

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



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

(standards.iteh.ai)

Techniques des essais à haute intensité – Définitions et exigences relatives  
aux courants d'essai et systèmes de mesure

IEC 62475:2010  
<https://standards.iteh.ai/catalog/standards/sist/2a6bdaa6-4c33-4874-a6f8-66b950777ef/iec-62475-2010>



## THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2010 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester.

If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de la CEI ou du Comité national de la CEI du pays du demandeur.

Si vous avez des questions sur le copyright de la CEI ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de la CEI de votre pays de résidence.

IEC Central Office  
3, rue de Varembe  
CH-1211 Geneva 20  
Switzerland  
Email: [inmail@iec.ch](mailto:inmail@iec.ch)  
Web: [www.iec.ch](http://www.iec.ch)

### About the IEC

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

### About IEC publications

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

- Catalogue of IEC publications: [www.iec.ch/searchpub](http://www.iec.ch/searchpub)

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 It also gives information on projects, withdrawn and replaced publications.

- IEC Just Published: [www.iec.ch/online\\_news/justpub](http://www.iec.ch/online_news/justpub)

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

[IEC 62475:2010](#)

- Electropedia: [www.electropedia.org](http://www.electropedia.org)

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

- Customer Service Centre: [www.iec.ch/webstore/custserv](http://www.iec.ch/webstore/custserv)

If you wish to give us your feedback on this publication or need further assistance, please visit the Customer Service Centre FAQ or contact us:

Email: [csc@iec.ch](mailto:csc@iec.ch)  
Tel.: +41 22 919 02 11  
Fax: +41 22 919 03 00

### A propos de la CEI

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

### A propos des publications CEI

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

- Catalogue des publications de la CEI: [www.iec.ch/searchpub/cur\\_fut-f.htm](http://www.iec.ch/searchpub/cur_fut-f.htm)

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

- Just Published CEI: [www.iec.ch/online\\_news/justpub](http://www.iec.ch/online_news/justpub)

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

- Electropedia: [www.electropedia.org](http://www.electropedia.org)

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

- Service Clients: [www.iec.ch/webstore/custserv/custserv\\_entry-f.htm](http://www.iec.ch/webstore/custserv/custserv_entry-f.htm)

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions, visitez le FAQ du Service clients ou contactez-nous:

Email: [csc@iec.ch](mailto:csc@iec.ch)  
Tél.: +41 22 919 02 11  
Fax: +41 22 919 03 00



IEC 62475

Edition 1.0 2010-09

# INTERNATIONAL STANDARD

## NORME INTERNATIONALE



**High-current test techniques – Definitions and requirements for test currents and measuring systems** (standards.iteh.ai)

**Techniques des essais à haute intensité – Définitions et exigences relatives aux courants d'essai et systèmes de mesure**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

PRICE CODE  
CODE PRIX

**XE**

ICS 19.080

ISBN 978-2-88912-184-7

## CONTENTS

FOREWORD.....	8
1 Scope.....	10
2 Normative references .....	10
3 Terms and definitions .....	10
3.1 Measuring systems.....	11
3.2 Components of a measuring system .....	11
3.3 Scale factors .....	12
3.4 Rated values .....	13
3.5 Definitions related to the dynamic behaviour .....	13
3.6 Definitions related to uncertainty .....	14
3.7 Definitions related to tests on measuring systems .....	16
4 Procedures for qualification and use of a measuring system.....	17
4.1 General principles .....	17
4.2 Schedule of performance tests .....	17
4.3 Schedule of performance checks.....	17
4.4 Requirements for the record of performance.....	18
4.4.1 Contents of the record of performance.....	18
4.4.2 Exceptions.....	18
4.5 Operating conditions .....	18
4.6 Uncertainty.....	19
5 Tests and test requirements for an approved measuring system.....	20
5.1 General requirements.....	20
5.2 Calibration – Determination of the scale factor .....	20
5.2.1 Calibration of a measuring system by comparison with a reference measuring system (preferred method) .....	20
5.2.2 Determination of the scale factor of a measuring system from those of its components .....	24
5.3 Linearity test .....	25
5.3.1 Application .....	25
5.3.2 Alternative methods in order of suitability .....	26
5.4 Dynamic behaviour.....	26
5.5 Short-term stability .....	27
5.5.1 Method .....	27
5.5.2 Steady-state current .....	27
5.5.3 Impulse current and short-time current .....	28
5.5.4 Periodic impulse current and periodic short-time current.....	28
5.6 Long-term stability.....	29
5.7 Ambient temperature effect .....	29
5.8 Effect of nearby current paths .....	30
5.9 Software effect .....	32
5.10 Uncertainty calculation .....	32
5.10.1 General .....	32
5.10.2 Uncertainty of calibration.....	32
5.10.3 Uncertainty of measurement using an approved measuring system .....	33
5.11 Uncertainty calculation of time-parameter measurements (impulse currents only).....	34
5.11.1 General .....	34

5.11.2	Uncertainty of the time-parameter calibration.....	34
5.11.3	Uncertainty of a time-parameter measurement using an approved measuring system .....	35
5.12	Interference test .....	36
5.12.1	Application .....	36
5.12.2	Current-converting shunts and current transformers with iron .....	37
5.12.3	Inductive measuring systems without iron (Rogowski coils) .....	38
5.13	Withstand tests .....	38
5.13.1	Voltage withstand tests.....	38
5.13.2	Current withstand tests.....	39
6	Steady-state direct current .....	39
6.1	Application .....	39
6.2	Terms and definitions .....	39
6.3	Test current.....	39
6.3.1	Requirements .....	39
6.3.2	Tolerances .....	39
6.4	Measurement of the test current.....	40
6.4.1	Requirements for an approved measuring system.....	40
6.4.2	Uncertainty contributions .....	40
6.4.3	Dynamic behaviour .....	40
6.4.4	Calibrations and tests on an approved measuring system.....	40
6.4.5	Performance check.....	41
6.5	Measurement of ripple amplitude.....	41
6.5.1	Requirements for an approved measuring system.....	41
6.5.2	Uncertainty contributions .....	41
6.5.3	Dynamic behaviour for ripple.....	41
6.5.4	Calibrations and tests on an approved ripple-current measuring system.....	42
6.5.5	Measurement of the scale factor at the ripple frequency .....	42
6.5.6	Performance check for ripple current measuring system .....	42
6.6	Test procedures .....	43
7	Steady-state alternating current.....	43
7.1	Application .....	43
7.2	Terms and definitions .....	43
7.3	Test current.....	43
7.3.1	Requirements .....	43
7.3.2	Tolerances .....	44
7.4	Measurement of the test current.....	44
7.4.1	Requirements for an approved measuring system.....	44
7.4.2	Uncertainty contributions .....	44
7.4.3	Dynamic behaviour .....	44
7.4.4	Calibrations and tests on an approved measuring system.....	46
7.4.5	Performance check.....	47
7.5	Test procedures .....	47
8	Short-time direct current.....	47
8.1	Application .....	47
8.2	Terms and definitions .....	48
8.3	Test currents.....	49
8.3.1	Requirements for the test current .....	49

8.3.2	Tolerances .....	49
8.4	Measurement of the test current.....	49
8.4.1	Requirements for an approved measuring system.....	49
8.4.2	Uncertainty contributions .....	49
8.4.3	Dynamic behaviour .....	49
8.4.4	Calibrations and tests on an approved measuring system.....	50
8.4.5	Performance check.....	51
8.4.6	Linearity test.....	51
8.5	Test procedures .....	51
9	Short-time alternating current .....	51
9.1	Application .....	51
9.2	Terms and definitions .....	52
9.3	Test current.....	53
9.3.1	Requirements for the test current .....	53
9.3.2	Tolerances .....	53
9.4	Measurement of the test current.....	54
9.4.1	Requirements for an approved measuring system.....	54
9.4.2	Uncertainty contributions .....	54
9.4.3	Dynamic behaviour .....	54
9.4.4	Calibrations and tests on an approved measuring system.....	55
9.4.5	Performance check.....	56
9.4.6	Linearity test.....	56
9.4.7	Interference test .....	57
9.5	Test procedures .....	57
10	Impulse currents.....	57
10.1	Application .....	57
10.2	Terms and definitions .....	57
10.3	Test current.....	61
10.3.1	General .....	61
10.3.2	Tolerances .....	61
10.4	Measurement of the test current.....	62
10.4.1	Requirements for an approved measuring system.....	62
10.4.2	Uncertainty contributions .....	62
10.4.3	Dynamic behaviour .....	62
10.4.4	Calibrations and tests on an approved measuring system.....	64
10.4.5	Performance check.....	64
10.5	Test procedures .....	65
11	Current measurement in high-voltage dielectric testing.....	65
11.1	Application .....	65
11.2	Terms and definitions .....	65
11.3	Measurement of the test current.....	66
11.3.1	Requirements for an approved measuring system.....	66
11.3.2	Uncertainty contributions .....	66
11.3.3	Dynamic behaviour .....	66
11.3.4	Calibrations and tests on an approved measuring system.....	66
11.3.5	Performance check.....	67
11.3.6	Linearity test.....	67
11.3.7	Interference test .....	67
11.4	Test procedures .....	67

IEC 62475:2010  
 (standards.iteh.ai)  
 ITC STANDARD PREVIEW  
<https://standards.iteh.ai/catalog/standards/sist/2a6bdaa6-4c33-4874-a68-66b950777ef/iec-62475-2010>

12 Reference measuring systems.....	67
12.1 General.....	67
12.2 Interval between subsequent calibrations of reference measuring systems.....	67
Annex A (informative) Uncertainty of measurement.....	68
Annex B (informative) Examples of the uncertainty calculation in high-current measurements.....	76
Annex C (informative) Step-response measurements.....	82
Annex D (informative) Convolution method for estimation of dynamic behaviour from step-response measurements.....	85
Annex E (informative) Constraints for certain wave shapes.....	88
Annex F (informative) Temperature rise of measuring resistors.....	90
Annex G (informative) Determination of r.m.s. values of short-time a.c. current.....	91
Annex H (informative) Examples of IEC standards with high current tests.....	98
Bibliography.....	100
Figure 1 – Examples of amplitude frequency responses for limit frequencies ( $f_1; f_2$ ). .....	14
Figure 2 – Calibration by comparison over full assigned measurement range.....	22
Figure 3 – Uncertainty contributions of the calibration (example with the minimum of 5 current levels).....	23
Figure 4 – Calibration by comparison over a limited current range with a linearity test (see 5.3) providing extension up to the largest value in the assigned measurement range.....	24
Figure 5 – Linearity test of the measuring system with a linear device in the extended voltage range.....	26
Figure 6 – Short-term stability test for steady-state current.....	28
Figure 7 – Short-term stability test for impulse current and short-time current.....	28
Figure 8 – Short-term stability test for periodic impulse-current and periodic short-time current.....	29
Figure 9 – Test circuit for effect of nearby current path for current-converting shunts and current transformers with iron. ....	31
Figure 10 – Test circuit for effect of nearby current path for inductive measuring systems without iron (Rogowski coils).....	31
Figure 11 – Principle of interference test circuit. ....	37
Figure 12 – Interference test on the measuring system $i_1(t)$ based on current-converting shunt or current transformer with iron in a typical 3-phase short-circuit set-up (example). ....	37
Figure 13 – Test circuit for interference test for inductive systems without iron. ....	38
Figure 14 – Acceptable normalized amplitude-frequency response of an a.c. measuring system intended for a single fundamental frequency $f_{nom}$ .....	45
Figure 15 – Acceptable normalized amplitude-frequency response of an a.c. measuring system intended for a range of fundamental frequencies $f_{nom1}$ to $f_{nom2}$ .....	46
Figure 16 – Example of short-time direct current.....	48
Figure 17 – Example of short-time alternating current. ....	52
Figure 18 – Exponential impulse current. ....	58
Figure 19 – Exponential impulse current – oscillating tail. ....	58
Figure 20 – Impulse current – Rectangular, smooth. ....	59



Figure 21 – Impulse current – Rectangular with oscillations.....	59
Figure A.1 – Normal probability distribution $p(x)$ of a continuous random variable $x$ .....	75
Figure A.2 – Rectangular symmetric probability distribution $p(x)$ of the estimate $x$ of an input quantity $X$ .....	75
Figure B.1 – Comparison between the system under calibration $X$ and the reference system $N$ .....	81
Figure C.1 – Circuit to generate current step using a coaxial cable.....	82
Figure C.2 – Circuit to generate current step using a capacitor.....	82
Figure C.3 – Definition of response parameters with respect to step response.....	84
Figure E.1 – Attainable combinations of time parameters (shaded area) for the 8/20 impulse at maximum 20 % undershoot and for 20 % tolerance on the time parameters .....	88
Figure E.2 – Locus for limit of attainable time parameters as a function of permissible undershoot for the 8/20 impulse.....	89
Figure E.3 – Locus for limit of attainable time parameters as a function of permissible undershoot for the 30/80 impulse.....	89
Figure G.1 – Equivalent circuit of short-circuit test.....	91
Figure G.2 – Symmetrical a.c. component of an alternating short-circuit current .....	92
Figure G.3 – Numerical evaluation of r.m.s value showing both instantaneous current and instantaneous squared value of the current.....	93
Figure G.4 – Three-crest method.....	94
Figure G.5 – Evaluation of conventional r.m.s. value of an arc current using the three-crest method.....	95
Figure G.6 – Evaluation of equivalent r.m.s value of a short-time current during a short-circuit test.....	96
Figure G.7 – Relation between peak factor $k$ and power factor $\cos(\varphi)$ .....	97
Table 1 – Required tests for steady-state direct current .....	40
Table 2 – Required tests for ripple current .....	42
Table 3 – Required tests for steady-state alternating current .....	46
Table 4 – Tolerance requirement on test-current parameters for short-time direct current.....	49
Table 5 – Required tests for short-time direct current.....	50
Table 6 – Tolerance requirements on the short-time alternating current test parameters .....	53
Table 7 – List of typical tests in a high-power laboratory and required minimum frequency range of the measuring system.....	54
Table 8 – Tolerance requirements on scale factor.....	55
Table 9 – Required tests for short-time alternating current.....	55
Table 10 – Examples of exponential impulse-current types .....	61
Table 11 – Required tests for impulse current.....	64
Table 12 – Required tests for impulse current in high-voltage dielectric testing.....	66
Table A.1 – Coverage factor $k$ for effective degrees of freedom $\nu_{\text{eff}}$ ( $p = 95,45 \%$ ) .....	73
Table A.2 – Schematic of an uncertainty budget .....	74
Table B.1 – Result of the comparison measurement .....	78
Table B.2 – Result of the comparison measurement .....	78
Table B.3 – Uncertainty budget for calibration of scale factor $F_x$ .....	79
Table B.4 – Result of linearity test .....	80



Table B.5 – Uncertainty budget of scale factor $F_{X,mes}$ .....	81
Table H.1 – List of typical tests with short-time alternating current.....	98
Table H.2 – List of typical tests with exponential impulse current.....	99
Table H.3 – List of typical tests with rectangular impulse current.....	99

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[IEC 62475:2010](https://standards.iteh.ai/catalog/standards/sist/2a6bdaa6-4c33-4874-a6f8-66b950777fef/iec-62475-2010)

<https://standards.iteh.ai/catalog/standards/sist/2a6bdaa6-4c33-4874-a6f8-66b950777fef/iec-62475-2010>

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**HIGH-CURRENT TEST TECHNIQUES –  
DEFINITIONS AND REQUIREMENTS FOR TEST CURRENTS  
AND MEASURING SYSTEMS**

FOREWORD

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

International Standard IEC 62475 has been prepared by IEC technical committee 42: High-voltage test techniques.

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

FDIS	Report on voting
42/278/FDIS	42/283/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 this specific publication. At this date, the publication will be:

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

**IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.**

## **iTeh STANDARD PREVIEW** **(standards.iteh.ai)**

[IEC 62475:2010](#)

<https://standards.iteh.ai/catalog/standards/sist/2a6bdaa6-4c33-4874-a6f8-66b950777fef/iec-62475-2010>

# HIGH-CURRENT TEST TECHNIQUES – DEFINITIONS AND REQUIREMENTS FOR TEST CURRENTS AND MEASURING SYSTEMS

## 1 Scope

This International Standard 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 d.c. testing), steady-state and short-time alternating current (as e.g. encountered in high-power a.c. testing), and impulse-current. In general, currents above 100 A are considered in this International Standard, although currents less than this can occur in tests.

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

This standard:

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

## 2 Normative references

The following referenced documents are indispensable for the application of this International Standard. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60051-2:1984, *Direct acting analogue electrical measuring instruments and their accessories – Part 2: Special requirements for ammeters and voltmeters*

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

IEC 61180-1, *High-voltage test techniques for low-voltage equipment – Part 1: Definitions, test and procedure requirements*

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

NOTE Further related standards, guides, etc. on subjects included in this standard are given in the bibliography.

## 3 Terms and definitions

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

### 3.1 Measuring systems

#### 3.1.1

##### measuring system

complete set of devices suitable for performing measurements of a quantity to be measured (measurand). Software used to obtain or calculate measurement results also forms a part of the measuring system

NOTE 1 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; and
- 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 standard.

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

#### 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 standard have been met. This evidence includes the results of the initial performance test and the schedule and results of each subsequent performance test and performance check

#### 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 this standard

#### 3.1.4

##### 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 current

NOTE A reference measuring system (maintained according to the requirements of this standard) can be used as an approved measuring system but the converse is not true.

### 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

#### 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

[IEC 60050-321:1986, 321-02-01]

NOTE Current transformers are usually defined for a single frequency, but special designs with a wide frequency range are possible.

### 3.2.4

#### **Rogowski coil**

inductive current-converting device without iron; measuring systems based on a Rogowski coil include an integrating circuit (passive, active, or numerical)

NOTE Measuring systems based on a Rogowski coil can be designed for current measurements in a wide range of frequencies.

### 3.2.5

#### **transmission system**

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

NOTE 1 A transmission system usually consists of a coaxial cable with its terminating impedance, but it may 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 A transmission system may be partially or completely included in the converting device or in the measuring instrument.

### 3.2.6

#### **measuring instrument**

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

[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 to be multiplied to obtain the value of the input quantity of the complete measuring system

NOTE 1 A measuring system may have multiple scale factors for different current ranges, frequency ranges or waveforms.

NOTE 2 Some measuring systems display the value of the input quantity directly (i.e., the scale factor of the measuring system is unity).

### 3.3.2

#### **scale factor of a converting device**

factor by which the output of the converting device is to be multiplied to obtain its input quantity

NOTE The scale factor of a converting device may be dimensionless (for example, the ratio of a current transformer) or may have dimensions (for example, related to the impedance of a current-converting shunt).

### 3.3.3

#### **scale factor of a transmission system**

factor by which the output of a transmission system is to be multiplied to obtain its input quantity

### 3.3.4

#### **scale factor of a measuring instrument**

factor by which the instrument reading is to be multiplied to obtain its input quantity

### 3.3.5 assigned scale factor

$F$

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

NOTE 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 Rated values

### 3.4.1 operating conditions

conditions under which a measuring system will operate within the specified uncertainty limits

### 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 The rated current may 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 standard, characterized by a single scale factor

NOTE 1 The limits of the assigned measurement range are chosen by the user and verified by the performance tests specified in this standard.

NOTE 2 A measuring system may have more than one assigned measurement range, with different scale factors established for the different ranges.

### 3.4.4 assigned operating time

longest time during which a d.c. or a.c. current measuring system can operate at the upper limit of the assigned measurement range within the uncertainty limits given in this standard

### 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 this standard

NOTE The assigned rate of application could for example be expressed as the number of applications per minute and the time interval in minutes or hours.

## 3.5 Definitions related to the dynamic behaviour

### 3.5.1 response of a measuring system,

$g$  or  $G$

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

### 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