonctionnement – Partie 32-1: Durabilité – Contrôle de stabilité des caractéristiques métrologiques en appliquant une température élevée

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX N

ICS 17.220; 19.020; 91.140.50

ISBN 978-2-88912-827-3

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTRICITY METERING EQUIPMENT – DEPENDABILITY –

Part 32-1: Durability – Testing of the stability of metrological characteristics by applying elevated temperature

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 Publication(s)"). 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.

International Standard IEC 62059-32-1 has been prepared by IEC technical committee 13: Electrical energy measurement, tariff- and load control.

The text of this standard is based on the following documents:

FDIS	RVD
13/1483/FDIS	13/1493/RVD

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of IEC 62059 series, under the general title *Electricity metering equipment – Dependability*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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

INTRODUCTION

Electricity meters are products designed for high reliability and durability to operate continuously for extended periods without supervision.

To manage metering assets effectively, it is important to have tools for predicting and estimating life characteristics of various types.

IEC 62059-41 provides methods for predicting the failure rate – assumed to be constant – of metering equipment, based on the parts stress method.

IEC 62059-31-1 provides a method for estimating life characteristics using accelerated reliability testing by operating the test specimens at elevated temperature and humidity. Future parts of IEC 62059-31 may be established to cover accelerated reliability testing, applying other stresses.

This standard, IEC 62059-32-1 provides a test method to evaluate one important aspect of durability, the stability of metrology characteristics, by operating a test specimen at the upper limit of the specified operating range of temperature, voltage and current for an extended period. Future parts of IEC 62059-32 may be established to cover other kinds of stress or other aspects of durability.

ELECTRICITY METERING EQUIPMENT – DEPENDABILITY –

Part 32-1: Durability – Testing of the stability of metrological characteristics by applying elevated temperature

1 Scope

The stability of metrological characteristics is one important aspect of durability.

This part of IEC 62059 specifies a method for testing the stability of metrological characteristics of electricity meters, by operating a test specimen at the upper limit of the specified operating range of temperature, voltage and current for an extended period.

Functional performance other than the accuracy of energy measurement is out of the scope of this standard.

Note, that from the results of this test, no conclusion can be drawn for the length of period during which the stability of the metrological characteristics will be maintained when the meter is operated under usual conditions.

This International Standard is applicable to all types of electricity meters in the scope of IEC TC 13.

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.

IEC 60068-2-2:2007, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 62052-11:2003, *Electricity metering equipment (AC) – General requirements, tests and test conditions – Part 11: Metering equipment*

IEC 62053-21:2003, *Electricity metering equipment (a.c.) – Particular requirements – Part 21: Static meters for active energy (classes 1 and 2)*

3 Terms and definitions

For the purposes of this document, the terms and definitions in IEC 62052-11 as well as the following apply.

3.1
durability
the ability of an item to perform a required function under given conditions of use and maintenance, until a limiting state is reached

NOTE A limiting state of an item may be characterized by the end of the useful life, unsuitability or any economic or technological reasons or other relevant factors.

[IEC 60050-191: 1990, 191-02-02]

4 General

The test procedure consists of:

- initial measurements, see Clause 5;
- operational conditioning at the maximum temperature, voltage and current of the specified operating range, see Clause 6. During the conditioning, intermediate measurements are taken, see Clause 7;
- recovery – see Clause 8 – and final measurements, see Clause 9.

The test shall be performed on (one of) the meter(s) submitted for type testing (meter under test, MUT).

During the conditioning, the MUT shall not exhibit any irregular behaviour concerning energy measurement and registration. This shall be verified as specified in Clause 7.

In addition, after conditioning and recovery, the change of the percentage error, when compared to the initial measurements, shall not exceed the limits specified in Clause 9. To verify this, the percentage error shall be measured, as specified in Clause 5, before conditioning and following the recovery period.

If the MUT passes the test, this gives a reasonable level of confidence that the meter type tested is free from serious design errors and material flaws that may prevent it from maintaining its specified accuracy for the period of use estimated by the manufacturer.

NOTE For this estimation, the acceleration factor determined according to IEC 62059-31 can be used.

5 Initial measurements

The percentage error of the MUT shall be measured – using the test output of the MUT and appropriate test equipment – at the following test points:

- value of voltage: U_n;
- value of current for direct connected meters: 0,1 I_b, I_b and I_{max};
- value of current for transformer operated meters: 0,05 I_n, I_n and I_{max};
- value of power factor for meters for active energy: cos φ = 1 and cos φ = 0,5 inductive;
- value of power factor for meters for reactive energy: sin φ = 1 and sin φ = 0,5 inductive.

The accuracy test conditions shall be as specified in the relevant type test standard.

6 Conditioning

The MUT shall be exposed to the elevated temperature according to IEC 60068-2-2 as follows:

- test Be: dry heat for heat-dissipating specimens with gradual change of temperature that are required to be powered throughout the test;
- air velocity: low preferred (see IEC 60068-2-2, 4.2);
- temperature: the upper limit of the operating temperature range specified by the manufacturer;
- duration of the test: 1 000 h;

- MUT in operating conditions, with test load:
  - value of voltage: 1,1 U_n. If the meter is intended for several reference voltages, then the highest reference voltage shall be taken into account;
  - value of current: I_{max};
  - value of power factor:
    - for meters for active energy cos φ = 1;
    - for meters for reactive energy sin φ = 1;
    - if the meter measures both active and reactive energy, then the value of the power factor shall be cos φ = 0,866 (sin φ = 0,5) inductive.

The tolerance of the voltage, current, power factor and the load that should be maintained depends on the method chosen to verify energy measurement and registration; see 7.2 and 7.3.

The MUT shall be mounted as for normal operation, with all covers and terminal covers in place. The ability of the MUT to transfer heat by thermal radiation shall be minimised. For details, see IEC 60068-2-2, 6.3.

The MUT shall be connected as specified by the manufacturer, using the cable type specified by the manufacturer. The length of the cables within the test chamber shall be 1 m each. The cross-section shall be selected so that the current density is between 3,2 A/mm^2 and 4 A/mm^2. If this would result in a cable with a cross-section of less than 1,5 mm^2, then a cable with a cross-section of 1,5 mm^2 shall be used.

In the case when the MUT is fitted with a load switch or when it is fitted with an overcurrent tripping device or residual current device, such devices shall be disabled for this test. It shall be confirmed that it is possible to calculate the energy consumption during the test using the meter register.

NOTE 1 The instructions of the manufacturer should be followed.

NOTE 2 The reason for this requirement is that for example in the case of pre-payment meters, a test running for 1 000 h would require huge amounts of credit. An overcurrent load switch might trip when tested for long periods at I_{max}.

The MUT is introduced into the chamber, which is at the temperature of the laboratory. The load specified above is then applied, and the meter is checked to ascertain whether it is capable of functioning in accordance with the relevant specification.

If necessary, a test shall be performed to determine if the test facility fulfils the requirements of a low air velocity chamber or not. See IEC 60068-2-2, 4.2.

The temperature is then adjusted to the test temperature. The rate of change of the temperature within the test chamber shall not exceed 1 K per minute, averaged over a period of not more than 5 min.

After temperature stability of the MUT has been reached, it is exposed to the conditions specified above for the specified duration.

NOTE 3 Temperature stability is reached, when the variation of percentage error at I_{max} during 20 min does not exceed 1/5th of the limit of percentage error at reference conditions, specified in the relevant standard. This may be determined using the test output and a reference standard meter, or by applying a stable load and measuring the frequency of the test output pulse stream.

7 Intermediate measurements – verification of energy measurement and registration

7.1 General

During the conditioning, it shall be verified that the MUT does not exhibit any irregular behaviour in energy measurement and registration.

NOTE 1 Examples of irregular behaviour are significant negative or positive measurement errors, mechanical register jamming, LCD failure and the like.

To verify this, the percentage error of the energy registration shall be determined at the test load, using the following formula:

$$percentage\ error = \frac{energy\ registered\ by\ the\ meter - true\ energy}{true\ energy} \times 100$$

The energy registered by the meter during a given interval is read from the register of the MUT.

The true energy is determined using one of the following methods:

- Method A: using a reference meter. In this case, the true energy is read from the register of a reference meter. For the test method and the relevant limits of percentage error, see 7.2.
- Method B: using a stable load. In this case, the true energy is calculated by multiplying the test load with the length of the interval between two readings. For the test method and the relevant limits of percentage error, see 7.3.

The percentage error shall be calculated at least at the end of the test, and preferably at regular intervals.

NOTE 2 Checking the accuracy at regular intervals facilitates an early discovery of any irregular behaviour.

7.2 Method A: Test method using a reference meter

7.2.1 Test conditions

In this case, a reference meter is installed outside the test chamber, exposed to the same load as the MUT. The true energy is determined by reading this reference meter.

The test conditions shall be the following:

- voltage: 1,1 U_n + 2 % …- 5 %;
- voltage balance (in the case of polyphase meters): ± 2 %;
- current: I_{max} + 2 % …- 5 %;
- current balance (in the case of polyphase meters): ± 4 %;
- phase displacement of each phase current from the corresponding phase-to-neutral voltage irrespective of the phase angle: 4°;
- power factor: corresponding to ± 4°;
- overall tolerance of the test load: ± 5 %;
- the laboratory temperature shall be 23 °C ± 2 °C.

NOTE As with this test method the variation of the load may cause only secondary effects, the tolerances compared to the usual accuracy test conditions have been relaxed and do not require a high precision test bench.

7.2.2 Test using a reference standard meter

In this case, a reference standard meter shall be used.

NOTE The measurement errors of this meter should be negligible compared to the error limits of the MUT.

The limit of the percentage error, calculated using the formula in 7.1 is:

$$e_{max} = 2\sqrt{e_o^2 + e_U^2 + e_T^2}$$

where:

- e_o is the limit of the percentage error at the test load and at the reference conditions;
- e_U is the limit of variation in percentage error due to voltage variation;
- e_T is the limit of variation in percentage error due to temperature variation,

specified in the relevant type test standard.

If the meter is for active and reactive energy, then the test, as specified in Clause 6, shall be performed at cos φ = 0,866 (sin φ = 0,5) inductive. For the values of e_o, e_U and e_T, the values relevant for cos φ = 0,5 and sin φ = 0,5 shall be taken into account.

If the percentage error exceeds e_{max}, this indicates that the behaviour of the MUT is irregular. The MUT failed and the test can be terminated.

EXAMPLE

– the MUT is a static meter for active energy, of accuracy class 2. The reference temperature is + 23 °C. The upper limit of the operating temperature range is + 55 °C;

– according to IEC 62053-21, at the test load:
  - the limit of the percentage error is ± 2 %;
  - the limit of the variation in percentage error due to voltage variation is ± 1 %;
  - the limit of the variation in percentage error due to temperature variation is ± 3,2 % (0,1 % / K × 32 K);

– if the percentage error exceeds $2\sqrt{2^2 + 1^2 + 3{,}2^2} = \pm 7{,}8\%$, this indicates an irregular behaviour and the MUT failed.

7.2.3 Test using a reference meter of the same type as the MUT

In this case, the reference meter shall be of the same type and shall have the same reference values as the MUT.

NOTE 1 It is assumed, that the behaviour of the MUT and the reference meter in the presence of influence quantities and disturbances is similar.

NOTE 2 Special care should be taken to ensure that the load on the reference meter and the MUT is the same. In the case of meters, where the voltage and current circuits cannot be separated, the voltage circuits of the MUT and the reference meter should be supplied via appropriate multi-secondary voltage transformers, so that the test conditions are met.

Before the test, the percentage error of the reference meter at the test load (1,1 U_n, I_{max}) shall be determined. The absolute value of this percentage error is denoted e_r.

The limit of the percentage error, calculated using the formula in 7.1 is:

$$e_{max} = 2\sqrt{(e_o + e_r)^2 + e_T^2}$$