IEC 61083-3

Edition 1.0 2020-11

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Instruments and software used for measurement in high-voltage and high-current tests –
Part 3: Requirements for hardware for tests with alternating and direct voltages and currents

Appareils et logiciels utilisés pour les mesurages pendant les essais à haute tension et à courant élevé –
Partie 3: Exigences relatives au matériel pendant les essais avec des tensions et des courants alternatifs et continus

IEC 61083-3:2020-11(en-fr)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
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 corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform
The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,…). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished
Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc
If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

Electropedia - www.electropedia.org
The world's leading online dictionary on electrotechnology, containing more than 22 000 terminological entries in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary
67 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

A propos de l'IEC
La Commission Electrotechnique Internationale (IEC) 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 IEC
Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Recherche de publications IEC - webstore.iec.ch/advsearchform
La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,…). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished
Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

Service Clients - webstore.iec.ch/csc
Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

Electropedia - www.electropedia.org
Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 000 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

Glossaire IEC - std.iec.ch/glossary
67 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

IEC 61083-3

Edition 1.0 2020-11

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Instruments and software used for measurement in high-voltage and high-current tests –
Part 3: Requirements for hardware for tests with alternating and direct voltages and currents

Appareils et logiciels utilisés pour les mesurages pendant les essais à haute tension et à courant élevé –
Partie 3: Exigences relatives au matériel pendant les essais avec des tensions et des courants alternatifs et continus

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

ICS 17.220.20; 19.080

ISBN 978-2-8322-9037-8

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

____

INSTRUMENTS AND SOFTWARE USED FOR MEASUREMENT IN HIGH-VOLTAGE AND HIGH-CURRENT TESTS –

Part 3: Requirements for hardware for tests with alternating and direct voltages and currents

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 61083-3 has been prepared by IEC technical committee 42: High-voltage and high-current test techniques.

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

FDIS	Report on voting
42/380/FDIS	42/387/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 61083 series, published under the general title *Instruments and software used for measurement in high-voltage and high-current tests*, can be found on the IEC website.

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

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.

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.

INTRODUCTION

The electric power industry requires standardized tools to provide confidence in testing results, and to prove equivalence between tests performed in different laboratories and test fields.

This part of IEC 61083 specifies requirements for the performance of digital recording instruments used for tests with alternating and direct voltages and currents.

The intention of this document is to provide recommendations on the digital recording instruments to be used in tests with alternating and direct voltages and currents.

Digital recording instruments are considered as black boxes (including hardware, firmware, and software). They are characterized for their intended application by physical calibration with the waveforms needed for that application.

This document does not apply to simple analogue or digital meters that do not have recording capability.

INSTRUMENTS AND SOFTWARE USED FOR MEASUREMENT IN HIGH-VOLTAGE AND HIGH-CURRENT TESTS –

Part 3: Requirements for hardware for tests with alternating and direct voltages and currents

1 Scope

This part of IEC 61083 is applicable to digital recording instruments used for measurements during tests with high alternating and direct voltages and currents. It specifies the measuring characteristics and calibrations required to meet the measuring uncertainties and procedures specified in the relevant IEC standards (e.g. IEC 60060-1, IEC 60060-2, IEC 60060-3, IEC 62475, IEC 61180).

This document is applicable to those digital recording instruments that will be designed and type tested according to this document.

This document

- defines performance requirements for digital recording instruments used during tests with alternating voltages and currents (AC) or direct voltages and currents (DC);
- specifies the necessary requirements for such instruments to ensure their suitability for use under the relevant standards;
- establishes the tests and procedures necessary to demonstrate their compliance;
- defines the terms related to digital recording instruments with recording function and access to raw data.

NOTE Examples of relevant alternating and direct voltages and currents to be measured are listed in Annex D.

This International Standard has the status of a horizontal standard in accordance with IEC Guide 108.

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

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

IEC 62475, *High-current test techniques – Definitions and requirements for test currents and measuring systems*

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 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 Digital recording instruments

3.1.1
approved instrument
measuring device that is shown to comply with the requirements set out in IEC 61083-3

3.1.2
digital recording instrument
device with digital output capability of the recorded input

Note 1 to entry: This definition includes digital recorders, digital oscilloscopes, digital peak voltmeters and other digital recording instruments if applicable.

Note 2 to entry: The waveform of the digital record is usually displayed on a screen, plotted or printed. This process may change the appearance of the waveform due to the processing involved.

3.1.3
assigned measurement range
range of input voltage for which the digital recording instrument can be used within the uncertainty limits given in IEC 61083-3

3.1.4
output
displayed (in any way) value of a digital recording instrument at a specific instant or the numerical value of a digital recording instrument recorded at a specific instant

3.1.5
full-scale deflection
minimum input value, which produces the nominal maximum output of the digital recording instrument in the specified range

3.1.6
offset
output of a digital recording instrument for zero input

3.1.7
raw data
original record of sampled and quantized information obtained when a digital recording instrument converts an analogue signal into a digital form, with the correction of the output for offset and multiplying the record by a constant factor being permitted

3.1.8
test duration
range of a time interval in which the measurement is done

3.1.9
reading rate
rate with which the instrument displays or stores the readings of the measured AC or DC voltage or current

Note 1 to entry: In sampling instruments, readings are calculated e.g. by averaging (DC) or by calculating the RMS value (AC) of several samples.

3.2 Rated values

3.2.1
rated resolution
r
reciprocal of two to the power of the rated number of bits N of the A/D converter, defined as

$$r = 2^{-N}$$

3.2.2
sampling rate
number of samples taken per unit of time

3.2.3
record length
duration of the record expressed either in a time unit or as the total number of samples

3.2.4
warm-up time
time interval from when an instrument is first switched on to when an instrument meets operational requirements

3.3 Factors

3.3.1
scale factor
factor by which the output corrected for offset is multiplied in order to determine the measured value of the input quantity

Note 1 to entry: Scale factor includes the ratio of any built-in or external attenuator and is determined by calibration.

3.3.2
static scale factor
scale factor for a direct voltage or a direct current input

3.3.3
non-linearity of amplitude
deviation of the actual output of a digital recording instrument from the nominal value, which is determined by dividing the input voltage or input current by the scale factor

Note 1 to entry: The static non-linearity for a DC input voltage or current is different from the non-linearity under dynamic conditions.

3.3.4
peak factor
numerical value calculated from the peak value divided by the RMS value of a measurement

3.4 Dynamic performance

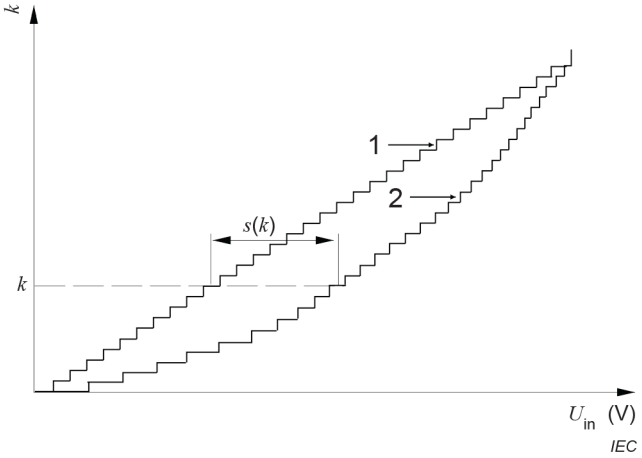
3.4.1
integral non-linearity
$s(k)$
difference between corresponding points on the measured quantization characteristic and on the ideal quantization characteristic that is based on the static scale factor

SEE: Figure 1.

3.4.2
quantization characteristic
characteristic showing the relationship between the output of the digital recording instrument and the direct voltage on the input which produces this output

SEE: Figure 1.

Note 1 to entry: The average slope of the quantization characteristic is equal to the reciprocal of the static scale factor of the A/D converter.



Curve 1: Quantization characteristic of an ideal 5-bit digital recording instrument.

Curve 2: Quantization characteristic of a non-linear 5-bit digital recording instrument (the low resolution of 5 bits has been chosen to clarify the illustration).

Figure 1 – Integral non-linearity *s(k)* at code *k*

3.4.3
code *k*
integer used to identify a digital level

3.4.4
code bin width
$w(k)$
range of input voltage or input current allocated to code k

SEE: Figure 2.

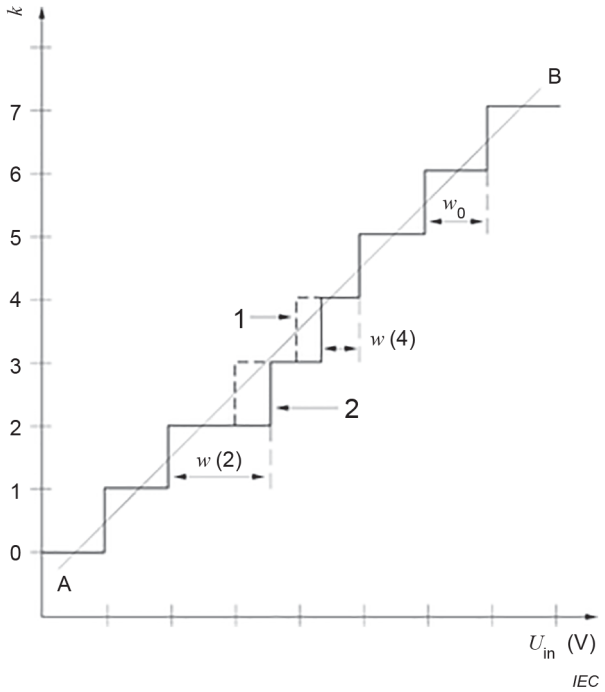
3.4.5
average code bin width
w_0
product of the full-scale deflection and the rated resolution

SEE: Figure 2.

Note 1 to entry: The average code bin width is approximately equal to the static scale factor.

3.4.6
differential non-linearity
***d*(*k*)**
difference between a measured code bin width $w(k)$ for code k and the average code bin width w_0 divided by the average code bin width w_0

$$d(k) = \frac{w(k) - w_0}{w_0}$$



Curve 1: Quantization characteristic of an ideal 3-bit digital recording instrument.

Curve 2: Quantization characteristic of a 3 bit digital recording instrument showing large $d(k)$ at codes k = 2, 3 and 4.

Line AB: A straight line joining the midpoints of the code bins of an ideal instrument (the low resolution of 3 bits has been chosen to clarify the illustration).

Figure 2 – Non-linearity $d(k)$ and code bin width $w(k)$ under DC conditions

3.4.7
rise time
t_R
time interval within which the response to an applied step passes from 10 % to 90 % of its steady-state amplitude

3.4.8
time base
unit of the digital recording instrument horizontal scale against which a time interval is measured

3.5 Uncertainties

3.5.1
uncertainty
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: Uncertainty is positive and given without sign.

Note 2 to entry: Uncertainty of measurement should not be confused with the tolerance of the test value.

3.5.2
standard uncertainty
uncertainty of the result of a measurement expressed as a standard deviation

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

3.6 Tests

3.6.1
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

[SOURCE: IEC 60050-311:2001, 311-01-09, modified – The notes have been deleted.]

3.6.2
type test
conformity test made on one or more items representative of the production

Note 1 to entry: For a measuring system, this is understood as 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 – The note has been added.]

3.6.3
routine test
conformity test made on each individual item during or after manufacture

Note 1 to entry: This is understood as 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 – The note has been added.]

3.6.4
performance test
test performed on a complete measuring system to characterize it under operating conditions

3.6.5
performance check
simple procedure to ensure that the most recent performance test is still valid

3.6.6
record of performance
detailed record, established and maintained by the user, describing the measuring system and containing evidence that the requirements given in IEC 61083-3 have been met, which includes the results of the initial performance test and the schedule and results of each subsequent performance test and performance check

4 Operating conditions

The limits of operating conditions given in Table 1 are those under which the digital recording instrument shall operate and meet the uncertainty requirements specified for this instrument.

Table 1 – Operating conditions

Condition	Range
Environment	
Ambient temperature	5 °C to 40 °C
Ambient relative humidity (non-condensing)	10 % to 90 %
Mains power supply	
Supply voltage	Rated voltage ±10 % (RMS)
	Rated voltage ±12 % (AC peak)
Supply frequency	Rated frequency ±5 %

Any exceptions to the values given in Table 1 shall be explicitly and clearly stated in the record of performance.

NOTE The general requirements for testing electromagnetic compatibility of electrical equipment for measurement, control and laboratory use are described in IEC 61326-1.

5 Calibration and test methods

5.1 Applicability

A digital recording instrument may be qualified for all requirements in this document, or for a suitable subset.

5.2 Qualification of digital recording instruments

Digital recording instruments for measurement of high voltage and/or high current are qualified by comparative measurements against known reference systems traceable to national standards, proving both requirements on accuracy and dynamic performance.

Qualifications are performed both as type tests performed once for each type of instrument and routine tests performed once for each instrument, and calibrations are performed regularly on each instrument.

For electromagnetic interference tests in high-voltage and high-current laboratories and test fields, see recommendations in Annex B.

5.3 Requirements for reference generators

A reference waveform generator is only necessary for calibration when the digital recording instrument contains a measurement device which is to be used as a reference instrument (see 6.3). Otherwise any waveform generator can be used if it fulfils general requirements for amplitude and frequency stability and noise.

NOTE An approved waveform generator can be considered qualified if the amplitude and the frequency are stable within 0,1 % of output and the noise is < 1 % of output.

5.4 Available methods for qualification of digital recording instruments

Calibration (scale factor determination) (5.5),

Dynamic performance tests (5.6.2),

Internal noise (5.6.3),

Interference tests (5.6.4),

Displaying performance (5.6.5).