

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



**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**



## THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2020 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 l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

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

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

#### IEC publications search - [webstore.iec.ch/advsearchform](http://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](http://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](http://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](mailto:sales@iec.ch).

#### Electropedia - [www.electropedia.org](http://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](http://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](http://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](http://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](http://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](mailto:sales@iec.ch).

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

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



---

**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

**Warning! Make sure that you obtained this publication from an authorized distributor.  
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

## CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	7
2 Normative references .....	7
3 Terms and definitions .....	8
3.1 Digital recording instruments.....	8
3.2 Rated values.....	9
3.3 Factors .....	9
3.4 Dynamic performance .....	9
3.5 Uncertainties.....	11
3.6 Tests .....	12
4 Operating conditions.....	12
5 Calibration and test methods .....	13
5.1 Applicability .....	13
5.2 Qualification of digital recording instruments.....	13
5.3 Requirements for reference generators .....	13
5.4 Available methods for qualification of digital recording instruments.....	13
5.5 Calibration .....	14
5.6 Alternative test methods .....	14
5.6.1 General .....	14
5.6.2 Test of the rise time, step response .....	14
5.6.3 Internal noise level .....	14
5.6.4 Interference test .....	14
5.6.5 Reading rate.....	14
5.7 Uncertainty contribution .....	15
5.8 Input impedance .....	15
6 Requirements for AC and DC measurements.....	15
6.1 Requirements for digital recording instruments used in approved measuring systems .....	15
6.2 Individual requirements.....	15
6.2.1 General .....	15
6.2.2 Scale factor .....	15
6.2.3 Sampling rate .....	15
6.2.4 Rated resolution .....	16
6.2.5 Rise time (bandwidth).....	16
6.2.6 Noise level.....	16
6.2.7 Interference .....	16
6.2.8 Non-linearity of amplitude.....	16
6.2.9 Record length of digital recording instruments .....	16
6.3 Requirements for digital recording instruments used in reference measuring systems .....	16
6.4 Tests .....	17
6.4.1 General .....	17
6.4.2 Type tests.....	17
6.4.3 Routine tests .....	17
6.4.4 Performance tests .....	17
6.4.5 Performance checks .....	18

7	Uncertainty contributions for complete measuring systems .....	18
8	Record of performance .....	18
Annex A (normative) Electromagnetic interference in high-voltage and high-current laboratories and test fields .....		
A.1	General.....	19
A.2	Precautions.....	19
A.2.1	Electromagnetic shielding.....	19
A.2.2	Reduction of conducted interference from the supply line .....	19
A.2.3	Reduction of interference on the signal line .....	19
A.2.4	Signal transmission by optical means .....	20
A.3	Tests with transient induced electromagnetic fields.....	20
A.4	Tests with current injection .....	20
Annex B (informative) Electromagnetic interference in high-voltage and high-current laboratories and test fields – Recommendations for digital recording instruments .....		
Annex C (informative) Procedure to determine the non-linearity of amplitude of sampling instruments .....		
Annex D (informative) Examples and considerations.....		
D.1	Suggested requirements for digital recording instruments for AC and DC voltage measurements .....	26
D.1.1	Test cases .....	26
D.1.2	Background .....	27
D.1.3	Recommendations for digital recording instruments for AC testing (up to 60 Hz without consideration of harmonics).....	27
D.1.4	Recommendations for digital recording instruments for DC testing (without consideration of ripple).....	27
D.1.5	Recommendations for digital recording instruments for AC and DC testing under consideration of harmonics or superimposed or combined voltages.....	27
D.2	Examples of relevant voltage and current characteristics to be measured .....	27
D.3	Determination of the necessary rise time of instruments .....	29
D.4	Considerations regarding the large variety of AC and DC measurements .....	30
Bibliography.....		
Figure 1 – Integral non-linearity $s(k)$ at code $k$ .....		
Figure 2 – Non-linearity $d(k)$ and code bin width $w(k)$ under DC conditions .....		
Figure A.1 – Application of electric and magnetic fields.....		
Figure A.2 – Current injection into the shield of the cable .....		
Figure C.1 – Digitalization of a sinusoidal waveform with a 4 bit A/D converter .....		
Figure C.2 – Ideal code distribution of a sinusoidal waveform digitized by a 4 bit A/D converter .....		
Figure C.3 – Example of a non-ideal measurement of ideal sinusoidal waveform .....		
Figure C.4 – Example of the determination of the differential non-linearity .....		
Table 1 – Operating conditions .....		
Table 2 – Tests required for digital recording instruments .....		
Table B.1 – Increased immunity levels suggested for digital recording instruments used in high-voltage environments.....		
Table D.1 – Relevant voltages and currents.....		

## 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)*