IEC 61180

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

High-voltage test techniques for low-voltage equipment – Definitions, test and procedure requirements, test equipment

Techniques des essais à haute tension pour matériel à basse tension – Définitions, exigences et modalités relatives aux essais, matériel d'essai

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CONTENTS

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HIGH-VOLTAGE TEST TECHNIQUES FOR LOW-VOLTAGE EQUIPMENT –

Definitions, test and procedure requirements, test equipment

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

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International Standard IEC 61180 has been prepared by IEC technical committee 42: High-voltage and high-current test techniques.

This 1st edition of IEC 61180 cancels and replaces the 1st edition of IEC 61180-1, issued in 1992, and the 1st edition of IEC 61180-2, issued in 1994.

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

FDIS	Report on voting
42/341/FDIS	42/342/RVD

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

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

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

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

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HIGH-VOLTAGE TEST TECHNIQUES FOR LOW-VOLTAGE EQUIPMENT –

Definitions, test and procedure requirements, test equipment

1 Scope

This International Standard is applicable to:

– dielectric tests with direct voltage;
– dielectric tests with alternating voltage;
– dielectric tests with impulse voltage;
– test equipment used for dielectric tests on low-voltage equipment.

This standard is applicable only to tests on equipment having a rated voltage of not more than 1 kV a.c. or 1,5 kV d.c.

This standard is applicable to type and routine tests for objects which are subjected to high voltage tests as specified by the technical committee.

The test equipment comprises a voltage generator and a measuring system. This standard covers test equipment in which the measuring system is protected against external interference and coupling by appropriate screening, for example a continuous conducting shield. Therefore, simple comparison tests are sufficient to ensure valid results.

This standard is not intended to be used for electromagnetic compatibility tests on electric or electronic equipment

NOTE Tests with the combination of impulse voltages and currents are covered by IEC 61000-4-5.

This standard provides the relevant technical committees as far as possible with:

– defined terms of both general and specific applicability;
– general requirements regarding test objects and test procedures;
– methods for generation and measurement of test voltages;
– test procedures;
– methods for the evaluation of test results and to indicate criteria for acceptance;
– requirements concerning approved measuring devices and checking methods;
– measurement uncertainty.

Alternative test procedures may be required and these should be specified by the relevant technical committees.

Care should be taken if the test object has voltage limiting devices, as they may influence the results of the test. The relevant technical committees should provide guidance for testing objects equipped with voltage limiting devices.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For

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

IEC 60060-1:2010, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60060-2:2010, *High-voltage test techniques – Part 2: Measuring systems*

IEC 60068-1:2013, *Environmental testing – Part 1: General and guidance*

IEC 60335(all parts): *Household and similar electrical appliances – Safety*

IEC 60664-1:2007, *Insulation co-ordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 61083-1:2001, *Instruments and software used for measurement in high-voltage impulse test – Part 1: Requirements for instruments*

IEC 61083-2:2013, *Instruments and software used for measurement in high-voltage and high-current tests – Part 2: Requirements for software for tests with impulse voltages and currents*

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

3 Terms and definitions

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

3.1 General terms

3.1.1
clearance
distance between two conductive parts along a string stretched across the shortest path between these conductive parts

[SOURCE: IEC 60050-441:1984, 441-17-31]

3.1.2
creepage distance
shortest distance along the surface of a solid insulating material between two conductive parts

[SOURCE: IEC 60050-151: 2001, 151-15-50]

3.2 Definitions related to disruptive discharge and test voltages

3.2.1
disruptive discharge
failure of insulation under electric stress, in which the discharge completely bridges the insulation under test, reducing the voltage between electrodes to practically zero

3.2.2
withstand voltage
specified voltage value which characterizes the insulation of the object with regard to a withstand test

Note 1 to entry: Unless otherwise specified, withstand voltages are referred to standard reference atmospheric conditions (see 4.2).

3.3 Characteristics related to the test equipment

3.3.1
calibration
set of operations that establishes, by reference to standards, the relationship which exists, under specified conditions, between an indication and a result of a measurement

Note 1 to entry: The determination of the scale factor is included in the calibration.

[SOURCE: IEC 60050-311:2001, 311-01-09, modified: note modified]

3.3.2
type test
conformity test made on one or more items representative of the production

Note 1 to entry: For a measuring system, this is a test performed on a component or on a complete measuring system of the same design to characterize it under operating conditions.

[SOURCE: IEC 60050-151: 2001, 151-16-16, modified:note added]

3.3.3
routine test
conformity test made on each individual item during or after manufacture

Note 1 to entry: This is a test performed on each component or on each complete measuring system to characterize it under operating conditions.

[SOURCE: IEC 60050-151: 2001, 151-16-17, modified:note added]

3.3.4
performance test
test performed on a complete measuring system to characterize it under operating conditions

3.3.5
test equipment
complete set of devices needed to generate and measure the test voltage or current applied to a test object

3.3.6
reference measuring system
measuring system with its calibration traceable to relevant national and/or international standards, and having sufficient accuracy and stability for use in the approval of other systems by making simultaneous comparative measurements with specific types of waveform and ranges of voltage

3.3.7
assigned scale factor
scale factor of a measuring system determined at the most recent performance test

Note 1 to entry: A measuring system may have more than one assigned scale factor; for example, it may have several ranges, each with a different scale factor.

3.4 Characteristics related to direct voltage tests

3.4.1
value of the test voltage
arithmetic mean value

3.4.2
ripple
periodic deviation from the arithmetic mean value of the test voltage

3.4.3
ripple amplitude
half the difference between the maximum and minimum values

Note 1 to entry: In cases where the ripple shape is nearly sinusoidal, true r.m.s. values multiplied by $\sqrt{2}$ are acceptable for determination of the ripple amplitude.

3.4.4
ripple factor
ratio of the ripple amplitude to the value of test voltage

3.5 Characteristics related to alternating voltage tests

3.5.1
peak value
average of the magnitudes of the positive and negative maximum values

3.5.2
r.m.s. value
square root of the mean value of the square of the voltage values during a complete cycle

3.5.3
true r.m.s. value
value obtained from

$$I_{\mathrm{rms}} = \sqrt{\frac{1}{T}\int_0^T i^2(t)\,\mathrm{d}t}$$

where

0 is the time instant ($t = 0$) of an a.c. periodic wave, convenient for the beginning of integration;

T is the time taken over an integral number of cycles;

$i(t)$ is the instantaneous value of the current.

Note 1 to entry: The true r.m.s. value can in general be calculated from a digitized record of any periodic waveform, provided a sufficient number of samples have been taken.

Note 2 to entry: In cases with varying frequency, no strict formula for true r.m.s. value can be given.

3.5.4
total harmonic distortion
THD
the ratio of the rms value of the harmonic content of an alternating quantity to the rms value of the fundamental component of the quantity

[SOURCE: IEC 60050-551: 1998, 551-17-06]

3.6 Characteristics related to impulse tests (see Figure 1)

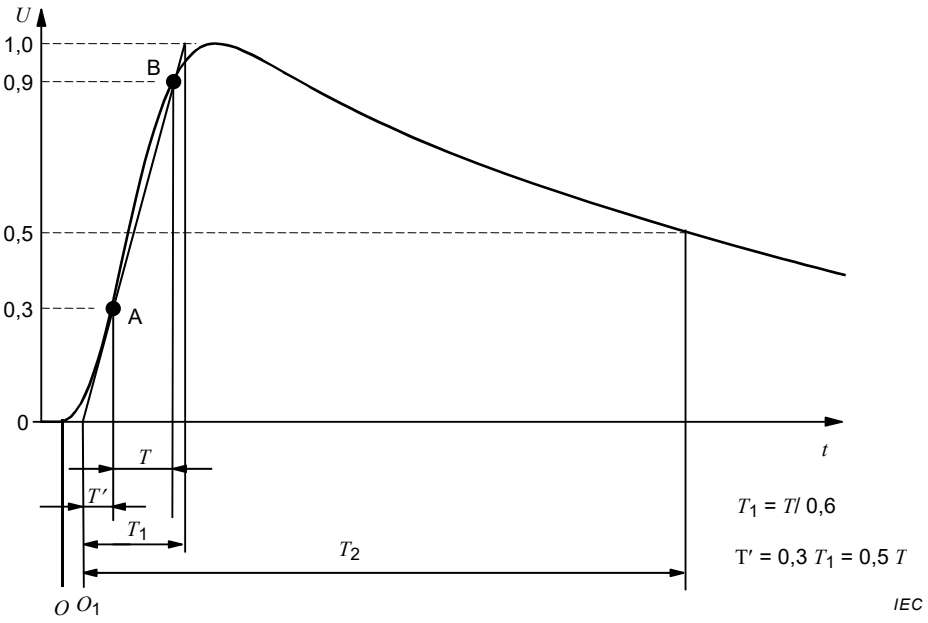

Figure 1 – Full impulse voltage time parameters

Note 1 to entry: Oscillations are negligible.

3.6.1
impulse voltage
intentionally applied aperiodic transient voltage which usually rises rapidly to a peak value and then falls more slowly to zero

3.6.2
peak value
maximum value

3.6.3
value of the test voltage
for an impulse without overshoot or oscillations, its peak value

Note 1 to entry: The determination of the peak value, in the case of oscillations or overshoot on standard impulses, is considered in IEC 60060-1.

3.6.4
front time
T_1
virtual parameter defined as 1/0,6 times the interval T between the instants when the impulse is 30 % and 90 % of the peak value on the test voltage curve (points A and B, Figure 1)

3.6.5
virtual origin
O_1
instant preceding point A, of the test voltage curve (see Figure 1) by a time 0,3 T_1

Note 1 to entry: For records having linear time scales, this is the intersection with the time axis of a straight line drawn through the reference points A and B on the front.

3.6.6
time to half-value
T_2
virtual parameter defined as the time interval between the virtual origin O_1 and the instant when the voltage has decreased to half the peak value

3.6.7
recorded curve
graphical or digital representation of the test data of an impulse voltage

3.7 Definitions relating to tolerance and uncertainty

3.7.1
tolerance
permitted difference between the measured value and the specified value

3.7.2
uncertainty of measurement
parameter, associated with the result of a measurement, that characterizes the dispersion of the values that could be reasonably attributed to the measurand

Note 1 to entry: Uncertainty is positive and given without sign.

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

3.7.3
error
measured quantity value minus a reference quantity value

[SOURCE: ISO/IEC Guide 98-3:2008, GUM 2.3.2]

3.7.4
standard uncertainty
u
uncertainty of the result of a measurement expressed as a standard deviation

Note 1 to entry: The standard uncertainty associated with an estimate of a measurand has the same dimension as the measurand.

Note 2 to entry: In some cases, the relative standard uncertainty of a measurement may be appropriate. The relative standard uncertainty of measurement is the standard uncertainty divided by the measurand, and is therefore dimensionless.

[SOURCE: ISO/IEC Guide 98-3:2008, GUM 2.3.1]

3.7.5
combined standard uncertainty
u_c
standard uncertainty of the result of a measurement when that result is obtained from the values of a number of other quantities, equal to the positive square root of a sum of terms, the terms being the variances or covariances of these other quantities weighted according to how the measurement result varies with changes in these quantities

[SOURCE: ISO/IEC Guide 98-3:2008, GUM 2.3.4]

3.7.6
expanded uncertainty
U
quantity defining an interval about the result of a measurement that may be expected to encompass a large fraction of the distribution of values that could reasonably be attributed to the measurand

Note 1 to entry: Expanded uncertainty is the closest match to the term “overall uncertainty”.

Note 2 to entry: The true, but unknown test-voltage value may lie outside the limits given by the uncertainty because the coverage probability is < 100 % (see 3.7.7).

[SOURCE: ISO/IEC Guide 98-3:2008, GUM 2.3.5, modified:notes added]

3.7.7
coverage factor
k
numerical factor used as multiplier of the combined standard uncertainty in order to obtain an expanded uncertainty

Note 1 to entry: For 95 % coverage probability and normal (Gaussian) probability distribution the coverage factor is approximately $k = 2$.

[SOURCE: ISO/IEC Guide 98-3:2008, GUM 2.3.6, modified:note added]

3.7.8
type A evaluation
method of evaluation of an uncertainty by statistical analysis of a series of observations

3.7.9
type B evaluation
method of evaluation of an uncertainty by means other than statistical analysis of a series of observations

3.7.10
national metrology institute
institute designated by national decision to develop and maintain national measurement standards for one or more quantities

4 General requirements

4.1 General

Unless otherwise specified by the relevant technical committee, the test object should be clean and dry, stabilized to ambient environmental conditions and the voltage application shall be as specified in the relevant clauses of this standard. The test procedures applicable to particular types of test objects, should be specified by the relevant technical committee, having regard to such factors as:

- the required accuracy of test results;
- the random nature of the observed phenomenon and any polarity dependence of the measured characteristics;
- the possibility of progressive deterioration with repeated voltage applications.

This includes for example, the polarity to be used, the preferred order if both polarities are to be used, the number of applications and the interval between applications, and any conditioning and preconditioning.