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High-current test techniques - Definitions and requirements for test currents and measuring systems

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FOREWORD

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IEC 62475 has been prepared by IEC technical committee 42: High-voltage and high-current test techniques. It is an International Standard.

This second edition cancels and replaces the first edition published in 2010. This edition constitutes a technical revision.

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

a) minor errors in edition 1 have corrected;
b) terms and definitions have been modified to achieve best possible adherence to IEC 60060-2:2025 and have been ascribed appropriate [SOURCE];
c) terms and definitions which in edition 1 were presented in clauses other than Clause 3 have been moved into Clause 3.

d) Annex B, Clause B.4 has been amended to provide an example of uncertainty calculation for the use of an approved measuring system;

e) Clause C.2 has been deleted since the definitions given there are not referred to, with the exception of the origin of the step, which is used in Annex D. The applicable information has been added to Annex D as Note 1.

f) Annex G, Clause G.8 has been amended to replace “peak factor” by “a factor”. Texts have been clarified. Equations for relation between factor κ and cos ϕ have been developed to a simplified form.

g) Annex G, Clause G.9 has been added.

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

Draft	Report on voting
42/472/FDIS	42/475/RVD

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

The language used for the development of this International Standard is English.

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

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

– reconfirmed,

– withdrawn, or

– revised.

1 Scope

This document is applicable to high-current testing and measurements on both high-voltage and low-voltage equipment. It deals with steady-state and short-time direct current (as e.g. encountered in high-power DC testing), steady-state and short-time alternating current (as e.g. encountered in high-power AC testing), and impulse-current. In general, currents above 100 A are considered in this document, although currents less than this can occur in tests.

NOTE This document also covers fault detection during, for example, lightning impulse testing.

This document:

– defines the terms used;
– defines parameters and their tolerances;
– describes methods to estimate uncertainties of high-current measurements;
– states the requirements applicable to a complete measuring system;
– describes the methods for approving a measuring system and checking its components;
– describes the procedure by which the user shows that a measuring system meets the requirements of this document, including limits set for uncertainty of measurement.

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.

NOTE Informative references on subjects included in this document are given in the bibliography.

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

3 Terms and definitions

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

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

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

3.1 Measuring systems

3.1.1
measuring system
complete set of devices suitable for performing measurements of a quantity to be measured

Note 1 to entry: A high-current measuring system usually comprises the following components:

– converting device with either terminals to connect this device in circuit or appropriate coupling to the circuit, and connections to earth;

– transmission system(s) connecting the output terminals of the converting device to the measuring instrument(s) with its attenuating, terminating, and adapting impedances or networks;

– measuring instrument(s) together with any connections to the power supply. Measuring systems which comprise only some of the above components or which are based on non-conventional principles are acceptable if they meet the uncertainty requirements specified in this document;

– and in some cases the measuring system can include software to calculate the measurand.

Note 2 to entry: The environment in which a measuring system functions, its clearances to live, current carrying, and earthed structures, and the presence of electromagnetic fields can significantly affect the measurement result and its uncertainty.

[SOURCE: IEC 60060-2:2025, 3.1.1, modified – " a high-voltage measurement" replaced with " measurements of a quantity to be measured"; in Note 1: addition of "high-current" in the introductory sentence, modification of the first and third hyphens; in Note 2 to entry, addition of "current carrying" and replacement of " electric or magnetic fields may" with " electromagnetic fields can ".]

3.1.2
record of performance
detailed record, established and maintained by the user, describing the measuring system and containing evidence that the requirements given in this document have been met

Note 1 to entry: This evidence includes the results of the initial performance test and the schedule and results of each subsequent performance test and performance check.

[SOURCE: IEC 60060-2:2025, 3.1.2]

3.1.3
approved measuring system
measuring system that is shown to comply with one or more of the sets of requirements set out in IEC 62475

3.1.4
reference measuring system
measuring system with its calibration traceable to relevant national or international standards of measurement, 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 current

Note 1 to entry: A reference measuring system (maintained in accordance with the requirements of this document) can be used as an approved measuring system but the converse is not true.

[SOURCE: IEC 60060-2:2025, 3.1.4, modified – In the definition, replacement of "conducted in conformity with" with "traceable to", and "voltage" with "current".]

3.2 Components of a measuring system

3.2.1
converting device
device for converting the quantity to be measured (measurand) into a quantity compatible with the measuring instrument

[SOURCE: IEC 60060-2:2025, 3.2.1]

3.2.2
current-converting shunt
resistor across which the voltage is proportional to the current to be measured

3.2.3
current transformer
instrument transformer in which the secondary current, in normal conditions of use, is substantially proportional to the primary current and differs in phase from it by an angle which is approximately zero for an appropriate direction of the connections

Note 1 to entry: Current transformers are usually defined for a single frequency, but special designs with a wide frequency range are possible.

[SOURCE: IEC 60050-321:1986, 321-02-01, modified – Addition of Note 1 to entry.]

3.2.4
Rogowski coil
inductive current-converting device without iron that includes an integrating circuit (passive, active, or numerical)

3.2.5
transmission system
set of devices that transfers the output signal of a converting device to a measuring instrument(s)

Note 1 to entry: A transmission system usually consists of a coaxial cable with its terminating impedance, but it can include attenuators, amplifiers, or other devices connected between the converting device and the measuring instrument(s). For example, an optical link includes a transmitter, an optical cable, and a receiver as well as related amplifiers.

Note 2 to entry: A transmission system can be partially or completely included in the converting device or in the measuring instrument.

Note 3 to entry: A transmission system for purely digital data is not intended as this term.

[SOURCE: IEC 60060-2:2025, 3.2.6 modified – NOTE 3 to entry added.]

3.2.6
measuring instrument
device intended to make measurements, alone or in conjunction with supplementary devices

[SOURCE: IEC 60050-300:2001, 311-03-01]

3.3 Scale factors

3.3.1
scale factor
<of a measuring system> factor by which the value of the measuring-instrument reading is multiplied to obtain the value of the input quantity of the complete measuring system

Note 1 to entry: A measuring system can have multiple scale factors for different current ranges, frequency ranges or waveforms.

Note 2 to entry: Some measuring systems display the value of the input quantity directly (i.e., the nominal scale factor of the measuring system is unity).

[SOURCE: IEC 60060-2:2025, 3.3.1, modified – In Note 1 to entry, replacement of "assigned measurement" to "current"; In Note 2 to entry, addition of "i.e" and parentheses.]

3.3.2
scale factor
<of a converting device> factor by which the output of the converting device is multiplied to obtain its input quantity

Note 1 to entry: The scale factor of a converting device can be dimensionless (for example, the ratio of a current transformer) or can have dimensions (for example, related to the impedance of a current-converting shunt).

[SOURCE: IEC 60060-2:2025, 3.3.2, modified – In Note 1 to entry, replacement of "divider" with "current transformer" and "voltage converting impedance" with "current-converting shunt".]

3.3.3
scale factor
<of a transmission system> factor by which the output of a transmission system is multiplied to obtain its input quantity

[SOURCE: IEC 60060-2:2025, 3.3.3]

3.3.4
scale factor
<of a measuring instrument> factor by which the instrument reading is multiplied to obtain its input quantity

[SOURCE: IEC 60060-2:2025, 3.3.4]

3.3.5
assigned scale factor
F
scale factor of a measuring system determined at the most recent performance test

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

[SOURCE: IEC 60060-2:2025, 3.3.5]

3.4 Rated values

3.4.1
operating conditions
specified ranges of conditions under which a measuring system will operate within the specified uncertainty limits

[SOURCE: IEC 60060-2:2025, 3.4.1]

3.4.2
rated current
maximum level of current of specified frequency or waveform at which a measuring system is designed to be used

Note 1 to entry: The rated current can be higher than the upper limit of the assigned measurement range.

3.4.3
assigned measurement range
range of current of specified frequency or waveform in which a measuring system can be used within the uncertainty limits given in this document, characterized by a single scale factor

Note 1 to entry: The limits of the assigned measurement range are chosen by the user and verified by the performance tests specified in this document.

Note 2 to entry: A measuring system can have more than one assigned measurement range, with different scale factors established for the different ranges.

[SOURCE: IEC 60060-2:2025, 3.4.3, modified – In the definition, replacement of "voltage" with "current" and addition of " within the uncertainty limits given in this document"; in Note 2 to entry, addition of "for the different ranges".]

3.4.4
assigned operating time
longest time during which a DC or AC current measuring system can operate at the upper limit of the assigned measurement range within the uncertainty limits given in IEC 62475

[SOURCE: IEC 60060-2:2025, 3.4.4, modified – Replacement of "a measuring system for direct or alternating voltages" with " a DC or AC current measuring system" and addition of " within the uncertainty limits given in IEC 62475".]

3.4.5
assigned rate of application

highest rate of specified short-time currents or impulse currents that can be applied in a given time interval, at which the measuring system can operate at the upper limit of the assigned measurement range and stay within the uncertainty limits given in IEC 62475

Note 1 to entry: The assigned rate of application is normally given as applications per minute and the time interval in minutes or hours.

[SOURCE: IEC 60060-2:2025, 3.4.5]

3.5 Terms and definitions related to the dynamic behaviour

3.5.1
response of a measuring system
G
output, as a function of time or frequency, when a specified current is applied to the input of the system

[SOURCE: IEC 60060-2:2025, 3.5.1, modified – “voltage” replaced by “current”.]

3.5.2
amplitude-frequency response
$G(f)$
ratio of the output to the input of a measuring system as a function of frequency, f, when the input is sinusoidal, see Figure 1