

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

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

See Eesti standard EVS-EN 61180:2016 sisaldab Euroopa standardi EN 61180:2016 ingliskeelset teksti.	This Estonian standard EVS-EN 61180:2016 consists of the English text of the European standard EN 61180:2016.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas.	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation.
Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 28.10.2016.	Date of Availability of the European standard is 28.10.2016.
Standard on kättesaadav Eesti Standardikeskusest.	The standard is available from the Estonian Centre for Standardisation.

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile standardiosakond@evs.ee.

ICS 19.080

Standardite reprodutseerimise ja levitamise õigus kuulub Eesti Standardikeskusele

Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonsesse süsteemi või edastamine ükskõik millises vormis või millisel teel ilma Eesti Standardikeskuse kirjaliku loata on keelatud.

Kui Teil on küsimusi standardite autorikaitse kohta, võtke palun ühendust Eesti Standardikeskusega:
Koduleht www.evs.ee; telefon 605 5050; e-post info@evs.ee

The right to reproduce and distribute standards belongs to the Estonian Centre for Standardisation

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, without a written permission from the Estonian Centre for Standardisation.

If you have any questions about copyright, please contact Estonian Centre for Standardisation:

Homepage www.evs.ee; phone +372 605 5050; e-mail info@evs.ee

English Version

**High-voltage test techniques for low-voltage equipment -
Definitions, test and procedure requirements, test equipment
(IEC 61180:2016)**

Techniques des essais à haute tension pour matériel à
basse tension - Définitions, exigences et modalités relatives
aux essais, matériel d'essai
(IEC 61180:2016)

Hochspannungs-Prüftechnik für Niederspannungsgeräte -
Begriffe, Prüfung und Prüfbedingungen, Prüfgeräte
(IEC 61180:2016)

This European Standard was approved by CENELEC on 2016-07-29. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.



European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

European foreword

The text of document 42/341/FDIS, future edition 1 of IEC 61180, prepared by IEC/TC 42 "High-voltage and high-current test techniques" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61180:2016.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2017-04-29
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2019-07-29

This document supersedes EN 61180-1:1994 and EN 61180-2:1994.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 61180:2016 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 61000-4-5:2014	NOTE	Harmonized as EN 61000-4-5:2014 (not modified).
IEC 61010-1	NOTE	Harmonized as EN 61010-1.
IEC 61010-2-030:2010	NOTE	Harmonized as EN 61010-2-030:2010 (not modified).

Annex ZA

(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 When an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60060-1	2010	High-voltage test techniques - Part 1: General definitions and test requirements	EN 60060-1	2010
IEC 60060-2	2010	High-voltage test techniques - Part 2: Measuring systems	EN 60060-2	2011
IEC 60068-1	2013	Environmental testing - Part 1: General and guidance	EN 60068-1	2014
IEC 60335	series	Household and similar electrical appliances - Safety	EN 60335	series
IEC 60664-1	2007	Insulation coordination for equipment within low-voltage systems - Part 1: Principles, requirements and tests	EN 60664-1	2007
IEC 61083-1	2001	Instruments and software used for measurement in high-voltage impulse tests - Part 1: Requirements for instruments	EN 61083-1	2001
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	EN 61083-2	2013
ISO/IEC Guide 98-3	2008	Uncertainty of measurement - Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)	-	-

CONTENTS

FOREWORD.....	5
1 Scope.....	7
2 Normative references.....	7
3 Terms and definitions	8
3.1 General terms	8
3.2 Definitions related to disruptive discharge and test voltages.....	8
3.3 Characteristics related to the test equipment	9
3.4 Characteristics related to direct voltage tests.....	9
3.5 Characteristics related to alternating voltage tests	10
3.6 Characteristics related to impulse tests (see Figure 1)	11
3.7 Definitions relating to tolerance and uncertainty.....	12
4 General requirements	13
4.1 General.....	13
4.2 Atmospheric conditions for test procedures and verification of test equipment	14
4.3 Procedures for qualification and use of measuring systems.....	14
4.3.1 General principles	14
4.3.2 Schedule of performance tests	15
4.3.3 Requirements for the record of performance	15
4.3.4 Uncertainty	15
4.4 Tests and test requirements for an approved measuring system and its components	16
4.4.1 Calibration – Determination of the scale factor.....	16
4.4.2 Influence of load	18
4.4.3 Dynamic behaviour	18
4.4.4 Short-term stability.....	19
4.4.5 Long-term stability	19
4.4.6 Ambient temperature effect	20
4.4.7 Uncertainty calculation of the scale factor.....	20
4.4.8 Uncertainty calculation of time parameter measurement (impulse voltages only)	22
5 Tests with direct voltage	25
5.1 General.....	25
5.2 Test voltage	25
5.2.1 Requirements for the test voltage	25
5.2.2 Generation of the test voltage	25
5.2.3 Measurement of the test voltage.....	25
5.3 Test procedures	26
5.3.1 Withstand voltage tests	26
6 Tests with alternating voltage.....	27
6.1 Test voltage	27
6.1.1 Requirements for the test voltage	27
6.1.2 Generation of the test voltage	27
6.1.3 Measurement of the test voltage.....	28
6.2 Test procedures	30
6.2.1 Withstand voltage tests	30
7 Tests with impulse voltage	30

7.1	Test voltage	30
7.1.1	General	30
7.1.2	Requirements for the test voltage	31
7.1.3	Generation of the test voltage	31
7.1.4	Measurement of the test voltage and determination of impulse shape.....	32
7.2	Test procedures	32
7.2.1	Verification of impulse voltage waveshape	32
7.2.2	Impulse voltage tests	32
7.3	Measurement of the test voltage	32
7.3.1	Requirements for an approved measuring system	32
7.3.2	Uncertainty contributions	33
7.3.3	Dynamic behaviour	33
7.3.4	Requirements for measuring instrument.....	33
8	Reference measurement systems	33
8.1	Requirements for reference measuring systems	33
8.1.1	Direct voltage	33
8.1.2	Alternating voltage	33
8.1.3	Impulse voltages	33
8.2	Calibration of a reference measuring system.....	33
8.2.1	General	33
8.2.2	Reference method: comparative measurement	34
8.3	Interval between successive calibrations of reference measuring systems	34
8.4	Use of reference measuring systems	34
Annex A	(informative) Uncertainty of measurement.....	35
A.1	General.....	35
A.2	Terms and definitions in addition to 3.7.....	35
A.3	Model function	36
A.4	Type A evaluation of standard uncertainty	36
A.5	Type B evaluation of standard uncertainty	37
A.6	Combined standard uncertainty	38
A.7	Expanded uncertainty	39
A.8	Effective degrees of freedom	40
A.9	Uncertainty budget	40
A.10	Statement of the measurement result	41
Annex B	(informative) Example for the calculation of measuring uncertainties in high-voltage measurements	43
Annex C	(informative) Atmospheric correction	47
C.1	Standard reference atmosphere.....	47
C.2	Atmospheric correction factor	47
C.2.1	General	47
C.2.2	Humidity correction factor k_2	47
C.2.3	Air density correction factor k_1	48
Bibliography	49
Figure 1	– Full impulse voltage time parameters	11
Figure 2	– Calibration by comparison over the full voltage range.....	17
Figure 3	– Uncertainty contributions of the calibration (example with a minimum of 5 voltage levels)	18

Figure 4 – Shaded area for acceptable normalised amplitude-frequency responses of measuring systems intended for single fundamental frequencies f_{nom} (to be tested in the range $(1 \dots 7)f_{\text{nom}}$)	29
Figure 5 – Shaded area for acceptable normalised amplitude-frequency responses of measuring systems intended for a range of fundamental frequencies f_{nom1} to f_{nom2} (to be tested in the range f_{nom1} to $7 f_{\text{nom2}}$).....	29
Figure 6 – 1,2/50 μs standard impulse voltage.....	31
Figure A.1 – Normal probability distribution $p(x)$	42
Figure A.2 – Rectangular probability distribution $p(x)$	42
Table 1 – Tests required for an approved direct voltage measuring system	26
Table 2 – Minimum currents of the test circuit.....	27
Table 3 – Tests required for an approved alternating voltage measuring system.....	30
Table 4 – Tests required for an approved impulse voltage measuring system	33
Table A.1 – Coverage factor k for effective degrees of freedom ν_{eff} ($p = 95,45 \%$).....	40
Table A.2 – Schematic of an uncertainty budget	41
Table B.1 – Result of the comparison measurement up to 500 V at a single voltage level	44
Table B.2 – Summary of results for $h = 5$ voltage levels ($V_{X\text{max}} = 500 \text{ V}$).....	45
Table B.3 – Uncertainty budget of the assigned scale factor F_X	46

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