IEC 61557-1

Edition 3.0 2019-07

REDLINE VERSION

colour inside

Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures
Part 1: General requirements



IEC 61557-1:2019-07 RLV(en)



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Part 1: General requirements

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ELECTRICAL SAFETY IN LOW VOLTAGE DISTRIBUTION SYSTEMS UP TO 1 000 V AC AND 1 500 V DC – EQUIPMENT FOR TESTING, MEASURING OR MONITORING OF PROTECTIVE MEASURES

Part 1: General requirements

FOREWORD

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This Redline version provides you with a quick and easy way to compare all the changes between this standard and its previous edition. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

International Standard IEC 61557-1 has been prepared by technical committee 85: Measuring equipment for electrical and electromagnetic quantities.

This third edition cancels and replaces the second edition published in 2007. This edition constitutes a technical revision.

This third edition includes the following significant technical changes with respect to the previous edition:

a) terms aligned with IEC 60050;
b) measurement of uncertainty revised according to the equations in 4.2 of ISO/IEC Guide 98-3:2008 (GUM);
c) updated references for safety and EMC requirements;
d) updated references for marking and operating instructions;
e) updated references for testing safety and EMC;
f) Annex A contains an explanation of GUM;
g) Annex B addresses environmental aspects.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
85/689/FDIS	85/692/RVD

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

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

A list of all parts in the IEC 61557 series, published under the general title *Electrical safety in low voltage distribution systems up to 1 000 V AC and 1 500 V DC – Equipment for testing, measuring or monitoring of protective measures*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://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.

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INTRODUCTION

IEC 60364-6~~:2006,~~ stipulates standardized conditions for the initial test of power installations in TN, TT or IT ~~(IEC 60364)~~ systems for continuous monitoring and for testing these installations after modifications. In addition to general references for the ~~execution~~ performance of the tests, IEC 60364-6 contains requirements that have to be verified by measurements. Only in a few instances, for example when measuring the insulation resistance, ~~the standard contains~~ does IEC 60364-6 contain details of the characteristics of the measuring device to be used. Circuits which are given as examples in IEC 60364-6, and referred to within the text of that document, are generally not suitable for practical use.

The tests are carried out in installations where hazardous voltages can occur and where careless use or a defect in the equipment can easily cause an accident. Therefore, the technician has to rely on measuring devices which ensure~~, apart from simplification of the measurements,~~ safe test methods, in addition to simplifying the measurements.

The application of the general safety regulations for electrical and electronic measuring devices (IEC 61010-1) for testing the protective measures is not sufficient in itself. The ~~execution~~ performance of measurements in the installation can cause hazards not only to the technician, but also to third persons, depending on the measuring method~~, also to third persons~~ used.

Likewise, reliable and comparable results of measurement with measuring devices from different manufacturers are an important precondition in order to obtain an objective ~~judgement~~ assessment about the installation, for example when the installation is handed over for periodic tests, for continuous insulation monitoring or in the case of performance warranty.

The IEC 61557 series has been established with the aim of stipulating common principles for measuring and monitoring equipment for testing electrical safety and measuring performances in systems with nominal voltages up to 1 000 V AC and 1 500 V DC which correspond to the above-mentioned characteristics.

For that reason, the following common ~~specifications~~ requirements have been stipulated in ~~Part 1 and other individual parts of the series of standards~~ IEC 61557-1 (other parts of IEC 61557 can specify additional requirements or deviations):

– protection against extraneous voltages;
– class II protection (except insulation monitoring devices and insulation fault location systems);
– ~~specifications~~ requirements and safety precautions against hazardous touch voltages at the measuring device;
– ~~specifications~~ requirements for the ~~judgement~~ assessment of connection configurations with respect to wiring errors in the tested equipment;
– special mechanical requirements;
– measuring methods;
– measured quantity;
– specification of the maximum operating uncertainty;
– ~~specifications~~ requirements for testing the influencing quantity and the calculation of the ~~operational~~ operating uncertainty;
– uncertainties of the measuring device at the thresholds specified in the respective standards;
– specification of the nature of type and routine tests and the required conditions for testing.

Contrary to the usual convention, terms and definitions that occur more than once in another part of the series are listed in IEC 61557-1:2019, Clause 3. Only terms and definitions specific to the respective part of IEC 61557 are listed in Clause 3 of that part.

ELECTRICAL SAFETY IN LOW VOLTAGE DISTRIBUTION SYSTEMS UP TO 1 000 V AC AND 1 500 V DC – EQUIPMENT FOR TESTING, MEASURING OR MONITORING OF PROTECTIVE MEASURES

Part 1: General requirements

1 Scope

This part of IEC 61557 specifies the general requirements ~~for~~ applicable to measuring and monitoring equipment for testing the electrical safety in low-voltage distribution systems with nominal voltages up to 1 000 V AC and 1 500 V DC.

When measuring equipment or measuring installations involve measurement tasks of various measuring equipment covered by this series of standards, then the part of this series relevant to each of the measurement tasks is applicable.

NOTE The term "measuring equipment" will hereafter be used to designate "testing, measuring and monitoring equipment".

Other parts of IEC 61557 can specify additional requirements or deviations.

This document does not cover functional safety or cybersecurity.

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.

IEC 60038:~~1983~~ [1)] 2009, *IEC standard voltages*
~~Amendment 1: 1994~~
~~Amendment 2: 1997~~

~~IEC 60364-6:2006, *Electrical installations of buildings – Part 6: Verification*~~

~~IEC 60664-1, *Insulation coordination for equipment within low-voltage systems - Part 1: Principles, requirements and tests*~~

IEC 60529: ~~2001~~1989, *Degrees of protection provided by enclosures (IP code)*
IEC 60529:1989/AMD1:1999
IEC 60529:1989/AMD2:2013[2]

IEC 61010-1:~~2001~~2010, *Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements*
IEC 61010-1:2010/AMD1:2016[3]

~~1)~~ ~~There exists a consolidated edition (6.2), which includes IEC 60038:1983 and its Amendments 1 (1994) and 2 (1997).~~

2 A consolidated version of this publication exists, comprising IEC 60529:1989, IEC 60529:1989/AMD1:1999 and IEC 60529:1989/AMD2:2013.

IEC 61010-031, *Safety requirements for electrical equipment for measurement, control and laboratory use – Part 031: Safety requirements for hand-held and hand-manipulated assemblies for electrical test and measurement*

IEC 61010-2-030:2017, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 2-030: ~~Special~~ Particular requirements for equipment having testing ~~and~~ or measuring circuits*~~4)~~

IEC 61010-2-032, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 2-032: Particular requirements for hand-held and hand-manipulated current sensors for electrical test and measurement*

IEC 61010-2-034:2017, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 2-034: Particular requirements for measurement equipment for insulation resistance and test equipment for electric strength*

IEC 61326-1:2012, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements*

~~IEC 61326-2-2:2005, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 2-2: Particular requirements – Test configurations, operational conditions and performance criteria for portable test, measuring and monitoring equipment used in low-voltage distribution systems*~~

~~IEC 61326-2-4:2006, *Electrical equipment for measurement, control and laboratory use, - EMC requirements - Part 2: Particular requirements – Test configurations, operational conditions and performance criteria for insulation monitoring devices according to IEC 61557-8 and for equipment for insulation fault location according to IEC 61557-9*~~

~~IEC 61557-2, *Electrical safety in low voltage distribution systems up to 1000 V a.c. and 1500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 2: Insulation resistance*~~

~~IEC 61557-3, *Electrical safety in low voltage distribution systems up to 1000 V a.c. and 1500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 3: Loop impedance*~~

~~IEC 61557-4, *Electrical safety in low voltage distribution systems up to 1000 V a.c. and 1500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 4: Resistance of earth connection and equipotential bonding*~~

~~IEC 61557-5, *Electrical safety in low voltage distribution systems up to 1000 V a.c. and 1500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 5: Resistance to earth*~~

~~IEC 61557-6, *Electrical safety in low voltage distribution systems up to 1000 V a.c. and 1500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 6: Residual current devices (RCD) in TT and TN systems*~~

~~IEC 61557-7, *Electrical safety in low voltage distribution systems up to 1000 V a.c. and 1500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 7: Phase sequence*~~

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3 A consolidated version of this publication exists, comprising IEC 61010-1:2010 and IEC 61010-1:2010/AMD 1:2016.

~~4) To be published.~~

IEC 61557-8:2014, *Electrical safety in low voltage distribution systems up to 1 000 V AC and 1 500 V DC – Equipment for testing, measuring or monitoring of protective measures – Part 8: Insulation monitoring devices for IT systems*

IEC 61557-9:2014, *Electrical safety in low voltage distribution systems up to 1 000 V AC and 1 500 V DC – Equipment for testing, measuring or monitoring of protective measures – Part 9: Equipment for insulation fault location in IT systems*

~~IEC 61557-10, *Electrical safety in low voltage distribution systems up to 1000 V a.c. and 1500 V d.c. – Equipment for testing, measuring or monitoring of protective measures – Part 10: Combined measuring equipment for testing, measuring or monitoring of protective measures*~~

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
nominal system voltage ~~of the distribution system~~
U_n
value of the voltage by which the distribution system ~~or equipment~~ is designated and to which certain ~~operating~~ characteristics are ~~referred~~ assigned

~~[IEC 60038, Clause 1, modified]~~

~~**3.2**~~
~~**operating voltage in a system**~~
~~the value of the voltage under normal conditions, at a given instant and a given point of the system~~

~~[IEV 601-01-22, modified]~~

3.2
voltage against earth
U_o
<in distribution systems with an earthed neutral point> voltage between a phase conductor and the earthed neutral point

3.3
voltage against earth
U_o
<in all other distribution systems> voltage present between the remaining phase conductors and earth when one of the phase conductors is ~~shorted~~ short-circuited to earth

3.4
fault voltage
U_f
~~voltage appearing under fault conditions between exposed conductive parts (and/or extraneous conductive parts) and earth~~
voltage between a given point of fault and reference earth resulting from an insulation fault

[SOURCE: IEC 60050-826:2004, 826-11-02, modified – The symbol has been added.]

3.5
~~(~~effective~~)~~ touch voltage
U_t
voltage between conductive parts when touched simultaneously by a person or an animal

Note 1 to entry: The value of the effective touch voltage may be appreciably influenced by the impedance of the person or the animal in electric contact with these conductive parts.

~~[IEV 826-11-05]~~

[SOURCE: IEC 60050-195:1998, 195-05-11, modified – The symbol has been added.]

3.6
conventional touch voltage limit
U_L
maximum value of the touch voltage which is permitted to be maintained indefinitely in specified conditions of external influences and is usually equal to 50 V AC, RMS or 120 V ripple free DC

~~[IEV 826-02-04, modified]~~

[SOURCE: IEC 60050-826:2004, 826-11-04, modified – "prospective" has been omitted from the term and from the definition and values for the limit have been added to the definition; the symbol has been added.]

~~**3.7**~~
~~**rated range of voltages**~~
~~voltage range for which the measuring and monitoring equipment is intended to be used and for which it has been designed~~

3.7
supply voltage
voltage that is used to power the measurement equipment

Note 1 to entry: If a supply voltage is specified, for instance in the supply contract, then it is called "declared supply voltage".

3.8
rated supply voltage
U_S
value of the supply voltage at a point where the measuring equipment does or can accept electric energy as a supply

3.9
output voltage
U_a
voltage across the measuring equipment terminals where this equipment does or can output electric energy

3.10
open-circuit voltage
U_q
voltage present across unloaded terminals on the measuring equipment

~~**3.11**~~
~~**rated voltage of measuring equipment**~~
~~U_{ME}~~
~~voltage for which the measuring equipment is intended to be used and the value of which is marked on the equipment~~

3.11
rated voltage
U_N
voltage value assigned by a manufacturer or other entity for a specified operating condition of the measuring equipment

Note 1 to entry: The value for the rated voltage of low-voltage equipment is generally assigned from the list of nominal voltages in IEC 60038:2009, Tables 1 and 6.

Note 2 to entry: Equipment may have more than one rated voltage value or may have a rated voltage range.

[SOURCE: IEC 60050-614:2016, 614-03-09, modified – The domain <of equipment> and Note 1 have been omitted; the symbol has been added; the term specifically adapted for measuring equipment.]

3.12
extraneous voltage
external voltage to which the measuring equipment can be subjected ~~by external influences~~ during measurement. ~~This is not required for the operation of the measuring equipment, but can interfere with its operation~~

3.13
rated current
I_N
~~current of the measuring equipment under rated conditions~~
current assigned by the manufacturer for the specified operating condition of the measuring equipment

Note 1 to entry: The specified operating condition is a value (or values) within the rated operating conditions that are designated by the manufacturer.

[SOURCE: IEC 60050-442:1998, 442-01-02, modified – "for accessories" has been deleted from the term and Note 1 has been added; the definition has been adapted for application to measuring equipment.]

3.14
short-circuit current
~~I_k~~
~~current flowing across the short-circuited terminals of the measuring equipment~~
over-current resulting from a short circuit due to a fault on the terminals or within the measuring equipment

3.15
rated frequency
f_N
frequency for which the measuring equipment is intended to be used and for which it has been designed

~~**3.16**~~
~~**earth**~~
~~the conductive mass of the earth whose electric potential at any point is conventionally taken as equal to zero~~

~~[IEV 826-04-01]~~

~~**3.17**~~
~~**earth electrode**~~
~~a conductive part or group of conductive parts in intimate contact with and providing an electrical connection with earth~~

~~[IEV 826-04-02]~~

~~**3.18**~~
~~**total earthing resistance**~~
~~R_A~~
~~the resistance between the main earthing terminal and the earth~~

~~[IEV 826-04-03]~~

~~**3.19**~~
~~**percentage fiducial uncertainty**~~
~~(absolute) uncertainty of measuring equipment expressed as a percentage of the fiducial value (see 3.26)~~

3.16
uncertainty of measurement
parameter, associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand

Note 1 to entry: This term is used in the "uncertainty" approach.

Note 2 to entry: The parameter can be, for example, a standard deviation (or a given multiple of it), or a half-width of an interval having a stated level of confidence. Various ways of obtaining uncertainty are defined in the GUM.

Note 3 to entry: Uncertainty of measurement comprises, in general, many components. Some of these components can be evaluated from the statistical distribution of the results of a series of measurements and can be characterized by experimental standard deviations. The other components, which can also be characterized by standard deviations, are evaluated from the assumed probability distributions based on experience or other information.

[SOURCE: IEC 60050-311:2001, 311-01-02]

3.17
operating uncertainty
calculated uncertainty taking into account the intrinsic uncertainty and defined influence quantities to mirror the worst case situation

3.18
fiducial uncertainty
uncertainty of measuring equipment expressed as a percentage of the fiducial value

3.19
fiducial value
clearly specified value to which reference is made in order to define the fiducial uncertainty

~~[IEV 311-01-16, modified]~~

Note 1 to entry: This value can be, for example, the upper limit of the measuring range, the scale length or any other value which is clearly stated.

[SOURCE: IEC 60050-311:2001, 311-01-16, modified – "error" has been replaced by "uncertainty"; Note 1 has been omitted.]

~~**3.21**~~
~~**operating instrumental uncertainty**~~
~~instrumental uncertainty under the rated operating conditions~~

~~[IEC 60359, definition 3.2.11]~~

~~NOTE The operating uncertainty will have an extreme value (without regard to sign) at some combination of values of influence quantities within their operating ranges.~~

3.20
percentage operating uncertainty
operating uncertainty of measuring equipment expressed as a percentage of the fiducial value

3.21
intrinsic uncertainty
uncertainty of a measuring instrument or supply instrument when used under reference conditions

Note 1 to entry: The uncertainty caused by friction is part of the intrinsic uncertainty.

~~[IEC 60359, definition 3.2.10]~~

[SOURCE: IEC 60050-311:2001, 311-03-09, modified – "or supply instrument" has been added to the definition; the Note has been deleted and Note 1 has been added.]

3.22
performance
characteristics defining the ability of a measuring instrument to achieve the intended functions

[SOURCE: IEC 60050-311:2001, 311-06-11]

~~**3.23**~~
~~**performance characteristic**~~
~~one of the quantities (described by values, tolerances, ranges) assigned to an equipment in order to define its performance~~

~~NOTE Depending on its application, one and the same quantity may be referred to in this standard as a "performance characteristic" and as a "measured or supplied quantity" and also may act as an "influence quantity".~~

~~In addition, the term "performance characteristic" includes quotients of quantities, such as voltage per unit of length.~~

3.23
influence quantity
~~quantity which is not the subject of the measurement and whose change affects the realationship between the indication and the result of the measurement~~

~~[IEC 60359, definition 3.1.14]~~

~~NOTE An influence quantity may be external or internal with reference to the equipment. When the value of one of the influence quantities changes within its measuring range, it may affect the uncertainty due to another. The measured quantity or a parameter of it may itself act as an influence quantity. For example, for a voltmeter the value of the measured voltage may produce an additional uncertainty due to non-linearity or its frequency may also cause an additional uncertainty.~~

quantity which is not the subject of the measurement and whose change affects the result of the measurement

Note 1 to entry: This term is used in the "uncertainty" approach.

Note 2 to entry: Influence quantities can originate from the measured system, the measuring equipment or the environment.

Note 3 to entry: As the calibration diagram depends on the influence quantities, in order to assign the result of a measurement it is necessary to know whether the relevant influence quantities lie within the specified range.

Note 4 to entry: An influence quantity may be external or internal with reference to the equipment. When the value of one of the influence quantities changes within its measuring range, it may affect the uncertainty due to another quantity. The measured quantity, or a parameter of it, may itself act as an influence quantity. For example, for a voltmeter, the value of the measured voltage may produce an additional uncertainty due to non-linearity or its frequency may also cause an additional uncertainty.

[SOURCE: IEC 60050-311:2001, 311-06-01, modified – "the relationship between the indication and" has been deleted from the definition; Note 4 has been added.]

3.24
variation
<due to an influence quantity> difference between the indicated values for the same value of the measurand of an indicating measuring instrument, or the values of a material measure, when an influence quantity assumes, successively, two different values

~~[IEC 60359, definition 3.3.5]~~

[SOURCE: IEC 60050-311:2001, 311-07-03]

3.25
reference conditions
~~appropriate~~ set of specified values and/or ranges of values of influence quantities under which the~~ smallest permissible~~ uncertainties~~ of~~, or limits of error, admissible for a measuring instrument are specified

~~[IEC 60359, definition 3.3.10]~~

[SOURCE: IEC 60050-311:2001, 311-06-02, modified – "are the smallest" has been replaced with "are specified".]

3.26
operating condition
characteristic which may affect performance of a component, device or equipment

Note 1 to entry: Examples of operating conditions are ambient conditions, characteristics of the power supply, duty cycle or duty type.

[SOURCE: IEC 60050-151:2001, 151-16-01]

3.27
rated operating conditions
~~set of conditions that must be fulfilled during the measurement in order that a calibration diagram may be valid~~
specified set of conditions which may affect the performance of a measuring device and under which the operating uncertainty is maintained

~~[IEC 60359, definition 3.3.13]~~

3.28
~~**rated**~~ **measuring voltage**
U_m
voltage present at the measuring terminals during the measurement

3.29
uncertainty of measuring equipment
uncertainty of the result of a direct measurement of a measurand having negligible intrinsic uncertainty

Note 1 to entry: Unless explicitly stated otherwise, the measuring equipment uncertainty is expressed as an interval with coverage factor 2.

Note 2 to entry: In single-reading direct measurements of measurands having low intrinsic uncertainty with respect to the measuring equipment uncertainty, the uncertainty of the measurement coincides, by definition, with the measuring equipment uncertainty. Otherwise the measuring equipment uncertainty is to be treated as a component of category B in evaluating the uncertainty of the measurement on the basis of the model connecting the several direct measurements involved.

Note 3 to entry: The measuring equipment uncertainty automatically includes, by definition, the effects due to the quantization of the reading values (minimum evaluable fraction of the scale interval in analogic outputs, unit of the last stable digit in digital outputs).

Note 4 to entry: For material measures, the measuring equipment uncertainty is the uncertainty that should be associated to the value of the quantity reproduced by the material measure in order to ensure the compatibility of the results of its measurements.

~~**3.28**~~
~~**specified operating range**~~
~~range of values of a single influence quantity which forms a part of the rated operating conditions (see 3.31)~~

~~**3.29**~~
~~**effect of the supply voltage**~~
~~effect influencing the functioning of measuring equipment, and consequently the measured value produced by it~~

~~**3.30**~~
~~**effects of the distribution system voltage**~~
~~effect influencing the operation and, consequently, the measured value produced by it~~

4 Requirements

4.1 General requirements

Measuring equipment, when used for a designated purpose, shall not endanger persons, livestock or property. Furthermore, measuring equipment with additional functions not forming part of the application of the IEC 61557 series shall also not endanger persons, livestock or property.

~~Measuring equipment shall comply with IEC 61010-1 provided nothing to the contrary is specified hereafter.~~

~~If the measuring equipment indicates the voltage conditions at its measuring terminals, it must also indicate if the system voltage exists and if the live conductor is exchanged with the protective conductor.~~

4.2 Influence quantities – Operating uncertainty (B), percentage operating uncertainty (B [%])

The operating uncertainty shall be calculated by means of Equation 1:

~~$$B = \pm\left(|A| + 1{,}15 \times \sqrt{\sum_{i=1}^{N} E_i^2}\right)$$~~

$$B = \pm\sqrt{A^2 + \frac{4}{3}\sum\nolimits_i E_i^2} \qquad (1)$$

where

A is the intrinsic uncertainty;

E_i is the variation;

i is the consecutive number of the variations.

~~N is the number of influencing factors.~~

The percentage operating uncertainty shall be calculated by means of Equation 2:

$$B[\%] = \pm\frac{B}{F} \times 100\,\% \qquad (2)$$

where

F is the fiducial value.

The influencing variations used for calculating the operating uncertainty are denoted as follows:

- variation due to changing the position E_1
- variation due to changing the supply voltage E_2
- variation due to changing the temperature E_3
- variation due to interference voltages E_4
- variation due to earth electrode resistance E_5
- variation due to changing the phase angle of impedance of circuit under test E_6
  - variation due to system phase angle 0° to 18° (use as applicable) $E_{6.1}$
  - variation due to system phase angle 0° to 30° (use as applicable) $E_{6.2}$
- variation due to changing the system frequency E_7
- variation due to changing the system voltage E_8
- variation due to system harmonics E_9
- variation due to system DC quantities E_{10}
- variation due to external low-frequency magnetic fields E_{11}
- variation due to load current E_{12}
- variation due to touch current caused by common mode voltage E_{13}
- variation due to frequency E_{14}
- variation due to repeatability E_{15}

The permissible percentage operating uncertainties are stated in other parts of IEC 61557.

~~NOTE~~ Only one of the influence quantities is varied when calculating the operating uncertainty, whilst the remaining influence quantities are kept under reference conditions. The larger of the respective values of the variation (positive and negative variation) is inserted into the equation for the calculation of the operating uncertainty.

~~Not all influence quantities are relevant to measuring equipment covered by Parts 2 to 8 of IEC 61557.~~

~~Variations measured during type tests can be used in certain cases for calculating the operating uncertainty in routine tests. Details for this are specified in the relevant parts of the IEC 61557 series.~~

4.3 Rated operating conditions

~~The stated operating uncertainties shall apply under the following rated operating conditions:~~

The following rated operating conditions shall apply, except for insulation monitoring devices (IMD) in accordance with IEC 61557-8 and for insulation fault location systems (IFLS) in accordance with IEC 61557-9:

- temperature range from 0 °C to 35 °C;
- a position of ±90° from the reference position for portable measuring equipment;
- 85 % to 110 % of the nominal supply voltage for supply from the distribution systems (if applicable). The values in IEC 60038 shall be ~~used~~ applied for a supply from the distribution system;
- the charge condition in accordance with 4.4 shall apply to the battery or batteries/ accumulators for measuring equipment with a supply from batteries/accumulators;

– the range of revolutions per minute stated by the manufacturer for measuring equipment with a supply from a hand-driven generator;

– frequency of the supply voltage ± ~~1~~ 5 % (if applicable).

NOTE Additional rated operating conditions are stated in other parts of the IEC 61557 series.

4.4 Battery ~~check~~ test facility

Measuring equipment with power supplied from dry or rechargeable battery cells shall ~~check~~ test and indicate that the state of charge of these batteries will permit measurement within the specification. This may be done automatically as part of the measurement cycle or as a separate function. ~~The battery should be loaded at least as heavily as during a measurement.~~ Where the battery test is a separate function, the test load shall be of the same level as the one appearing during a measurement.

~~**4.4 Terminals**~~

~~The terminals shall be designed so that the probe assembly can be connected to the measuring equipment reliably and accidental touching of any live parts is impossible.~~

~~In this instance, the protective conductor shall be treated as a live part, with the exception of measuring devices covered in IEC 61557-8.~~

~~**4.5 Class of protection**~~

~~Measuring equipment shall be designed with double or reinforced insulation (protection class II), with the exception of measuring devices covered in IEC 61557-8 and IEC 61557-9.~~

~~**4.6 Class of pollution**~~

~~Measuring equipment shall be designed for at least pollution class 2 in accordance with IEC 61010-1.~~

~~**4.7 Overvoltage category**~~

~~Measuring equipment covered by IEC 61557-8 and IEC 61557-9 shall be designed for at least overvoltage category III according to IEC 60664-1.~~

~~**4.8 Measuring category**~~

~~Measuring equipment covered by IEC 61557-3, IEC 61557-5, IEC 61557-6, IEC 61557-7 and IEC 61557-10 shall be designed for at least measuring category III according IEC 61010-2-030. Measuring equipment covered by IEC 61557-2, IEC 61557-4, IEC 61557-5 (battery powered) and IEC 61557-4 shall be designed for at least measuring category II.~~

4.5 Safety

Measuring and monitoring equipment shall be in accordance with IEC 61010-1, IEC 61010-2-030, IEC 61010-031, IEC 61010-2-034 and, if applicable, IEC 61010-2-032, and with the following additional requirements.

Overvoltage categories and/or measurement categories are specified in the relevant parts of IEC 61557.

Handheld measuring equipment shall fulfil the requirements for double or reinforced insulation.

The conductive parts of the terminals shall not be accessible and hazardous in connected, partially connected or unconnected conditions.

The protective conductor if used for measuring purposes shall be treated as a live part, except where a different requirement is specified in other parts of IEC 61557.

The terminals shall be designed so that the probe assembly can be connected to the measuring equipment reliably.

4.6 Electromagnetic compatibility

~~Measuring equipment covered by IEC 61557-2, IEC 61557-3, IEC 61557-4, IEC 61557-5, IEC 61557-6, IEC 61557-7 and IEC 61557-10 shall be designed according to IEC 61326-2-2.~~

~~Measuring equipment covered by IEC 61557-8 and IEC 61557-9 shall be designed according to IEC 61326-2-4.~~

4.6.1 Immunity

For immunity requirements, IEC 61326-1:2012, Table 2 shall apply. For testing, see 6.5.

4.6.2 Emission

For emissions, either class A or class B limits in accordance with IEC 61326-1:2012, 7.2 shall apply.

4.7 ~~Vibration test~~ Mechanical strength against vibration

In addition to the mechanical resistance tests in accordance with IEC 61010-1, measuring equipment shall successfully pass the following vibration conditions (type test):

– direction: three mutually perpendicular axes;
– amplitude: 1 mm;
– frequency: 25 Hz;
– duration: 20 min.

5 Marking and operating instructions

5.1 General

Marking and operating instructions shall comply with IEC 61010-1, IEC 61010-2-032, IEC 61010-2-030 and, in addition, these instructions shall comply with the requirements ~~unless otherwise~~ specified in ~~other~~ the relevant parts of IEC 61557.

5.2 Marking

The measuring equipment shall carry the following marking ~~which shall be clearly readable and indelible~~:

– type of equipment;

~~– Units of the measured quantity.~~

~~– Ranges of measurement.~~

– type and current rating of the fuse in the case of exchangeable fuses;
– type of battery/accumulator and polarity of connection in the battery compartment;
– nominal system voltage ~~of the distribution system~~ and, if applicable, the symbol for double insulation in accordance with IEC 61010-1:2010, Table 1, symbol 11 ~~for measuring equipment with distribution system power supply~~;
– manufacturer’s name or registered trade mark;

– model number, name or other means to identify the equipment (inside or outside);

– reference to the operating instructions ~~with the symbol~~  in accordance with IEC 61010-1:2010, Table 1, symbol 14.

Units of the measured quantities and ranges of measurement shall be stated on the enclosure or on the display.

5.3 Operating instructions

5.3.1 Performance requirements

The operating uncertainty, the intrinsic uncertainty and the variations E_1 to ~~E_{10}~~ E_{15} shall be provided in the operating instructions (with the exception of measuring devices covered by IEC 61557-8 and IEC 61557-9).

5.3.2 Other information

The operating instructions shall ~~comprise~~ contain the following details:

– connection diagrams;

– instructions for measurements;

– brief description of the principle of measurement;

– diagrams or tables showing the maximum permissible indicated values taking into consideration the tolerances stated by the manufacturer (if necessary);

– type of battery/rechargeable cells;

– information on the charging current, charging voltage and duration of charging for rechargeable cells;

– operational lifetime/runtime of the battery/rechargeable cells or the possible number of measurements;

– type of IP protection according to IEC 60529;

– any necessary special guidance notes.

6 Tests

6.1 General

Measuring equipment shall be tested in accordance with ~~IEC 61010-2-030 and IEC 61326-2-2 unless otherwise specified in the following subclauses or in other parts of IEC 61557 series~~ the safety standards IEC 61010-1, IEC 61010-2-030, IEC 61010-031, IEC 61010-2-034 and, if applicable, IEC 61010-2-032, and the EMC standards of IEC 61326 (all relevant parts).

All tests shall be carried out under reference conditions unless otherwise specified. The reference conditions are stated in the ~~various~~ relevant parts of IEC 61557 ~~series~~.

Tolerances are added in the relevant parts of IEC 61557.

6.2 Operating uncertainty

6.2.1 General

The operating uncertainty shall be determined according to 6.2.2 to 6.2.4.

6.2.2 Influence of changing position

The variation E_1 due to changing the position in accordance with 4.2 and 4.3, if applicable, shall be determined for positions +90° or −90° from the reference position stated by the manufacturer (routine test).

6.2.3 Influence of temperature

~~The variation E_3 due to changing the temperature in accordance with 4.2 shall be determined under the following rated operating conditions:~~

~~– at 0 °C and 35 °C after reaching a state of equilibrium (type test).~~

The variation E_3 shall be determined from the reference temperature at 0 °C and 35 °C after the device has reached a state of equilibrium (type test).

6.2.4 Influence of the supply voltage

The variation E_2 due to changing the supply voltage shall be determined under the following rated operating conditions (routine test):

– limits in accordance with 4.3 for measuring equipment supplied from distribution systems;

– limits in accordance with 4.4 and 6.3 for measuring equipment supplied from a battery/accumulator;

– limits in accordance with 4.3 for measuring equipment supplied by a hand-driven generator.

6.3 Battery ~~check~~ test facility

The lower and upper limits for the battery voltage to which the battery ~~check~~ test facility in accordance with 4.4 is set, shall be determined by means of an external voltage source. These values shall be used during the test in accordance with 6.2.4 as limits for variation E_2 by changing the supply voltage (routine test).

6.4 Safety tests

Compliance with 4.5 shall be tested (type test).

6.5 EMC tests

For the electromagnetic radio frequency field (RF) and conducted RF the following requirements apply:

– the auxiliary circuits of the measuring equipment shall be energised with the rated voltage;

– the measuring equipment shall be tested in its operating conditions.

~~6.5 Protection class~~

~~Compliance with double or reinforced insulation (protection class II) in accordance with 4.5 shall be checked, with the exception of measuring devices covered by IEC 61557-8 and IEC 61557-9 *(type test)*.~~

~~6.6 Terminals~~

~~Terminals in accordance with 4.4 shall be checked for protection against accidental contact with live parts *(type test)*.~~

6.6 Mechanical requirements

The test shall be ~~executed~~ performed in accordance with 4.7 (type test).

The tests are deemed to have been passed successfully when no parts have become loose or bent and the connecting leads are not damaged. After the process, the measuring equipment shall comply with the requirements ~~with respect to operating uncertainty in accordance with 4.1 *(type test)*~~ for intrinsic uncertainty of the equipment (type test), if applicable.

6.7 Marking and operating instructions

~~The marking and the operating instructions in accordance with Clause 5 of Parts 1 to 10 of the IEC 61557 series shall be checked by visual inspection *(type test, except correct marking as routine test).*~~

The marking and the operating instructions shall be confirmed by visual inspection (type test).

The marking shall be inspected during type test and routine test.

6.8 Records

Compliance with the tests in Clause 6 shall be recorded.

Annex A
(informative)

Explanation of the application of GUM in series IEC 61557

A.1 Overview

The operating uncertainty is a predictive parameter characterizing the expanded uncertainty of the results generated by the measuring device under defined operational conditions.

The operating uncertainty forms an upper limit of the expanded uncertainty which can be expected if the device is operated within the defined operational conditions.

The operating uncertainty might be used to characterize results generated by the device if the device is used within defined operational conditions.

When possible and convenient, the uncertainty may be expressed in the relative form or in the fiducial form. The relative uncertainty is the ratio U/V of the absolute uncertainty U to the measure value V, and the fiducial uncertainty is the ratio U/V_{f} of the absolute uncertainty U to a conventionally chosen value V_{f}.

The principles of the GUM (ISO/IEC Guide 98-3:2008) are used to calculate the operating uncertainty.

A.2 Basic model of evaluation of results under operational conditions

A.2.1 General

The basic model for the evaluation of the results under operational conditions is:

$$Y_{\mathrm{oper}} = Y_{\mathrm{ref}} + \sum_i \delta E_i$$

The result under reference conditions Y_{ref} is the result which could be generated under reference (calibration) conditions. The uncertainty $u(Y_{\mathrm{ref}})$ is evaluated during calibration.

The deviations δE_i are derived from the operational conditions. Usually the expectation value of the δE_i is zero and some limits are known.

A.2.2 Standard uncertainty of a result

The standard uncertainty of a result under operational conditions $u(Y_{\mathrm{oper}})$ can be calculated using uncertainty propagation. The sensitivity of all input quantities is equal to 1.

$$u\left(Y_{\mathrm{oper}}\right) = \sqrt{u\left(Y_{\mathrm{ref}}\right)^2 + \sum_i u\left(\delta E_i\right)^2}$$

The standard uncertainty under reference conditions is equal to the expanded uncertainty evaluated during calibration divided by the coverage factor:

$$u\left(Y_{\mathrm{ref}}\right) = \frac{U_{\mathrm{cal}}\left(Y\right)}{k_{\mathrm{cal}}}$$

A.2.3 Expanded uncertainty

The expanded uncertainty of the calibration $U_{\text{cal}}(Y)$ and the coverage factor k_{cal} (usually equal to 2) are stated in the calibration certificate.

For the deviations δE_i, usually only some limits symmetric to zero are known. According to GUM, limits can be converted to a standard uncertainty with the use of a rectangular distribution:

$$u\left(\delta E_i\right) = \frac{e_i}{\sqrt{3}}$$

The e_i is the half width of the limits characterizing the deviation δE_i.

The operating uncertainty is equal to the standard uncertainty under operational conditions multiplied by the operating coverage factor:

$$U\left(Y_{\text{oper}}\right) = k_{\text{oper}} \times u\left(Y_{\text{oper}}\right)$$

The operating coverage factor k_{oper} is fixed to 2,0.

This is equivalent to the half width of coverage interval with a coverage probability of 95,45 % under the assumption that the results are distributed normally.

A.2.4 Relative operating uncertainty

The relative operating uncertainty as a percentage can be calculated using a fiducial value Y_{f}.

$$W\left(Y_{\text{oper}}\right) = \frac{U\left(Y_{\text{oper}}\right)}{Y_{\text{f}}} \times 100\,\%$$

The operating uncertainty and the relative operating uncertainty as a percentage can be written as symmetric interval limits using plus and minus signs.

A.2.5 Calibration uncertainty

For practical calculations, the calibration uncertainty $U_{\text{cal}}(Y)$ may be replaced by A, and e_i, by E_i. The resulting equation is:

$$U\left(Y_{\text{oper}}\right) = \sqrt{A^2 + \frac{4}{3}\sum_i E_i^2} \le |A| + 1{,}5 \times \sqrt{\sum_i E_i^2}$$

under the assumption that the coverage factor k_{cal} stated in the calibration certificate is equal to the operating coverage factor k_{oper} = 2,0.

Therefore the following equation may be used as an upper bound for the operating coverage interval:

$$B = \pm\left[\left|A\right| + 1{,}15 \times \sqrt{\sum_i E_i^{\,2}}\right]$$

A.3 Operating uncertainty calculations as basis for 4.1

A.3.1 Standard uncertainty

The basis for this model is the addition of faults.

Uncertainty in respect to GUM (ISO/IEC Guide 98-1:2009, measuring method B) for any statistical distribution:

$$u = \sqrt{a^2 + \sum_i e_i^{\,2}}$$

where

a is the expected intrinsic operating uncertainty for example by calibration certificates;

e_i $e_i =$ is the expected operating uncertainty by influencing factors for example through temperature;

u is the standard uncertainty of the result of a measurement expressed as a standard deviation.

A.3.2 Operating uncertainty in accordance with 4.1

The basis for this model of calculation is the expanded uncertainty according to GUM (ISO/IEC Guide 98-3:2008, 6.2).

Determination of the operating uncertainty for the IEC 61557 series with stipulation of the defined statistical distributions based on empirical values:

– $B = \pm\, k \times u$ with $k = 2$ for coverage probability of 95,45 %;

– $a = \dfrac{A}{2}$ standard distribution for the intrinsic uncertainty;

– $e_i = \dfrac{E_i}{\sqrt{3}}$ rectangular distribution for the operating uncertainty through influence factors in the operation;

– $B = \pm\sqrt{A^2 + \frac{4}{3}\sum_i E_i^2}$ uncertainty for coverage probability of 95,45 % according to GUM, (ISO/IEC Guide 98-3:2008, 7.22).

Annex B
(informative)

Environmental aspects

B.1 Overview

Every product has an effect on the environment, which may occur at any or all stages of its life cycle – raw-material acquisition, manufacture, distribution, use, maintenance, re-use and end-of-life. These effects may range from slight to significant; they may be short term or long term, and they may occur at the local, national, regional or global level (or a combination thereof).

The widespread use of electrical and electronic products has drawn increased awareness to their environmental impacts. As a result, legislation, as well as market-driven requirements for environmentally conscious design, is emerging.

The continuous introduction of new products and materials can make evaluation increasingly complex, since additional data will need to be gathered to assess the life-cycle impacts of such new products and materials. The gathered data is used as a basis for improvement of the products with respect to environmental impacts. Life-cycle assessment (LCA) and environmentally conscious design (ECD) principles provide instruments that may be useful in this respect.

The application of LCA to an ECD process allows the reduction of adverse environmental impacts of a product throughout its entire life cycle. This can involve balancing the environmental aspects of the product with other factors, such as its intended use, performance, cost, safety, marketability, and quality and choosing methods to meet legal and regulatory requirements in an environmentally conscious way. In striving for this goal, multiple benefits can be achieved for the organization, its customers and other stakeholders. The consideration of environmental aspects particularly in the very early stage of the product design process can contribute to cost reduction and to better marketability. Environmentally conscious design is not a separate design activity; rather it is an integral part of the existing design process. The design in this context includes the activities associated with the processes of product planning, development and decision making as well as the creation of policies within the organization.

ECD is intended to be used by all those involved in the design and development of electrical and electronic products. This includes all parties in the supply chain regardless of organization type, size, location and complexity. It is applicable for all types of products, new as well as modified. Sector-specific documents may be developed to address needs not covered in this document. The use of this annex as a base reference is encouraged so as to ensure consistency throughout the electrotechnical sector.

This annex provides a set of guidelines to establish the material declaration and the end-of-life information in the general framework of the information that shall be shared according to IEC 62430.

B.2 Guidelines to establish a material declaration and end-of-life information

B.2.1 General

Manufacturers are increasingly requested to provide a material declaration and end-of-life information in accordance with regulations or in the form of labels, or they are asked directly by their customers to communicate and declare information about the material composition of their products. The main intended uses of this information are to:

– enable assessment of product compliance with substance-restriction requirements;
– improve product end-of-life by facilitating integration in the appropriate recycling processes.

Providing the material declaration is at the discretion of the manufacturer.

NOTE Since IEC 62474 is intended to establish requirements for material declarations, standardize protocols, and facilitate transfer and processing of data, it is possible that its application throughout the supply chain will make the compilation of material declarations of products easier.

B.2.2 Guidelines for material declaration

The material declaration should be made in accordance with IEC 62474 and contain the two following sections as a minimum.

– Base data requirements:
  - product family name;
  - product identification: commercial references covered by the declaration;
  - total product mass;
  - mass and type of batteries, if integrated;
  - mass of packaging.
– Material class information:
  - distribution of the product mass according to the 15 generic material classes as defined in the IEC 62474 database.

NOTE Examples of material declarations are given in IEC 62474.

Single-material declarations can be made for a family of products only when the composition is the same for all the products thereof.

B.2.3 Guidelines for end-of-life (EoL)

Different regulations (for waste electrical and electronic equipment, batteries, packaging), incentives on circular economy or customers require or push the design of products that are easily recyclable.

If required, the end-of-life information (EoLI) should be prepared in accordance with IEC TR 62635 and should contain the following as a minimum:

– manufacturer identification;
– product identification;
– potential hazard identification;
– selective treatment;
– sketches, drawings or pictures to identify and locate parts and materials listed.

B.2.4 Example of a material declaration and end-of-life information

B.2.4.1 Manufacturer identification

Address: xxxxxxxxxxxxxxxxxx

Website: xxxxxxxxxxxxxxxxxx

B.2.4.2 Product identification

Range: multifunction meter xxxxxx

Commercial references: xxxxxx, xxxxx, xxxxxx, etc.

B.2.4.3 Purpose of the document

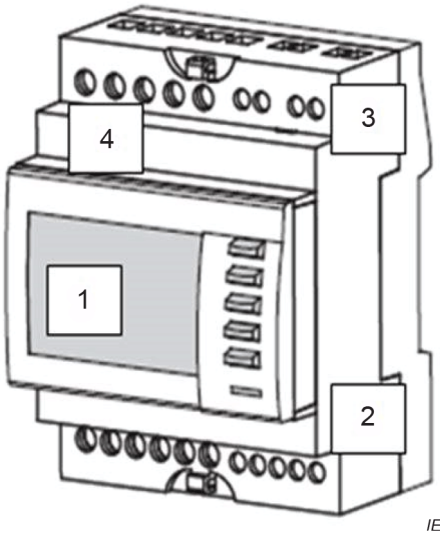
This declaration is intended to provide basic information on the product material content (see Table B.1) and end-of-life information.

Table B.1 – Material content according to IEC 62474 material classes

Metals, weight (%)		Plastics, weight (%)		Others, weight (%)	
Stainless steel	< 1	Polyvinyl chloride	< 1	Ceramics and glass	7,5
Other ferrous alloys, non-stainless steel	5	Other thermoplastics	60	Other organic materials	< 1
Aluminium and its alloys	< 1				
Copper and its alloys	15				
Magnesium and its alloys	< 1				
Nickel and its alloys	< 1				
Zinc and its alloys	1,5				
Precious metals	< 1				
Other non-ferrous metals and alloys	< 1				
Total product mass: 400 g					
Mass of packaging: 100 g					

B.2.4.4 End-of-life information

A list of components and materials that can be subjected to selective treatment may be requested according to local/national regulations; for measuring equipment, such components may be as in the example in Figure B.1.



Key

1 LCD screen

2 Printed circuit boards (inside the module)

3 Lithium cell (inside the module)

4 Plastics with brominated flame retardants

Figure B.1 – Components listed for EoL of a product

Decommissioning and disassembly should be performed by qualified personnel.

Bibliography

IEC 60050-195, *International Electrotechnical Vocabulary (IEV) – Part 195: Earthing and protection against electric shock*

~~IEC 60050-300:2001, *International Electrotechnical Vocabulary – Electrical and electronic measurements and measuring instruments – Part 311: General terms relating to measurements*~~

IEC 60050-311:2001, *International Electrotechnical Vocabulary (IEV) – Part 311: General terms relating to measurements*

IEC 60050-442:1998, *International Electrotechnical Vocabulary (IEV) – Part 442: Electrical accessories*

~~IEC 60050-601:1985, *International Electrotechnical Vocabulary – Chapter 601: Generation, transmission and distribution of electricity – General*~~

IEC 60050-614:2016, *International Electrotechnical Vocabulary (IEV) – Part 614: Generation, transmission and distribution of electricity – Operation*

~~IEC 60050-826:1982, Amendment 1:1998, *International Electrotechnical Vocabulary – Part 826: Electrical installations of buildings*~~

IEC 60050-826:2004, *International Electrotechnical Vocabulary (IEV) – Part 826: Electrical installations*

~~IEC 60359:2001, *Expression of the performance of electrical and electronic measuring equipment*~~

IEC 60359, *Electrical and electronic measurement equipment – Expression of performance*

IEC 60364-1~~:2001~~, *Low-voltage electrical installations ~~of buildings~~ – Part 1: Fundamental principles, assessment of general characteristics, definitions*

IEC 60364-6~~:2006~~, *Low-voltage electrical installations – Part 6 : Verification*

IEC 60664-1, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

~~IEC 61326-1:2005, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements*~~

IEC 61326 (all parts), *Electrical equipment for measurement, control and laboratory use – EMC requirements*

IEC 61326-2-4, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 2-4: Particular requirements – Test configurations, operational conditions and performance criteria for insulation monitoring devices according to IEC 61557-8 and for equipment for insulation fault location according to IEC 61557-9*

IEC 62430, *Environmentally conscious design for electrical and electronic products*

IEC 62474, *Material declaration for products of and for the electrotechnical industry*

IEC TR 62635, *Guidelines for end-of-life information provided by manufacturers and recyclers and for recyclability rate calculation of electrical and electronic equipment*

ISO/IEC Guide 98-1:2009, *Uncertainty of measurement – Part 1: Introduction to the expression of uncertainty in measurement*

ISO/IEC Guide 98-3:2008, *Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

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IEC 61557-1

Edition 3.0 2019-07

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Electrical safety in low voltage distribution systems up to 1 000 V a.c. and 1 500 V d.c. – Equipment for testing, measuring or monitoring of protective measures
Part 1: General requirements

Sécurité électrique dans les réseaux de distribution basse tension au plus égale à 1 000 V c.a. et 1 500 V c.c. – Dispositifs de contrôle, de mesure ou de surveillance de mesures de protection
Partie 1: Exigences générales



IEC 61557-1:2019-07(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ELECTRICAL SAFETY IN LOW VOLTAGE DISTRIBUTION SYSTEMS UP TO 1 000 V AC AND 1 500 V DC – EQUIPMENT FOR TESTING, MEASURING OR MONITORING OF PROTECTIVE MEASURES

Part 1: General requirements

FOREWORD

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International Standard IEC 61557-1 has been prepared by technical committee 85: Measuring equipment for electrical and electromagnetic quantities.

This third edition cancels and replaces the second edition published in 2007. This edition constitutes a technical revision.

This third edition includes the following significant technical changes with respect to the previous edition:

a) terms aligned with IEC 60050;
b) measurement of uncertainty revised according to the equations in 4.2 of ISO/IEC Guide 98-3:2008 (GUM);
c) updated references for safety and EMC requirements;

d) updated references for marking and operating instructions;

e) updated references for testing safety and EMC;

f) Annex A contains an explanation of GUM;

g) Annex B addresses environmental aspects.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
85/689/FDIS	85/692/RVD

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

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

A list of all parts in the IEC 61557 series, published under the general title *Electrical safety in low voltage distribution systems up to 1 000 V AC and 1 500 V DC – Equipment for testing, measuring or monitoring of protective measures*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://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.

INTRODUCTION

IEC 60364-6 stipulates standardized conditions for the initial test of power installations in TN, TT or IT systems for continuous monitoring and for testing these installations after modifications. In addition to general references for the performance of the tests, IEC 60364-6 contains requirements that have to be verified by measurements. Only in a few instances, for example when measuring the insulation resistance, does IEC 60364-6 contain details of the characteristics of the measuring device to be used. Circuits which are given as examples in IEC 60364-6, and referred to within the text of that document, are generally not suitable for practical use.

The tests are carried out in installations where hazardous voltages can occur and where careless use or a defect in the equipment can easily cause an accident. Therefore, the technician has to rely on measuring devices which ensure safe test methods, in addition to simplifying the measurements.

The application of the general safety regulations for electrical and electronic measuring devices (IEC 61010-1) for testing the protective measures is not sufficient in itself. The performance of measurements in the installation can cause hazards not only to the technician, but also to third persons, depending on the measuring method used.

Likewise, reliable and comparable results of measurement with measuring devices from different manufacturers are an important precondition in order to obtain an objective assessment about the installation, for example when the installation is handed over for periodic tests, for continuous insulation monitoring or in the case of performance warranty.

The IEC 61557 series has been established with the aim of stipulating common principles for measuring and monitoring equipment for testing electrical safety and measuring performances in systems with nominal voltages up to 1 000 V AC and 1 500 V DC which correspond to the above-mentioned characteristics.

For that reason, the following common requirements have been stipulated in IEC 61557-1 (other parts of IEC 61557 can specify additional requirements or deviations):

– protection against extraneous voltages;
– class II protection (except insulation monitoring devices and insulation fault location systems);
– requirements and safety precautions against hazardous touch voltages at the measuring device;
– requirements for the assessment of connection configurations with respect to wiring errors in the tested equipment;
– special mechanical requirements;
– measuring methods;
– measured quantity;
– specification of the maximum operating uncertainty;
– requirements for testing the influencing quantity and the calculation of the operating uncertainty;
– uncertainties of the measuring device at the thresholds specified in the respective standards;
– specification of the nature of type and routine tests and the required conditions for testing.

Contrary to the usual convention, terms and definitions that occur more than once in another part of the series are listed in IEC 61557-1:2019, Clause 3. Only terms and definitions specific to the respective part of IEC 61557 are listed in Clause 3 of that part.

ELECTRICAL SAFETY IN LOW VOLTAGE DISTRIBUTION SYSTEMS UP TO 1 000 V AC AND 1 500 V DC – EQUIPMENT FOR TESTING, MEASURING OR MONITORING OF PROTECTIVE MEASURES

Part 1: General requirements

1 Scope

This part of IEC 61557 specifies the general requirements applicable to measuring and monitoring equipment for testing the electrical safety in low-voltage distribution systems with nominal voltages up to 1 000 V AC and 1 500 V DC.

When measuring equipment or measuring installations involve measurement tasks of various measuring equipment covered by this series of standards, then the part of this series relevant to each of the measurement tasks is applicable.

NOTE The term "measuring equipment" will hereafter be used to designate "testing, measuring and monitoring equipment".

Other parts of IEC 61557 can specify additional requirements or deviations.

This document does not cover functional safety or cybersecurity.

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.

IEC 60038:2009, *IEC standard voltages*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP code)*
IEC 60529:1989/AMD1:1999
IEC 60529:1989/AMD2:2013[1]

IEC 61010-1:2010*, Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements*
IEC 61010-1:2010/AMD1:2016[2]

IEC 61010-031, *Safety requirements for electrical equipment for measurement, control and laboratory use – Part 031: Safety requirements for hand-held and hand-manipulated assemblies for electrical test and measurement*

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[1] A consolidated version of this publication exists, comprising IEC 60529:1989, IEC 60529:1989/AMD1:1999 and IEC 60529:1989/AMD2:2013.

[2] A consolidated version of this publication exists, comprising IEC 61010-1:2010 and IEC 61010-1:2010/AMD 1:2016.

IEC 61010-2-030:2017, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 2-030: Particular requirements for equipment having testing or measuring circuits*

IEC 61010-2-032, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 2-032: Particular requirements for hand-held and hand-manipulated current sensors for electrical test and measurement*

IEC 61010-2-034:2017, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 2-034: Particular requirements for measurement equipment for insulation resistance and test equipment for electric strength*

IEC 61326-1:2012, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements*

IEC 61557-8:2014, *Electrical safety in low voltage distribution systems up to 1 000 V AC and 1 500 V DC – Equipment for testing, measuring or monitoring of protective measures – Part 8: Insulation monitoring devices for IT systems*

IEC 61557-9:2014, *Electrical safety in low voltage distribution systems up to 1 000 V AC and 1 500 V DC – Equipment for testing, measuring or monitoring of protective measures – Part 9: Equipment for insulation fault location in IT systems*

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
nominal system voltage
U_n
value of the voltage by which the distribution system is designated and to which certain characteristics are assigned

3.2
voltage against earth
U_o
<in distribution systems with an earthed neutral point> voltage between a phase conductor and the earthed neutral point

3.3
voltage against earth
U_o
<in all other distribution systems> voltage present between the remaining phase conductors and earth when one of the phase conductors is short-circuited to earth

3.4
fault voltage
U_f
voltage between a given point of fault and reference earth resulting from an insulation fault

[SOURCE: IEC 60050-826:2004, 826-11-02, modified – The symbol has been added.]

3.5
effective touch voltage
U_t
voltage between conductive parts when touched simultaneously by a person or an animal

Note 1 to entry: The value of the effective touch voltage may be appreciably influenced by the impedance of the person or the animal in electric contact with these conductive parts.

[SOURCE: IEC 60050-195:1998, 195-05-11, modified – The symbol has been added.]

3.6
conventional touch voltage limit
U_L
maximum value of the touch voltage which is permitted to be maintained indefinitely in specified conditions of external influences and is usually equal to 50 V AC, RMS or 120 V ripple free DC

[SOURCE: IEC 60050-826:2004, 826-11-04, modified – "prospective" has been omitted from the term and from the definition and values for the limit have been added to the definition; the symbol has been added.]

3.7
supply voltage
voltage that is used to power the measurement equipment

Note 1 to entry: If a supply voltage is specified, for instance in the supply contract, then it is called "declared supply voltage".

3.8
rated supply voltage
U_S
value of the supply voltage at a point where the measuring equipment does or can accept electric energy as a supply

3.9
output voltage
U_a
voltage across the measuring equipment terminals where this equipment does or can output electric energy

3.10
open-circuit voltage
U_q
voltage present across unloaded terminals on the measuring equipment

3.11
rated voltage
U_N
voltage value assigned by a manufacturer or other entity for a specified operating condition of the measuring equipment

Note 1 to entry: The value for the rated voltage of low-voltage equipment is generally assigned from the list of nominal voltages in IEC 60038:2009, Tables 1 and 6.

Note 2 to entry: Equipment may have more than one rated voltage value or may have a rated voltage range.

[SOURCE: IEC 60050-614:2016, 614-03-09, modified – The domain <of equipment> and Note 1 have been omitted; the symbol has been added; the term specifically adapted for measuring equipment.]

3.12
extraneous voltage
external voltage to which the measuring equipment can be subjected during measurement

3.13
rated current
I_N
current assigned by the manufacturer for the specified operating condition of the measuring equipment

Note 1 to entry: The specified operating condition is a value (or values) within the rated operating conditions that are designated by the manufacturer.

[SOURCE: IEC 60050-442:1998, 442-01-02, modified – "for accessories" has been deleted from the term and Note 1 has been added; the definition has been adapted for application to measuring equipment.]

3.14
short-circuit current
over-current resulting from a short circuit due to a fault on the terminals or within the measuring equipment

3.15
rated frequency
f_N
frequency for which the measuring equipment is intended to be used and for which it has been designed

3.16
uncertainty of measurement
parameter, associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand

Note 1 to entry: This term is used in the "uncertainty" approach.

Note 2 to entry: The parameter can be, for example, a standard deviation (or a given multiple of it), or a half-width of an interval having a stated level of confidence. Various ways of obtaining uncertainty are defined in the GUM.

Note 3 to entry: Uncertainty of measurement comprises, in general, many components. Some of these components can be evaluated from the statistical distribution of the results of a series of measurements and can be characterized by experimental standard deviations. The other components, which can also be characterized by standard deviations, are evaluated from the assumed probability distributions based on experience or other information.

[SOURCE: IEC 60050-311:2001, 311-01-02]

3.17
operating uncertainty
calculated uncertainty taking into account the intrinsic uncertainty and defined influence quantities to mirror the worst case situation

3.18
fiducial uncertainty
uncertainty of measuring equipment expressed as a percentage of the fiducial value

3.19
fiducial value
clearly specified value to which reference is made in order to define the fiducial uncertainty

Note 1 to entry: This value can be, for example, the upper limit of the measuring range, the scale length or any other value which is clearly stated.

[SOURCE: IEC 60050-311:2001, 311-01-16, modified – "error" has been replaced by "uncertainty"; Note 1 has been omitted.]

3.20
percentage operating uncertainty
operating uncertainty of measuring equipment expressed as a percentage of the fiducial value

3.21
intrinsic uncertainty
uncertainty of a measuring instrument or supply instrument when used under reference conditions

Note 1 to entry: The uncertainty caused by friction is part of the intrinsic uncertainty.

[SOURCE: IEC 60050-311:2001, 311-03-09, modified – "or supply instrument" has been added to the definition; the Note has been deleted and Note 1 has been added.]

3.22
performance
characteristics defining the ability of a measuring instrument to achieve the intended functions

[SOURCE: IEC 60050-311:2001, 311-06-11]

3.23
influence quantity
quantity which is not the subject of the measurement and whose change affects the result of the measurement

Note 1 to entry: This term is used in the "uncertainty" approach.

Note 2 to entry: Influence quantities can originate from the measured system, the measuring equipment or the environment.

Note 3 to entry: As the calibration diagram depends on the influence quantities, in order to assign the result of a measurement it is necessary to know whether the relevant influence quantities lie within the specified range.

Note 4 to entry: An influence quantity may be external or internal with reference to the equipment. When the value of one of the influence quantities changes within its measuring range, it may affect the uncertainty due to another quantity. The measured quantity, or a parameter of it, may itself act as an influence quantity. For example, for a voltmeter, the value of the measured voltage may produce an additional uncertainty due to non-linearity or its frequency may also cause an additional uncertainty.

[SOURCE: IEC 60050-311:2001, 311-06-01, modified – "the relationship between the indication and" has been deleted from the definition; Note 4 has been added.]

3.24
variation
<due to an influence quantity> difference between the indicated values for the same value of the measurand of an indicating measuring instrument, or the values of a material measure, when an influence quantity assumes, successively, two different values

[SOURCE: IEC 60050-311:2001, 311-07-03]

3.25
reference conditions
set of specified values and/or ranges of values of influence quantities under which the uncertainties, or limits of error, admissible for a measuring instrument are specified

[SOURCE: IEC 60050-311:2001, 311-06-02, modified – "are the smallest" has been replaced with "are specified".]

3.26
operating condition
characteristic which may affect performance of a component, device or equipment

Note 1 to entry: Examples of operating conditions are ambient conditions, characteristics of the power supply, duty cycle or duty type.

[SOURCE: IEC 60050-151:2001, 151-16-01]

3.27
rated operating conditions
specified set of conditions which may affect the performance of a measuring device and under which the operating uncertainty is maintained

3.28
measuring voltage
U_{m}
voltage present at the measuring terminals during the measurement

3.29
uncertainty of measuring equipment
uncertainty of the result of a direct measurement of a measurand having negligible intrinsic uncertainty

Note 1 to entry: Unless explicitly stated otherwise, the measuring equipment uncertainty is expressed as an interval with coverage factor 2.

Note 2 to entry: In single-reading direct measurements of measurands having low intrinsic uncertainty with respect to the measuring equipment uncertainty, the uncertainty of the measurement coincides, by definition, with the measuring equipment uncertainty. Otherwise the measuring equipment uncertainty is to be treated as a component of category B in evaluating the uncertainty of the measurement on the basis of the model connecting the several direct measurements involved.

Note 3 to entry: The measuring equipment uncertainty automatically includes, by definition, the effects due to the quantization of the reading values (minimum evaluable fraction of the scale interval in analogic outputs, unit of the last stable digit in digital outputs).

Note 4 to entry: For material measures, the measuring equipment uncertainty is the uncertainty that should be associated to the value of the quantity reproduced by the material measure in order to ensure the compatibility of the results of its measurements.

4 Requirements

4.1 General requirements

Measuring equipment, when used for a designated purpose, shall not endanger persons, livestock or property. Furthermore, measuring equipment with additional functions not forming part of the application of the IEC 61557 series shall also not endanger persons, livestock or property.

4.2 Influence quantities – Operating uncertainty (B), percentage operating uncertainty (B [%])

The operating uncertainty shall be calculated by means of Equation 1:

$$B = \pm\sqrt{A^2 + \tfrac{4}{3}\textstyle\sum_i E_i^2}\quad B = \pm\sqrt{A^2 + \frac{4}{3}\sum_i {E_i}^2} \tag{1}$$

where

A is the intrinsic uncertainty;

E_i is the variation;

i is the consecutive number of the variations.

The percentage operating uncertainty shall be calculated by means of Equation 2:

$$B[\%] = \pm\frac{B}{F} \times 100\,\% \tag{2}$$

where

F is the fiducial value.

The influencing variations used for calculating the operating uncertainty are denoted as follows:

- variation due to changing the position E_1
- variation due to changing the supply voltage E_2
- variation due to changing the temperature E_3
- variation due to interference voltages E_4
- variation due to earth electrode resistance E_5
- variation due to changing the phase angle of impedance of circuit under test E_6
  - variation due to system phase angle 0° to 18° (use as applicable) $E_{6.1}$
  - variation due to system phase angle 0° to 30° (use as applicable) $E_{6.2}$
- variation due to changing the system frequency E_7
- variation due to changing the system voltage E_8
- variation due to system harmonics E_9
- variation due to system DC quantities E_{10}
- variation due to external low-frequency magnetic fields E_{11}
- variation due to load current E_{12}
- variation due to touch current caused by common mode voltage E_{13}
- variation due to frequency E_{14}
- variation due to repeatability E_{15}

The permissible percentage operating uncertainties are stated in other parts of IEC 61557.

Only one of the influence quantities is varied when calculating the operating uncertainty, whilst the remaining influence quantities are kept under reference conditions. The larger of the respective values of the variation (positive and negative variation) is inserted into the equation for the calculation of the operating uncertainty.

4.3 Rated operating conditions

The following rated operating conditions shall apply, except for insulation monitoring devices (IMD) in accordance with IEC 61557-8 and for insulation fault location systems (IFLS) in accordance with IEC 61557-9:

– temperature range from 0 °C to 35 °C;

– a position of ±90° from the reference position for portable measuring equipment;

– 85 % to 110 % of the nominal supply voltage for supply from the distribution systems (if applicable). The values in IEC 60038 shall be applied for a supply from the distribution system;

– the charge condition in accordance with 4.4 shall apply to the battery or batteries/ accumulators for measuring equipment with a supply from batteries/accumulators;

– the range of revolutions per minute stated by the manufacturer for measuring equipment with a supply from a hand-driven generator;

– frequency of the supply voltage ±5 % (if applicable).

NOTE Additional rated operating conditions are stated in other parts of the IEC 61557 series.

4.4 Battery test facility

Measuring equipment with power supplied from dry or rechargeable battery cells shall test and indicate that the state of charge of these batteries will permit measurement within the specification. This may be done automatically as part of the measurement cycle or as a separate function. Where the battery test is a separate function, the test load shall be of the same level as the one appearing during a measurement.

4.5 Safety

Measuring and monitoring equipment shall be in accordance with IEC 61010-1, IEC 61010-2-030, IEC 61010-031, IEC 61010-2-034 and, if applicable, IEC 61010-2-032, and with the following additional requirements.

Overvoltage categories and/or measurement categories are specified in the relevant parts of IEC 61557.

Handheld measuring equipment shall fulfil the requirements for double or reinforced insulation.

The conductive parts of the terminals shall not be accessible and hazardous in connected, partially connected or unconnected conditions.

The protective conductor if used for measuring purposes shall be treated as a live part, except where a different requirement is specified in other parts of IEC 61557.

The terminals shall be designed so that the probe assembly can be connected to the measuring equipment reliably.

4.6 Electromagnetic compatibility

4.6.1 Immunity

For immunity requirements, IEC 61326-1:2012, Table 2 shall apply. For testing, see 6.5.

4.6.2 Emission

For emissions, either class A or class B limits in accordance with IEC 61326-1:2012, 7.2 shall apply.

4.7 Mechanical strength against vibration

In addition to the mechanical resistance tests in accordance with IEC 61010-1, measuring equipment shall successfully pass the following vibration conditions (type test):

– direction: three mutually perpendicular axes;
– amplitude: 1 mm;
– frequency: 25 Hz;
– duration: 20 min.

5 Marking and operating instructions

5.1 General

Marking and operating instructions shall comply with IEC 61010-1, IEC 61010-2-032, IEC 61010-2-030 and, in addition, these instructions shall comply with the requirements specified in the relevant parts of IEC 61557.

5.2 Marking

The measuring equipment shall carry the following marking:

– type of equipment;
– type and current rating of the fuse in the case of exchangeable fuses;
– type of battery/accumulator and polarity of connection in the battery compartment;
– nominal system voltage and, if applicable, the symbol for double insulation in accordance with IEC 61010-1:2010, Table 1, symbol 11;
– manufacturer’s name or registered trade mark;
– model number, name or other means to identify the equipment (inside or outside);
– reference to the operating instructions in accordance with IEC 61010-1:2010, Table 1, symbol 14.

Units of the measured quantities and ranges of measurement shall be stated on the enclosure or on the display.

5.3 Operating instructions

5.3.1 Performance requirements

The operating uncertainty, the intrinsic uncertainty and the variations E_1 to E_{15} shall be provided in the operating instructions (with the exception of measuring devices covered by IEC 61557-8 and IEC 61557-9).

5.3.2 Other information

The operating instructions shall contain the following details:

– connection diagrams;
– instructions for measurements;
– brief description of the principle of measurement;
– diagrams or tables showing the maximum permissible indicated values taking into consideration the tolerances stated by the manufacturer (if necessary);
– type of battery/rechargeable cells;
– information on the charging current, charging voltage and duration of charging for rechargeable cells;

– operational lifetime/runtime of the battery/rechargeable cells or the possible number of measurements;
– type of IP protection according to IEC 60529;
– any necessary special guidance notes.

6 Tests

6.1 General

Measuring equipment shall be tested in accordance with the safety standards IEC 61010-1, IEC 61010-2-030, IEC 61010-031, IEC 61010-2-034 and, if applicable, IEC 61010-2-032, and the EMC standards of IEC 61326 (all relevant parts).

All tests shall be carried out under reference conditions unless otherwise specified. The reference conditions are stated in the relevant parts of IEC 61557.

Tolerances are added in the relevant parts of IEC 61557.

6.2 Operating uncertainty

6.2.1 General

The operating uncertainty shall be determined according to 6.2.2 to 6.2.4.

6.2.2 Influence of changing position

The variation E_1 due to changing the position in accordance with 4.2 and 4.3, if applicable, shall be determined for positions +90° or −90° from the reference position stated by the manufacturer (routine test).

6.2.3 Influence of temperature

The variation E_3 shall be determined from the reference temperature at 0 °C and 35 °C after the device has reached a state of equilibrium (type test).

6.2.4 Influence of the supply voltage

The variation E_2 due to changing the supply voltage shall be determined under the following rated operating conditions (routine test):

– limits in accordance with 4.3 for measuring equipment supplied from distribution systems;
– limits in accordance with 4.4 and 6.3 for measuring equipment supplied from a battery/accumulator;
– limits in accordance with 4.3 for measuring equipment supplied by a hand-driven generator.

6.3 Battery test facility

The lower and upper limits for the battery voltage to which the battery test facility in accordance with 4.4 is set, shall be determined by means of an external voltage source. These values shall be used during the test in accordance with 6.2.4 as limits for variation E_2 by changing the supply voltage (routine test).

6.4 Safety tests

Compliance with 4.5 shall be tested (type test).

6.5 EMC tests

For the electromagnetic radio frequency field (RF) and conducted RF the following requirements apply:

– the auxiliary circuits of the measuring equipment shall be energised with the rated voltage;
– the measuring equipment shall be tested in its operating conditions.

6.6 Mechanical requirements

The test shall be performed in accordance with 4.7 (type test).

The tests are deemed to have been passed successfully when no parts have become loose or bent and the connecting leads are not damaged. After the process, the measuring equipment shall comply with the requirements for intrinsic uncertainty of the equipment (type test), if applicable.

6.7 Marking and operating instructions

The marking and the operating instructions shall be confirmed by visual inspection (type test).

The marking shall be inspected during type test and routine test.

6.8 Records

Compliance with the tests in Clause 6 shall be recorded.

Annex A
(informative)

Explanation of the application of GUM in series IEC 61557

A.1 Overview

The operating uncertainty is a predictive parameter characterizing the expanded uncertainty of the results generated by the measuring device under defined operational conditions.

The operating uncertainty forms an upper limit of the expanded uncertainty which can be expected if the device is operated within the defined operational conditions.

The operating uncertainty might be used to characterize results generated by the device if the device is used within defined operational conditions.

When possible and convenient, the uncertainty may be expressed in the relative form or in the fiducial form. The relative uncertainty is the ratio U/V of the absolute uncertainty U to the measure value V, and the fiducial uncertainty is the ratio U/V_{f} of the absolute uncertainty U to a conventionally chosen value V_{f}.

The principles of the GUM (ISO/IEC Guide 98-3:2008) are used to calculate the operating uncertainty.

A.2 Basic model of evaluation of results under operational conditions

A.2.1 General

The basic model for the evaluation of the results under operational conditions is:

$$Y_{\mathrm{oper}} = Y_{\mathrm{ref}} + \sum_i \delta E_i$$

The result under reference conditions Y_{ref} is the result which could be generated under reference (calibration) conditions. The uncertainty $u(Y_{\mathrm{ref}})$ is evaluated during calibration.

The deviations δE_i are derived from the operational conditions. Usually the expectation value of the δE_i is zero and some limits are known.

A.2.2 Standard uncertainty of a result

The standard uncertainty of a result under operational conditions $u(Y_{\mathrm{oper}})$ can be calculated using uncertainty propagation. The sensitivity of all input quantities is equal to 1.

$$u\left(Y_{\mathrm{oper}}\right) = \sqrt{u\left(Y_{\mathrm{ref}}\right)^2 + \sum_i u\left(\delta E_i\right)^2}$$

The standard uncertainty under reference conditions is equal to the expanded uncertainty evaluated during calibration divided by the coverage factor:

$$u\left(Y_{\mathrm{ref}}\right) = \frac{U_{\mathrm{cal}}\left(Y\right)}{k_{\mathrm{cal}}}$$

A.2.3 Expanded uncertainty

The expanded uncertainty of the calibration $U_{\text{cal}}(Y)$ and the coverage factor k_{cal} (usually equal to 2) are stated in the calibration certificate.

For the deviations δE_i, usually only some limits symmetric to zero are known. According to GUM, limits can be converted to a standard uncertainty with the use of a rectangular distribution:

$$u\left(\delta E_i\right) = \frac{e_i}{\sqrt{3}}$$

The e_i is the half width of the limits characterizing the deviation δE_i.

The operating uncertainty is equal to the standard uncertainty under operational conditions multiplied by the operating coverage factor:

$$U\left(Y_{\text{oper}}\right) = k_{\text{oper}} \times u\left(Y_{\text{oper}}\right)$$

The operating coverage factor k_{oper} is fixed to 2,0.

This is equivalent to the half width of coverage interval with a coverage probability of 95,45 % under the assumption that the results are distributed normally.

A.2.4 Relative operating uncertainty

The relative operating uncertainty as a percentage can be calculated using a fiducial value Y_{f}.

$$W\left(Y_{\text{oper}}\right) = \frac{U\left(Y_{\text{oper}}\right)}{Y_{\text{f}}} \times 100\,\%$$

The operating uncertainty and the relative operating uncertainty as a percentage can be written as symmetric interval limits using plus and minus signs.

A.2.5 Calibration uncertainty

For practical calculations, the calibration uncertainty $U_{\text{cal}}(Y)$ may be replaced by A, and e_i, by E_i. The resulting equation is:

$$U\left(Y_{\text{oper}}\right) = \sqrt{A^2 + \frac{4}{3}\sum_i E_i^2} \le |A| + 1{,}5 \times \sqrt{\sum_i E_i^2}$$

under the assumption that the coverage factor k_{cal} stated in the calibration certificate is equal to the operating coverage factor k_{oper} = 2,0.

Therefore the following equation may be used as an upper bound for the operating coverage interval:

$$B = \pm\left[\left|A\right| + 1{,}15 \times \sqrt{\sum_i E_i^{\,2}}\right]$$

A.3 Operating uncertainty calculations as basis for 4.1

A.3.1 Standard uncertainty

The basis for this model is the addition of faults.

Uncertainty in respect to GUM (ISO/IEC Guide 98-1:2009, measuring method B) for any statistical distribution:

$$u = \sqrt{a^2 + \sum_i e_i^{\,2}}$$

where

a is the expected intrinsic operating uncertainty for example by calibration certificates;

e_i $\boldsymbol{e_i} =$ is the expected operating uncertainty by influencing factors for example through temperature;

u is the standard uncertainty of the result of a measurement expressed as a standard deviation.

A.3.2 Operating uncertainty in accordance with 4.1

The basis for this model of calculation is the expanded uncertainty according to GUM (ISO/IEC Guide 98-3:2008, 6.2).

Determination of the operating uncertainty for the IEC 61557 series with stipulation of the defined statistical distributions based on empirical values:

– $B = \pm\, k \times u$ with $k = 2$ for coverage probability of 95,45 %;

– $\boldsymbol{a} = \frac{\boldsymbol{A}}{\boldsymbol{2}}\, a = \frac{A}{2}$ standard distribution for the intrinsic uncertainty;

– $\boldsymbol{e_i} = \frac{\boldsymbol{E_i}}{\boldsymbol{\sqrt{3}}}\, e_i = \frac{E_i}{\sqrt{3}}$ rectangular distribution for the operating uncertainty through influence factors in the operation;

– $B = \pm\sqrt{A^2 + \frac{4}{3}\sum_i E_i^2}$ uncertainty for coverage probability of 95,45 % according to GUM, (ISO/IEC Guide 98-3:2008, 7.22).

Annex B
(informative)

Environmental aspects

B.1 Overview

Every product has an effect on the environment, which may occur at any or all stages of its life cycle – raw-material acquisition, manufacture, distribution, use, maintenance, re-use and end-of-life. These effects may range from slight to significant; they may be short term or long term, and they may occur at the local, national, regional or global level (or a combination thereof).

The widespread use of electrical and electronic products has drawn increased awareness to their environmental impacts. As a result, legislation, as well as market-driven requirements for environmentally conscious design, is emerging.

The continuous introduction of new products and materials can make evaluation increasingly complex, since additional data will need to be gathered to assess the life-cycle impacts of such new products and materials. The gathered data is used as a basis for improvement of the products with respect to environmental impacts. Life-cycle assessment (LCA) and environmentally conscious design (ECD) principles provide instruments that may be useful in this respect.

The application of LCA to an ECD process allows the reduction of adverse environmental impacts of a product throughout its entire life cycle. This can involve balancing the environmental aspects of the product with other factors, such as its intended use, performance, cost, safety, marketability, and quality and choosing methods to meet legal and regulatory requirements in an environmentally conscious way. In striving for this goal, multiple benefits can be achieved for the organization, its customers and other stakeholders. The consideration of environmental aspects particularly in the very early stage of the product design process can contribute to cost reduction and to better marketability. Environmentally conscious design is not a separate design activity; rather it is an integral part of the existing design process. The design in this context includes the activities associated with the processes of product planning, development and decision making as well as the creation of policies within the organization.

ECD is intended to be used by all those involved in the design and development of electrical and electronic products. This includes all parties in the supply chain regardless of organization type, size, location and complexity. It is applicable for all types of products, new as well as modified. Sector-specific documents may be developed to address needs not covered in this document. The use of this annex as a base reference is encouraged so as to ensure consistency throughout the electrotechnical sector.

This annex provides a set of guidelines to establish the material declaration and the end-of-life information in the general framework of the information that shall be shared according to IEC 62430.

B.2 Guidelines to establish a material declaration and end-of-life information

B.2.1 General

Manufacturers are increasingly requested to provide a material declaration and end-of-life information in accordance with regulations or in the form of labels, or they are asked directly by their customers to communicate and declare information about the material composition of their products. The main intended uses of this information are to:

– enable assessment of product compliance with substance-restriction requirements;
– improve product end-of-life by facilitating integration in the appropriate recycling processes.

Providing the material declaration is at the discretion of the manufacturer.

NOTE Since IEC 62474 is intended to establish requirements for material declarations, standardize protocols, and facilitate transfer and processing of data, it is possible that its application throughout the supply chain will make the compilation of material declarations of products easier.

B.2.2 Guidelines for material declaration

The material declaration should be made in accordance with IEC 62474 and contain the two following sections as a minimum.

– Base data requirements:
  - product family name;
  - product identification: commercial references covered by the declaration;
  - total product mass;
  - mass and type of batteries, if integrated;
  - mass of packaging.
– Material class information:
  - distribution of the product mass according to the 15 generic material classes as defined in the IEC 62474 database.

NOTE Examples of material declarations are given in IEC 62474.

Single-material declarations can be made for a family of products only when the composition is the same for all the products thereof.

B.2.3 Guidelines for end-of-life (EoL)

Different regulations (for waste electrical and electronic equipment, batteries, packaging), incentives on circular economy or customers require or push the design of products that are easily recyclable.

If required, the end-of-life information (EoLI) should be prepared in accordance with IEC TR 62635 and should contain the following as a minimum:

– manufacturer identification;
– product identification;
– potential hazard identification;
– selective treatment;
– sketches, drawings or pictures to identify and locate parts and materials listed.

B.2.4 Example of a material declaration and end-of-life information

B.2.4.1 Manufacturer identification

Address: xxxxxxxxxxxxxxxxxx

Website: xxxxxxxxxxxxxxxxxx

B.2.4.2 Product identification

Range: multifunction meter xxxxxx

Commercial references: xxxxxx, xxxxx, xxxxxx, etc.

B.2.4.3 Purpose of the document

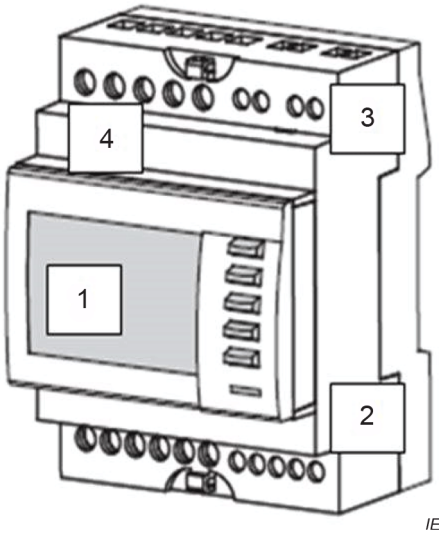
This declaration is intended to provide basic information on the product material content (see Table B.1) and end-of-life information.

Table B.1 – Material content according to IEC 62474 material classes

Metals, weight (%)		Plastics, weight (%)		Others, weight (%)	
Stainless steel	< 1	Polyvinyl chloride	< 1	Ceramics and glass	7,5
Other ferrous alloys, non-stainless steel	5	Other thermoplastics	60	Other organic materials	< 1
Aluminium and its alloys	< 1				
Copper and its alloys	15				
Magnesium and its alloys	< 1				
Nickel and its alloys	< 1				
Zinc and its alloys	1,5				
Precious metals	< 1				
Other non-ferrous metals and alloys	< 1				
Total product mass: 400 g					
Mass of packaging: 100 g					

B.2.4.4 End-of-life information

A list of components and materials that can be subjected to selective treatment may be requested according to local/national regulations; for measuring equipment, such components may be as in the example in Figure B.1.



Key

1 LCD screen

2 Printed circuit boards (inside the module)

3 Lithium cell (inside the module)

4 Plastics with brominated flame retardants

Figure B.1 – Components listed for EoL of a product

Decommissioning and disassembly should be performed by qualified personnel.

Bibliography

IEC 60050-195, *International Electrotechnical Vocabulary (IEV) – Part 195: Earthing and protection against electric shock*

IEC 60050-311:2001, *International Electrotechnical Vocabulary (IEV) – Part 311: General terms relating to measurements*

IEC 60050-442:1998, *International Electrotechnical Vocabulary (IEV) – Part 442: Electrical accessories*

IEC 60050-614:2016, *International Electrotechnical Vocabulary (IEV) – Part 614: Generation, transmission and distribution of electricity – Operation*

IEC 60050-826:2004, *International Electrotechnical Vocabulary (IEV) – Part 826: Electrical installations*

IEC 60359, *Electrical and electronic measurement equipment – Expression of performance*

IEC 60364-1, *Low-voltage electrical installations – Part 1: Fundamental principles, assessment of general characteristics, definitions*

IEC 60364-6, *Low voltage electrical installations – Part 6: Verification*

IEC 60664-1, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 61326 (all parts), *Electrical equipment for measurement, control and laboratory use – EMC requirements*

IEC 61326-2-4, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 2-4: Particular requirements – Test configurations, operational conditions and performance criteria for insulation monitoring devices according to IEC 61557-8 and for equipment for insulation fault location according to IEC 61557-9*

IEC 62430, *Environmentally conscious design for electrical and electronic products*

IEC 62474, *Material declaration for products of and for the electrotechnical industry*

IEC TR 62635, *Guidelines for end-of-life information provided by manufacturers and recyclers and for recyclability rate calculation of electrical and electronic equipment*

ISO/IEC Guide 98-1:2009, *Uncertainty of measurement – Part 1: Introduction to the expression of uncertainty in measurement*

ISO/IEC Guide 98-3:2008, *Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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SÉCURITÉ ÉLECTRIQUE DANS LES RÉSEAUX DE DISTRIBUTION BASSE TENSION AU PLUS ÉGALE À 1 000 V C.A. ET 1 500 V C.C. – DISPOSITIFS DE CONTRÔLE, DE MESURE OU DE SURVEILLANCE DE MESURES DE PROTECTION

Partie 1: Exigences générales

AVANT-PROPOS

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La Norme internationale IEC 61557-1 a été établie par le comité d'études 85 de l'IEC: Equipement de mesure des grandeurs électriques et électromagnétiques.

Cette troisième édition annule et remplace la deuxième édition parue en 2007. Cette édition constitue une révision technique.

Cette troisième édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) alignement des termes sur ceux de l'IEC 60050;

b) mesure de l'incertitude revue conformément aux équations données en 4.2 du Guide ISO/IEC 98-3:2008 (GUM);

c) mise à jour des références aux exigences de sécurité et de CEM;

d) mise à jour des références au marquage et aux instructions de fonctionnement;

e) mise à jour des références aux essais de sécurité et de CEM;

f) l'Annexe A comporte une explication du GUM;

g) l'Annexe B porte sur les aspects environnementaux.

Le texte de cette Norme internationale est issu des documents suivants:

FDIS	Rapport de vote
85/689/FDIS	85/692/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette Norme internationale.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2.

Une liste de toutes les parties de la série IEC 61557, publiées sous le titre général *Sécurité électrique dans les réseaux de distribution basse tension au plus égale à 1 000 V c.a. et 1 500 V c.c. — Dispositifs de contrôle, de mesure ou de surveillance de mesures de protection*, peut être consultée sur le site web de l'IEC.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous "http://webstore.iec.ch" dans les données relatives au document recherché. A cette date, le document sera

- reconduit,
- supprimé,
- remplacé par une édition révisée, ou
- amendé.

INTRODUCTION

L'IEC 60364-6 stipule les conditions normalisées de l'essai initial des installations de distribution dans les réseaux TN, TT ou IT pour la surveillance permanente et pour les essais de ces installations après des modifications. Outre des indications générales relatives à la réalisation des essais, l'IEC 60364-6 contient des exigences qui doivent être vérifiées par des mesures. Dans certains cas seulement, par exemple lors de la mesure de la résistance d'isolement, l'IEC 60364-6 contient quelques indications précises concernant les caractéristiques de l'appareil de mesure à utiliser. Les circuits de mesure fournis comme exemples dans l'IEC 60364-6 et cités dans le texte de ce document ne sont généralement pas adaptés à un usage pratique.

Les essais sont effectués dans des installations où des tensions dangereuses peuvent être présentes et où une imprudence ou une panne peut facilement être à l'origine d'un accident. Le technicien doit donc utiliser des dispositifs de mesure qui non seulement simplifient les mesures, mais garantissent également des méthodes d'essai sûres.

L'application des exigences de sécurité générales relatives aux dispositifs de mesure électriques et électroniques (IEC 61010-1) n'est pas suffisante pour les essais des mesures de protection. Selon la méthode de mesure utilisée, la prise des mesures au sein de l'installation peut présenter des dangers pour le technicien et pour les tierces personnes.

De même, des résultats de mesure fiables et comparables avec des appareils de mesure de différents fabricants constituent une condition préalable importante pour une évaluation objective de l'installation, par exemple lors du transfert de l'installation pour essais périodiques, pour la surveillance permanente de l'isolation ou en cas de prestations de garantie.

La série IEC 61557 a été établie dans le but de développer des principes communs pour les dispositifs de mesure et de surveillance utilisés aux fins d'essai de la sécurité électrique et de mesure des performances dans des réseaux à des tensions nominales jusqu'à 1 000 V c.a. et 1 500 V c.c. correspondant aux caractéristiques susmentionnées.

Pour cette raison, les exigences communes suivantes ont été établies dans l'IEC 61557-1 (les autres parties de l'IEC 61557 peuvent spécifier des exigences supplémentaires ou des écarts):

– protection contre les tensions extérieures;
– protection de classe II (à l'exception des contrôleurs d'isolement et des dispositifs de localisation de défaut d'isolement);
– exigences et précautions de sécurité contre les tensions de contact dangereuses au niveau de l'appareil de mesure;
– exigences relatives à l'appréciation des configurations de branchement par rapport aux erreurs de câblage dans l'installation soumise à essai;
– exigences mécaniques particulières;
– méthodes de mesure;
– grandeur mesurée;
– spécification relative à l'incertitude de fonctionnement maximale;
– exigences relatives aux essais de la grandeur d'influence et au calcul de l'incertitude de fonctionnement;
– incertitudes de l'appareil de mesure aux seuils spécifiés dans les normes respectives;
– spécification relative à la nature des essais de type et des essais individuels de série et aux conditions exigées pour ces essais.

Contrairement à la convention habituelle, les termes et définitions utilisés plusieurs fois dans une autre partie de la série sont répertoriés à l'Article 3 de l'IEC 61557-1:2019. Seuls les termes et définitions propres à la partie concernée de l'IEC 61557 sont répertoriés à l'Article 3 de cette partie.

SECURITE ELECTRIQUE DANS LES RESEAUX DE DISTRIBUTION BASSE TENSION AU PLUS ÉGALE À 1 000 V C.A. ET 1 500 V C.C. – DISPOSITIFS DE CONTRÔLE, DE MESURE OU DE SURVEILLANCE DE MESURES DE PROTECTION

Partie 1: Exigences générales

1 Domaine d'application

La présente partie de l'IEC 61557 spécifie les exigences générales applicables aux dispositifs de mesure et de surveillance utilisés aux fins d'essai de la sécurité électrique dans les réseaux de distribution basse tension au plus égale à 1 000 V c.a. et 1 500 V c.c.

Lorsque des appareils ou installations de mesure impliquent des mesures avec différents appareils couverts par la présente série de normes, la partie de cette série de normes qui est pertinente pour un type de mesure donné est applicable.

NOTE Le terme "appareil de mesure" est utilisé dans la suite du texte pour désigner un "dispositif de contrôle, de mesure et de surveillance".

Les autres parties de l'IEC 61557 peuvent spécifier des exigences supplémentaires ou des écarts.

La présente norme ne couvre pas la sécurité fonctionnelle ou la cybersécurité.

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60038:2009, *Tensions normales de l'IEC*

IEC 60529:1989, *Degrés de protection procurés par les enveloppes (code IP)*
IEC 60529:1989/AMD1:1999
IEC 60529:1989/AMD2:2013[1]

IEC 61010-1:2010, Règles *de sécurité pour appareils électriques de mesurage, de régulation et de laboratoire – Partie 1: Exigences générales*
IEC 61010-1:2010/AMD1:2016[2]

IEC 61010-031, *Règles de sécurité pour appareils électriques de mesurage, de régulation et de laboratoire – Partie 031: Prescriptions de sécurité pour sondes équipées portatives et manipulées à la main pour mesurage et essais électriques*

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[1] Il existe une version consolidée de cette publication, comprenant l'IEC 60529:1989, l'IEC 60529:1989/AMD1:1999 et l'IEC 60529:1989/AMD2:2013.

[2] Il existe une version consolidée de cette publication, comprenant l'IEC 61010-1:2010 et l'IEC 61010-1:2010/AMD1:2016.

IEC 61010-2-030:2017, *Exigences de sécurité pour appareils électriques de mesurage, de régulation et de laboratoire – Partie 2-030: Exigences particulières pour les appareils équipés de circuits d'essai ou de mesure*

IEC 61010-2-032, *Exigences de sécurité pour appareils électriques de mesurage, de régulation et de laboratoire – Partie 2-032: Exigences particulières pour les capteurs de courant, portatifs et manipulés à la main, de test et de mesure électriques*

IEC 61010-2-034:2017, *Exigences de sécurité pour appareils électriques de mesurage, de régulation et de laboratoire – Partie 2-034: Exigences particulières applicables aux appareils de mesure de la résistance d'isolement et aux appareils d'essai de rigidité diélectrique*

IEC 61326-1:2012, *Matériel électrique de mesure, de commande et de laboratoire – Exigences relatives à la CEM – Partie 1: Exigences générales*

IEC 61557-8:2014, *Sécurité électrique dans les réseaux de distribution basse tension au plus égale à 1 000 V c.a. et 1 500 V c.c. – Dispositifs de contrôle, de mesure ou de surveillance de mesures de protection – Partie 8: Contrôleur permanent d'isolement pour réseaux IT*

IEC 61557-9:2014, *Sécurité électrique dans les réseaux de distribution basse tension au plus égale à 1 000 V c.a. et 1 500 V c.c. – Dispositifs de contrôle, de mesure ou de surveillance de mesures de protection – Partie 9: Dispositifs de localisation de défauts d'isolement pour réseaux IT*

3 Termes et définitions

Pour les besoins du présent document, les termes et définitions suivants s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse http://www.electropedia.org/
- ISO Online browsing platform: disponible à l'adresse http://www.iso.org/obp

3.1
tension de réseau nominale
U_n
valeur de la tension utilisée pour désigner le réseau de distribution et à laquelle certaines caractéristiques sont assignées

3.2
tension par rapport à la terre
U_o
<dans un réseau de distribution dont le point neutre est mis à la terre> tension d'un conducteur de phase par rapport au point neutre mis à la terre

3.3
tension par rapport à la terre
U_o
<dans les autres réseaux de distribution> tension qui apparaît entre la terre et les autres conducteurs de phase lorsque l'un des conducteurs de phase est mis en court-circuit avec la terre

3.4
tension de défaut
U_f
tension entre un point de défaut donné et la terre de référence, consécutivement à un défaut de l'isolation

[SOURCE: IEC 60050-826:2004, 826-11-02, modifié – Le symbole a été ajouté.]

3.5
tension de contact effective
U_t
tension entre des parties conductrices touchées simultanément par une personne ou un animal

Note 1 à l'article: La valeur de la tension de contact effective peut être sensiblement influencée par l'impédance de la personne ou de l'animal en contact électrique avec ces parties conductrices.

[SOURCE: IEC 60050-195:1998, 195-05-11, modifié – Le symbole a été ajouté.]

3.6
tension limite conventionnelle de contact
U_L
valeur maximale de la tension de contact qu'il est admis de pouvoir maintenir indéfiniment dans des conditions d'influences externes spécifiées, et qui est généralement égale à 50 V c.a. en courant efficace ou à 120 V c.c. en courant lissé

[SOURCE: IEC 60050-826:2004, 826-11-04, modifié – L'adjectif "présumée" a été supprimé du terme et de la définition et des valeurs limites ont été ajoutées à la définition; le symbole a été ajouté.]

3.7
tension d'alimentation
tension utilisée pour alimenter un appareil de mesure

Note 1 à l'article: Si une tension d'alimentation est spécifiée, par exemple dans le contrat de fourniture, elle est appelée "tension d'alimentation déclarée".

3.8
tension d'alimentation assignée
U_S
valeur de la tension d'alimentation de l'appareil de mesure à un point où il prend ou peut prendre l'énergie électrique nécessaire à son fonctionnement

3.9
tension de sortie
U_a
tension aux bornes de l'appareil de mesure à l'endroit où cet équipement délivre ou peut délivrer une énergie électrique

3.10
tension en circuit ouvert
U_q
tension aux bornes non chargées de l'appareil de mesure

3.11
tension assignée
U_N
valeur de la tension fixée par un fabricant, ou une autre entité, pour le fonctionnement spécifié de l'appareil de mesure

Note 1 à l'article: La valeur de la tension assignée des matériels à basse tension est généralement fixée à partir de la liste des tensions nominales des Tableaux 1 et 6 de l'IEC 60038:2009.

Note 2 à l'article: Les matériels peuvent avoir plus d'une tension assignée ou peuvent avoir une plage de tension assignée.

[SOURCE: IEC 60050-614:2016, 614-03-09, modifié – Le domaine <des matériels> et la Note 1 à l'article ont été supprimés; le symbole a été ajouté; le terme a été adapté à l'application des appareils de mesure.]

3.12
tension extérieure
tension externe à laquelle l'appareil de mesure peut être exposé pendant le mesurage

3.13
courant assigné
I_N
courant fixé par le fabricant pour le fonctionnement spécifié de l'appareil de mesure

Note 1 à l'article: La condition de fonctionnement spécifiée correspond à une valeur (ou des valeurs) dans la plage de conditions de fonctionnement assignées fournie par le fabricant.

[SOURCE: IEC 60050-442:1998, 442-01-02, modifié – "pour le petit appareillage" a été supprimé du terme, la Note 1 a été ajoutée; la définition a été adaptée à l'application des appareils de mesure.]

3.14
courant de court-circuit
surintensité résultant d'un court-circuit dû à un défaut au niveau des bornes ou de l'appareil de mesure

3.15
fréquence assignée
f_N
fréquence à laquelle l'appareil de mesure est destiné à être utilisé et pour laquelle il a été conçu

3.16
incertitude de mesure
paramètre, associé à un résultat de mesure, qui caractérise la dispersion des valeurs qui pourraient raisonnablement être attribuées au mesurande

Note 1 à l'article: Ce terme est utilisé dans l'approche "incertitude".

Note 2 à l'article: Le paramètre peut être, par exemple, un écart-type (ou un multiple de celui-ci) ou la demi-largeur d'un intervalle de niveau de confiance déterminé. Diverses manières d'obtenir l'incertitude sont définies dans le GUM.

Note 3 à l'article: L'incertitude de mesure comprend, en général, plusieurs composantes. Certaines de ces composantes peuvent être évaluées à partir de la distribution statistique des résultats de séries de mesures et peuvent être caractérisées par des écarts-types expérimentaux. Les autres composantes, qui peuvent aussi être caractérisées par les écarts-types, sont évaluées en admettant des distributions de probabilité, d'après l'expérience acquise ou d'après d'autres informations.

[SOURCE: IEC 60050-311:2001, 311-01-02]

3.17
incertitude de fonctionnement
incertitude calculée d'après l'incertitude intrinsèque et les grandeurs d'influence définies afin de refléter la situation la plus défavorable

3.18
incertitude conventionnelle
incertitude de l'appareil de mesure exprimée en pourcentage de la valeur conventionnelle

3.19
valeur conventionnelle
valeur clairement spécifiée à laquelle il est fait référence en vue de définir l'incertitude conventionnelle

Note 1 à l'article: Cette valeur peut être, par exemple, la limite supérieure de l'étendue de mesure, la longueur de l'échelle ou toute autre valeur clairement définie.

[SOURCE: IEC 60050-311:2001, 311-01-16, modifié – Le terme "erreur réduite" a été remplacé par "incertitude", la Note 1 à l'article a été supprimée.]

3.20
incertitude de fonctionnement en pourcentage
incertitude de fonctionnement de l'appareil de mesure exprimée en pourcentage de la valeur conventionnelle

3.21
incertitude intrinsèque
incertitude d'un appareil de mesure ou d'un instrument d'alimentation lorsqu'on l'utilise dans les conditions de référence

Note 1 à l'article: L'incertitude causée par le frottement fait partie de l'incertitude intrinsèque.

[SOURCE: IEC 60050-311:2001, 311-03-09, modifié – "ou d'un instrument d'alimentation" a été ajouté à la définition; la Note a été supprimée, et la Note 1 à l'article a été ajoutée.]

3.22
qualités de fonctionnement
caractéristiques définissant l'aptitude d'un appareil de mesure à assurer les fonctions voulues

[SOURCE: IEC 60050-311:2001, 311-06-11]

3.23
grandeur d'influence
grandeur qui n'est pas l'objet de mesure et dont la variation affecte le résultat de la mesure

Note 1 à l'article: Ce terme est utilisé dans l'approche "incertitude".

Note 2 à l'article: Les grandeurs d'influence peuvent provenir du système de mesure, de l'appareil de mesure ou de l'environnement.

Note 3 à l'article: Comme le diagramme d'étalonnage dépend des grandeurs d'influence, pour assigner la mesure, il est nécessaire de savoir si les grandeurs d'influence applicables sont dans la plage spécifiée.

Note 4 à l'article: Une grandeur d'influence peut être extérieure ou intérieure à l'appareil. Lorsque la valeur de l'une des grandeurs d'influence varie dans son étendue de mesure, elle peut affecter l'incertitude due à une autre grandeur. La grandeur mesurée ou l'un de ses paramètres peut lui-même agir comme une grandeur d'influence. Par exemple, pour un voltmètre, la valeur de la tension mesurée peut produire une incertitude additionnelle due à la non-linéarité; sa fréquence peut aussi produire une incertitude additionnelle.

[SOURCE: IEC 60050:311:2001, 311-06-01, modifié – "la relation entre l'indication et" a été supprimé; la Note 4 à l'article a été ajoutée.]

3.24
variation
<due à une grandeur d'influence> différence entre les valeurs indiquées de la même valeur du mesurande d'un appareil de mesure indicateur, ou entre les valeurs d'une mesure matérialisée, lorsqu'une grandeur d'influence prend successivement deux valeurs différentes

[SOURCE: IEC 60050-311:2001, 311-07-03]

3.25
conditions de référence
ensemble de valeurs et/ou de domaines de valeurs spécifiés des grandeurs d'influence pour lequel les incertitudes, ou les limites d'erreur, admissibles d'un appareil de mesure sont spécifiées

[SOURCE: IEC 60050-311:2001, 311-06-02, modifié – Remplacement de "les plus petites" par "spécifiées".]

3.26
condition de fonctionnement
caractéristique qui peut influer sur le fonctionnement d'un composant, d'un dispositif ou d'un matériel

Note 1 à l'article: Des exemples de conditions de fonctionnement sont les conditions ambiantes, les caractéristiques de l'alimentation électrique, le cycle de service, le type de service.

[SOURCE: IEC 60050-151:2001, 151-16-01]

3.27
conditions de fonctionnement assignées
ensemble de conditions pouvant affecter la performance d'un dispositif de mesure et qui permettent de respecter l'incertitude de fonctionnement

3.28
tension de mesure
U_m
tension aux bornes de mesure pendant la mesure

3.29
incertitude de l'appareil de mesure
incertitude du résultat d'une mesure directe d'un mesurande présentant une incertitude intrinsèque négligeable

Note 1 à l'article: Sauf indication explicite contraire, l'incertitude de l'appareil de mesure est exprimée comme un intervalle avec facteur d'élargissement 2.

Note 2 à l'article: Pour les mesures directes à lecture unique de mesurandes présentant une faible incertitude intrinsèque par rapport à l'incertitude de l'appareil de mesure, l'incertitude de mesure correspond par définition à l'incertitude de l'appareil de mesure. Dans le cas contraire, l'incertitude de l'appareil de mesure doit être traitée comme une composante de catégorie B dans l'évaluation de l'incertitude de mesure sur la base du modèle qui connecte les mesures directes concernées.

Note 3 à l'article: L'incertitude de l'appareil de mesure inclut, par définition, les effets liés à la quantification des valeurs de lecture (fraction évaluable minimale de la valeur d'une division pour les sorties analogiques, unité du dernier chiffre stable pour les sorties numériques).

Note 4 à l'article: Pour les mesures matérialisées, l'incertitude de l'appareil de mesure est l'incertitude qu'il convient d'associer à la valeur de la grandeur reproduite par la mesure matérialisée afin de garantir la compatibilité des résultats de ses mesurages.

4 Exigences

4.1 Exigences générales

Dans les conditions d'utilisation prévues, les appareils de mesure ne doivent pas mettre en danger les personnes, les animaux ou les biens. De même, les appareils de mesure comportant des fonctions supplémentaires qui ne relèvent pas du domaine d'application de la série IEC 61557 ne doivent pas mettre en danger les personnes, les animaux ou les biens.

4.2 Grandeurs d'influence – Incertitude de fonctionnement (B), incertitude de fonctionnement en pourcentage (B [%])

L'incertitude de fonctionnement doit être calculée au moyen de l'équation 1:

$$B = \pm \sqrt{A^2 + \frac{4}{3} \sum_i E_i^2} \quad (1)$$

où

A est l'incertitude intrinsèque;

E_i est la variation;

i est le nombre consécutif des variations.

L'incertitude de fonctionnement en pourcentage doit être calculée au moyen de l'équation 2:

$$B[\%] = \pm \frac{B}{F} \times 100\ \% \quad (2)$$

où

F est la valeur conventionnelle.

Les variations d'influence utilisées pour le calcul de l'incertitude de fonctionnement sont désignées de la manière suivante:

- variation due au changement de position E_1
- variation due au changement de la tension d'alimentation E_2
- variation due au changement de température E_3
- variation due aux tensions parasites E_4
- variation due à la résistance de prise de terre E_5
- variation due au changement d'angle de phase de l'impédance du circuit en essai E_6
  - variation due à un angle de phase du réseau de 0° à 18° (utiliser si applicable) $E_{6.1}$
  - variation due à un angle de phase du réseau de 0° à 30° (utiliser si applicable) $E_{6.2}$
- variation due au changement de la fréquence du réseau E_7
- variation due au changement de la tension du réseau E_8
- variation due aux harmoniques du réseau E_9
- variation due aux composantes continues du réseau E_{10}
- variation due aux champs magnétiques externes basse fréquence E_{11}
- variation due au courant de charge E_{12}
- variation due au courant de contact provoqué par la tension en mode commu E_{13}
- variation due à la fréquence E_{14}
- variation due à la répétabilité E_{15}

Les incertitudes de fonctionnement en pourcentage admissibles sont indiquées dans les autres parties de la série IEC 61557.

Lors du calcul de l'incertitude de fonctionnement, une seule grandeur d'influence varie, les autres étant maintenues dans les conditions de référence. La valeur la plus élevée des deux

résultats de mesure (variation positive et négative) est utilisée dans l'équation pour calculer l'incertitude de fonctionnement.

4.3 Conditions de fonctionnement assignées

Les conditions de fonctionnement assignées suivantes doivent s'appliquer, sauf pour les contrôleurs d'isolement (CPI) conformément à l'IEC 61557-8 et pour les dispositifs de localisation de défauts d'isolement (IFLS) conformément à l'IEC 61557-9:

– plage de températures: 0 °C à 35 °C;
– pour les appareils de mesure portables, ±90° de la position de référence;
– 85 % à 110 % de la tension d'alimentation nominale pour une alimentation par les réseaux de distribution (s'il y a lieu). En cas d'alimentation par le réseau de distribution, les valeurs de l'IEC 60038 doivent être appliquées;
– pour les appareils de mesure alimentés par des piles ou batteries, l'état de charge des piles ou batteries doit être conforme aux exigences du 4.4;
– pour les appareils de mesure alimentés par un générateur manuel à magnéto: la plage de tours par minute, annoncée par le fabricant;
– fréquence de la tension d'alimentation ±5 % (s'il y a lieu).

NOTE Des conditions de fonctionnement assignées supplémentaires sont spécifiées dans d'autres parties de la série IEC 61557.

4.4 Dispositif d'essai des batteries

Les appareils de mesure alimentés par des batteries sèches/éléments rechargeables doivent soumettre à essai et indiquer si l'état de charge de ces batteries permet une mesure dans le respect de la spécification. Cela peut être réalisé automatiquement lors d'un cycle de mesure ou au moyen d'une mesure distincte. Lorsque l'essai des batteries constitue une fonction distincte, le niveau de la charge d'essai doit être identique à celui apparaissant lors d'une mesure.

4.5 Sécurité

L'appareil de mesure et de surveillance doit être conforme à l'IEC 61010-1, à l'IEC 61010-2-030, à l'IEC 61010-031, à l'IEC 61010-2-034 et si applicable à l'IEC 61010-2-032, ainsi qu'aux exigences supplémentaires suivantes.

Les catégories de surtension et/ou de mesure sont spécifiées dans les parties applicables de l'IEC 61557.

Les appareils de mesure portatifs doivent satisfaire aux exigences d'isolation double ou renforcée.

Les parties conductrices des bornes ne doivent pas être accessibles ni dangereuses lorsqu'elles sont connectées, partiellement connectées ou déconnectées.

S'il est utilisé à des fins de mesure, le conducteur de protection doit être pris en compte comme une partie active, sauf exigence contraire dans les autres parties de l'IEC 61557.

Les bornes doivent être conçues de telle sorte que la sonde puisse être connectée à l'appareil de mesure de façon fiable.

4.6 Compatibilité électromagnétique

4.6.1 Immunité

Pour l'immunité, les exigences du Tableau 2 de l'IEC 61326-1:2012 doivent s'appliquer. Pour les essais, voir 6.5.

4.6.2 Emission

Pour les émissions, les limites de classe A ou de classe B doivent s'appliquer conformément au 7.2 de l'IEC 61326-1:2012.

4.7 Résistance mécanique aux vibrations

Outre les essais de résistance mécanique selon l'IEC 61010-1, les appareils de mesure doivent satisfaire aux conditions vibratoires décrites ci-après (essai de type):

– direction: trois plans perpendiculaires les uns par rapport aux autres;
– amplitude: 1 mm;
– fréquence: 25 Hz;
– durée: 20 min.

5 Marquage et instructions de fonctionnement

5.1 Généralités

Le marquage et les instructions de fonctionnement doivent être conformes à l'IEC 61010-1, à l'IEC 61010-2-032, à l'IEC 61010-2-030, ainsi qu'aux exigences des parties applicables de l'IEC 61557.

5.2 Marquage

L'appareil de mesure doit comporter le marquage suivant:

– type d'appareil;
– type de fusible et courant assigné dans le cas des fusibles interchangeables;
– type de pile ou de batterie et polarité des connexions dans le logement à piles;
– tension de réseau nominale et si applicable symbole correspondant à la double isolation selon le symbole n° 11 du Tableau 1 de l'IEC 61010-1:2010;
– nom du fabricant ou marque déposée;
– numéro de modèle, nom ou tout autre moyen permettant d'identifier l'appareil (à l'intérieur ou à l'extérieur);
– référence aux instructions de fonctionnement conformément à l'IEC 61010-1:2010, Tableau 1, symbole nº 14.

Les unités des grandeurs mesurées et les plages de mesure doivent être indiquées sur le boîtier ou sur le dispositif d'affichage.

5.3 Instructions de fonctionnement

5.3.1 Exigences de performance

L'incertitude de fonctionnement, l'incertitude intrinsèque et les variations de E_1 à E_{15} doivent être indiquées dans les instructions de fonctionnement (à l'exception des dispositifs de mesure couverts par l'IEC 61557-8 et l'IEC 61557-9).

5.3.2 Informations diverses

Les instructions de fonctionnement doivent comporter les informations suivantes:

– schémas de raccordement;
– instructions de mesure;
– brève description du principe de mesure;
– schémas ou tableaux contenant les valeurs maximales admissibles affichées, en tenant compte des tolérances indiquées par le fabricant (si nécessaire);
– type de pile ou d'élément rechargeable;
– informations concernant le courant de charge, la tension de charge et la durée de charge des éléments rechargeables;
– durée de vie des piles ou durée de fonctionnement des batteries ou éléments rechargeables, ou nombre de mesures possible;
– type de protection IP selon l'IEC 60529;
– toutes notes de recommandation particulières nécessaires.

6 Essais

6.1 Généralités

Les appareils de mesure doivent être soumis à essai conformément aux normes de sécurité IEC 61010-1, IEC 61010-2-030, IEC 61010-031, IEC 61010-2-034 et, si applicable, IEC 61010-2-032, ainsi qu'aux normes de CEM IEC 61326-1 (toutes les parties applicables).

Sauf spécification contraire, tous les essais doivent être réalisés dans les conditions de référence. Les conditions de référence sont indiquées dans les parties applicables de l'IEC 61557.

Des tolérances sont ajoutées dans les parties applicables de l'IEC 61557.

6.2 Incertitude de fonctionnement

6.2.1 Généralités

L'incertitude de fonctionnement doit être déterminée conformément aux paragraphes 6.2.2 à 6.2.4.

6.2.2 Influence du changement de position

La variation E_1 due à un changement de position conformément au 4.2 et au 4.3, si applicable, doit être déterminée en déplaçant l'appareil de +90° ou −90° par rapport à la position de référence précisée par le fabricant (essai individuel de série).

6.2.3 Influence de la température

La variation E_3 doit être déterminée par rapport à la température de référence à 0 °C et à 35 °C lorsque l'appareil a atteint son régime permanent (essai de type).

6.2.4 Influence de la tension d'alimentation

La variation E_2 due à un changement de la tension d'alimentation doit être déterminée dans les conditions de fonctionnement assignées suivantes (essai individuel de série):

– pour les appareils de mesure alimentés par les réseaux de distribution, l'essai est réalisé dans les limites indiquées au 4.3;

– pour les appareils de mesure alimentés par des piles ou batteries, l'essai est réalisé dans les limites indiquées au 4.4 et au 6.3;

– pour les appareils de mesure alimentés par un générateur manuel à magnéto, l'essai est réalisé dans les limites indiquées au 4.3.

6.3 Dispositif d'essai des batteries

Les valeurs limites inférieures et supérieures de la tension de la batterie, à laquelle le dispositif d'essai de la batterie est fixé conformément au 4.4, doivent être déterminées au moyen d'une source de tension extérieure. Ces valeurs doivent servir de valeurs limites pour la variation E_2 lors des essais effectués en changeant la tension d'alimentation conformément au 6.2.4 (essai individuel de série).

6.4 Essais de sécurité

La conformité au 4.5 doit être soumise à essai (essai de type).

6.5 Essais de CEM

Les exigences suivantes s'appliquent aux champs électromagnétiques à fréquences radioélectriques et aux fréquences radioélectriques conduites:

– les circuits auxiliaires de l'appareil de mesure doivent être alimentés en tension assignée;

– l'appareil de mesure doit être soumis à essai dans ses conditions de fonctionnement.

6.6 Exigences mécaniques

L'essai doit être réalisé conformément au 4.7 (essai de type).

Il est estimé que les appareils ont satisfait aux essais lorsqu'aucune pièce ne s'est desserrée ou déformée et que les câbles de connexion ne sont pas endommagés. Après le processus, l'appareil de mesure doit satisfaire aux exigences d'incertitude intrinsèque de l'appareil (essai de type), si applicable.

6.7 Marquage et instructions de fonctionnement

Le marquage et les instructions de fonctionnement doivent être vérifiés par examen visuel (essai de type).

Le marquage doit être examiné lors de l'essai de type et de l'essai individuel de série.

6.8 Enregistrements

La conformité aux essais de l'Article 6 doit être enregistrée.

Annexe A
(informative)

Description de l'application du GUM dans la série IEC 61557

A.1 Introduction

L'incertitude de fonctionnement est un paramètre prédictif qui caractérise l'incertitude élargie des résultats générés par le dispositif de mesure dans les conditions de fonctionnement définies.

L'incertitude de fonctionnement constitue une limite supérieure de l'incertitude élargie qui peut être attendue si le dispositif fonctionne dans les conditions de fonctionnement définies.

L'incertitude de fonctionnement peut être utilisée pour caractériser les résultats générés par le dispositif si ce dernier est utilisé dans les conditions de fonctionnement définies.

Dans la mesure du possible et du raisonnable, l'incertitude peut être exprimée sous une forme relative ou conventionnelle. L'incertitude relative correspond au rapport U/V de l'incertitude absolue U sur la valeur de mesure V, et l'incertitude conventionnelle correspond au rapport U/V_{f} de l'incertitude absolue U sur une valeur conventionnelle choisie V_{f}.

Les principes du GUM (Guide ISO/IEC 98-3:2008) sont utilisés pour calculer l'incertitude de fonctionnement.

A.2 Modèle de base pour l'évaluation des résultats en conditions de fonctionnement

A.2.1 Généralités

Le modèle de base pour l'évaluation des résultats en conditions de fonctionnement est le suivant:

$$Y_{\mathrm{oper}} = Y_{\mathrm{ref}} + \sum_i \delta E_i$$

Le résultat en conditions de référence Y_{ref} correspond au résultat qui pourrait être généré en conditions de référence (étalonnage). L'incertitude $u(Y_{\mathrm{ref}})$ est évaluée pendant l'étalonnage.

Les écarts δE_i sont calculés à partir des conditions de fonctionnement. En général, la valeur attendue de δE_i est zéro et certaines limites sont connues.

A.2.2 Incertitude type d'un résultat

L'incertitude type d'un résultat en conditions de fonctionnement $u(Y_{\mathrm{oper}})$ peut être calculée par propagation de l'incertitude. La sensibilité de l'ensemble des grandeurs d'entrée est égale à 1:

$$u\left(Y_{\mathrm{oper}}\right) = \sqrt{u\left(Y_{\mathrm{ref}}\right)^2 + \sum_i u\left(\delta E_i\right)^2}$$

L'incertitude type en conditions de référence est égale à l'incertitude élargie évaluée lors de l'étalonnage divisée par le facteur d'élargissement:

$$u\left(Y_{\text{ref}}\right) = \frac{U_{\text{cal}}\left(Y\right)}{k_{\text{cal}}}$$

A.2.3 Incertitude élargie

L'incertitude élargie de l'étalonnage $U_{\text{cal}}(Y)$ et le facteur d'élargissement k_{cal} (qui équivaut en général à 2) sont indiqués dans le certificat d'étalonnage.

Pour les écarts δE_i, en général seules certaines limites symétriques par rapport à zéro sont connues. Conformément au GUM, les limites peuvent être converties en incertitude type en utilisant une distribution rectangulaire:

$$u\left(\delta E_i\right) = \frac{e_i}{\sqrt{3}}$$

La valeur e_i correspond à la demi-largeur des limites qui caractérisent l'écart δE_i.

L'incertitude de fonctionnement est égale à l'incertitude type en conditions de fonctionnement multipliée par le facteur d'élargissement de fonctionnement:

$$U\left(Y_{\text{oper}}\right) = k_{\text{oper}} \times u\left(Y_{\text{oper}}\right)$$

Le facteur d'élargissement de fonctionnement k_{oper} est défini sur 2,0.

Cela correspond à la demi-largeur de l'intervalle élargi avec une probabilité de couverture de 95,45 % en prenant pour hypothèse que les résultats sont distribués de manière normale.

A.2.4 Incertitude de fonctionnement relative

L'incertitude de fonctionnement relative en pourcentage peut être calculée à l'aide de la valeur conventionnelle Y_{f}.

$$W\left(Y_{\text{oper}}\right) = \frac{U\left(Y_{\text{oper}}\right)}{Y_{\text{f}}} \times 100\,\%$$

L'incertitude de fonctionnement et l'incertitude de fonctionnement relative en pourcentage peuvent être écrites comme des limites d'intervalle symétriques à l'aide des signes plus et moins.

A.2.5 Incertitude d'étalonnage

Pour les calculs pratiques, l'incertitude d'étalonnage $U_{\text{cal}}(Y)$ peut être remplacée par A et la valeur e_i par E_i. L'équation qui en résulte est la suivante:

$$U\left(Y_{\text{oper}}\right) = \sqrt{A^2 + \frac{4}{3}\sum_i E_i^{\,2}} \le |A| + 1{,}5 \times \sqrt{\sum_i E_i^{\,2}}$$

en prenant pour hypothèse que le facteur d'élargissement k_{cal} indiqué dans le certificat d'étalonnage équivaut au facteur d'élargissement de fonctionnement k_{oper} = 2,0.

Par conséquent, l'équation suivante peut être utilisée comme limite supérieure de l'intervalle élargi de fonctionnement:

$$B = \pm\left[\left|A\right| + 1{,}15 \times \sqrt{\sum_i E_i^{\,2}}\right]$$

A.3 Calcul de l'incertitude de fonctionnement comme base pour le 4.1

A.3.1 Incertitude type

Ce modèle repose sur l'ajout de défauts.

Incertitude relative au GUM (méthode de mesure B du Guide ISO/IEC 98-1:2009) pour une distribution statistique:

$$u = \sqrt{a^2 + \sum_i e_i^{\,2}}$$

où

a est l'incertitude de fonctionnement intrinsèque attendue, par les certificats d'étalonnage, par exemple;

e_i est l'incertitude de fonctionnement attendue par les facteurs d'influence (température, par exemple);

u est l'incertitude type du résultat de mesure exprimée comme un écart-type.

A.3.2 Incertitude de fonctionnement selon le 4.1

Ce modèle de calcul repose sur l'incertitude élargie conformément au GUM (Guide ISO/IEC 98-3:2008, 6.2).

Détermination de l'incertitude de fonctionnement pour la série de normes IEC 61557 avec précision des distributions statistiques définies en fonction de valeurs empiriques:

– $B = \pm\, k \times u$ avec $k = 2$ pour une probabilité de couverture de 95,45 %;

– $a = \dfrac{A}{2}$ distribution type de l'incertitude intrinsèque;

– $e_i = \dfrac{E_i}{\sqrt{3}}$ distribution rectangulaire de l'incertitude de fonctionnement en fonction des facteurs d'influence en fonctionnement;

– $B = \pm\sqrt{A^2 + \dfrac{4}{3}\sum_i E_i^{\,2}}$ incertitude pour une probabilité de couverture de 95,45 % conformément au GUM (Guide ISO/IEC 98-3:2008, 7.22).

Annexe B
(informative)

Aspects environnementaux

B.1 Introduction

Tout produit a un impact sur l'environnement qui peut se produire au cours de l'une des phases de son cycle de vie ou tout au long de celui-ci (acquisition des matières premières, fabrication, distribution, utilisation, maintenance, valorisation et fin de vie). L'importance de ces impacts peut s'échelonner de faible à significative; ils peuvent être à court ou à long terme, et ils peuvent se produire au niveau local, national, d'une région du monde ou mondial (ou une combinaison de ces éléments).

L'utilisation généralisée des produits électriques et électroniques a conduit à une prise de conscience accrue de leurs effets sur l'environnement. Ceci suscite des législations et des exigences dictées par le marché en faveur d'une écoconception des produits.

L'introduction continue de nouveaux produits et matériaux peut accroître considérablement la complexité de l'évaluation, d'autant qu'il est nécessaire de collecter des données complémentaires afin d'apprécier les impacts du cycle de vie de ces produits et matériaux. Les données collectées servent de base à l'amélioration des produits au regard de leurs impacts environnementaux. L'analyse du cycle de vie (ACV) et les principes d'écoconception (ECD) fournissent des instruments pouvant s'avérer utiles en la matière.

L'application de l'ACV à un processus d'ECD permet de réduire les impacts négatifs défavorables pour l'environnement d'un produit tout au long de son cycle de vie. Cette approche peut engager la recherche d'un équilibre entre les effets sur l'environnement du produit et d'autres facteurs comme son utilisation prévue, sa sécurité, ses performances, son coût, sa qualité marchande et sa qualité intrinsèque, et le choix de méthodes pour satisfaire aux exigences légales et réglementaires de manière à mieux prendre en compte le respect de l'environnement. La poursuite de cet objectif peut offrir des avantages multiples pour l'organisme concerné, ses clients et les autres parties prenantes. La prise en compte des aspects environnementaux, notamment aux prémices du processus de conception d'un produit, peut contribuer à la réduction des coûts et à l'optimisation du potentiel commercial. L'écoconception n'est pas une activité de conception isolée; elle fait plutôt partie intégrante du processus de conception existant. Dans le contexte de la présente norme, la "conception" inclut les activités associées aux processus de planification du produit, de développement et de prise de décision ainsi que la création de politiques à suivre au sein de l'organisme.

L'ECD est destinée à être utilisée par l'ensemble des acteurs impliqués dans la conception et le développement de produits électriques et électroniques. Toutes les parties prenantes à la chaîne logistique sont concernées, quels que soient leur type d'organisation, leur taille, leur localisation et leur complexité. Elle est applicable à tous les types de produits, aussi bien neufs que modifiés. Des documents spécifiques à un secteur peuvent être développés pour répondre aux besoins qui ne sont pas couverts dans le présent document. L'utilisation de la présente annexe comme référence de base est préconisée afin d'assurer une cohérence à l'intérieur du secteur électrotechnique.

La présente annexe donne un ensemble de lignes directrices pour établir la déclaration de matériaux et les informations de fin de vie dans le cadre général des données qui doivent être partagées conformément à l'IEC 62430 "Ecoconception pour les produits électriques et électroniques".

B.2 Lignes directrices pour établir la déclaration de matériaux et les informations de fin de vie

B.2.1 Généralités

Les réglementations, les labels ou les clients demandent de plus en plus aux fabricants de fournir la déclaration de matériaux et les informations de fin de vie afin de publier les données relatives à la composition de leurs produits. Ces informations sont principalement utilisées pour:

– apprécier la conformité des produits aux exigences de restriction en matière de substances;
– améliorer la fin de vie des produits en simplifiant l'intégration aux processus de recyclage adaptés.

La fourniture de la déclaration de matériaux relève de la discrétion du fabricant.

NOTE Dans la mesure où l'IEC 62474 a pour objet d'établir les exigences relatives aux déclarations de matériaux, de normaliser les protocoles et de faciliter le transfert et le traitement des données, son application tout au long de la chaîne logistique peut simplifier la compilation des déclarations de matériaux des produits.

B.2.2 Lignes directrices pour la déclaration de matériaux

Il convient de réaliser la déclaration de matériaux conformément à l'IEC 62474 en y incluant au moins les deux sections suivantes:

– exigences de données de base:
  - nom de la famille de produits;
  - identification du produit: références commerciales couvertes par la déclaration;
  - masse totale du produit;
  - poids et type de batteries, si intégrées;
  - poids de l'emballage;
– informations sur la classe de matériaux:
  - répartition de la masse conformément aux 15 classes de matériaux génériques définies dans la base de données IEC 62474.

NOTE L'IEC 62474 fournit des exemples de déclarations de matériaux.

Une déclaration de matériaux unique peut être déposée pour une famille de produits uniquement lorsque la composition est identique pour l'ensemble des produits.

B.2.3 Lignes directrices de fin de vie

Différentes réglementations (pour les appareils électriques et électroniques, les batteries et les emballages à mettre au rebut), incitations à une économie circulaire ou différents clients exigent ou encouragent la conception de produits facilement recyclables.

Si cela est exigé, il convient d'établir les informations relatives à la fin de vie (EoLI - End-of-Life Information) conformément à l'IEC TR 62635 en y incluant au moins les informations suivantes:

– identification du fabricant;
– identification du produit;
– identification des dangers potentiels;
– traitement sélectif;
– croquis, schémas ou images permettant d'identifier et de localiser les pièces et matériaux répertoriés.

B.2.4 Exemple de déclaration de matériaux et d'informations de fin de vie

B.2.4.1 Identification du fabricant

Adresse: xxxxxxxxxxxxxxxxx

Site web: xxxxxxxxxxxxxxxxx

B.2.4.2 Identification du produit

Plage: instrument de mesure multifonction xxxxxx

Références commerciales: xxxxxx, xxxxx, xxxxxx, etc.

B.2.4.3 Objet du document

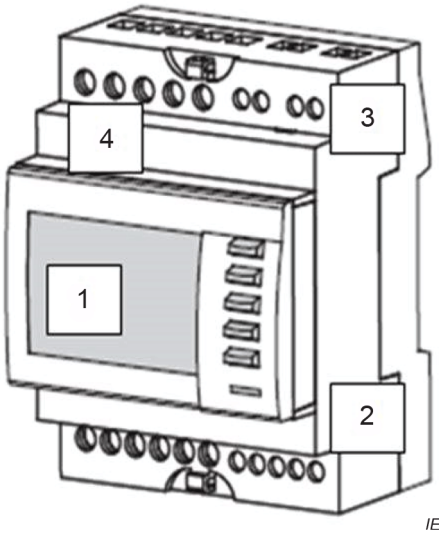
La présente déclaration vise à fournir des informations de base sur la teneur en matière du produit (voir Tableau B.1) et les informations de fin de vie.

Tableau B.1 – Teneur en matière conformément aux classes de matériaux de l'IEC 62474

Métaux, poids (%)		**Plastiques, poids (%)**		**Autres, poids (%)**	
Acier inoxydable	< 1	Polychlorure de vinyle	< 1	Céramique et verre	7,5
Autres alliages ferreux, aciers non inoxydables	5	Autres thermoplastiques	60	Autres matériaux organiques	< 1
Aluminium et ses alliages	< 1				
Cuivre et ses alliages	15				
Magnésium et ses alliages	< 1				
Nickel et ses alliages	< 1				
Zinc et ses alliages	1,5				
Métaux précieux	< 1				
Autres métaux et alliages non ferreux	< 1				
Masse totale du produit: 400 g					
Masse de l'emballage: 100 g					

B.2.4.4 Informations de fin de vie

Une liste des composants et matériaux pouvant être soumis au traitement sélectif peut être exigée conformément aux réglementations locales/nationales pour l'appareil de mesure. De tels composants peuvent être par exemple ceux représentés à la Figure B.1.



Légende

1 écran LCD

2 circuits imprimés (à l'intérieur du module)

3 élément au lithium (à l'intérieur du module)

4 matière plastique avec agents ignifugeants bromés

Figure B.1 – Composants répertoriés pour la fin de vie d'un produit

Il convient que la mise hors service et le démantèlement soient effectués par du personnel qualifié.

Bibliographie

IEC 60050-195:1998, *Vocabulaire Electrotechnique International (IEV) – Partie 195: Mise à la terre et protection contre les chocs électriques*

IEC 60050-311:2001, *Vocabulaire Electrotechnique International (IEV) – Partie 311: Termes généraux concernant les mesures*

IEC 60050-442:1998, *Vocabulaire Electrotechnique International (IEV) – Partie 442: Petit appareillage*

IEC 60050-614:2016, *Vocabulaire Electrotechnique International (IEV) – Partie 614: Production, transport et distribution de l'énergie électrique – Exploitation*

IEC 60050-826:2004, *Vocabulaire Electrotechnique International (IEV) – Partie 826: Installations électriques*

IEC 60359, *Appareils de mesure électriques et électroniques – Expression des performances*

IEC 60364-1, *Installations électriques à basse tension – Partie 1: Principes fondamentaux, détermination des caractéristiques générales, définitions*

IEC 60364-6, *Installations électriques à basse tension – Partie 6: Vérification*

IEC 60664-1, *Coordination de l'isolement des matériels dans les systèmes (réseaux) à basse tension – Partie 1: Principes, exigences et essais*

IEC 61326 (toutes les parties), *Matériel électrique de mesure, de commande et de laboratoire – Exigences relatives à la CEM*

IEC 61326-2-4, *Matériel électrique de mesure, de commande et de laboratoire – Exigences relatives à la CEM – Partie 2-4: Exigences particulières – Configurations d'essai, conditions de fonctionnement et critères de performance pour les contrôleurs d'isolement conformes à l'IEC 61557-8 et pour les dispositifs de localisation de défaut d'isolement conformes à l'IEC 61557-9*

IEC 62430, *Eco-conception pour les produits électriques et électroniques*

IEC 62474, *Déclaration de matières pour des produits de et pour l'industrie électrotechnique*

IEC TR 62635, *Guidelines for end-of-life information provided by manufacturers and recyclers and for recyclability rate calculation of electrical and electronic equipment* (disponible en anglais seulement)

Guide ISO/IEC 98-1:2009, *Incertitude de mesure – Partie 1: Introduction à l'expression de l'incertitude de mesure*

Guide ISO/IEC 98-3:2008, *Incertitude de mesure – Partie 3: Guide pour l'expression de l'incertitude de mesure (GUM:1995)*

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