

This document is a preview generated by EVS

High-voltage test techniques; Part 1: General definitions and test requirements

High-voltage test techniques; Part 1: General
definitions and test requirements

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

<p>Käesolev Eesti standard EVS-HD 588.1 S1:2003 sisaldab Euroopa standardi HD 588.1 S1:1991 ingliskeelset teksti.</p> <p>Käesolev dokument on jõustatud 15.01.2003 ja selle kohta on avaldatud teade Eesti standardiorganisatsiooni ametlikus väljaandes.</p> <p>Standard on kättesaadav Eesti standardiorganisatsioonist.</p>	<p>This Estonian standard EVS-HD 588.1 S1:2003 consists of the English text of the European standard HD 588.1 S1:1991.</p> <p>This document is endorsed on 15.01.2003 with the notification being published in the official publication of the Estonian national standardisation organisation.</p> <p>The standard is available from Estonian standardisation organisation.</p>
--	---

<p>Käsitlusala: Applies to dielectric tests with direct voltage, dielectric tests with alternating voltage; dielectric tests with impulse voltage and impulse current, and tests with combinations of these.</p>	<p>Scope: Applies to dielectric tests with direct voltage, dielectric tests with alternating voltage; dielectric tests with impulse voltage and impulse current, and tests with combinations of these.</p>
---	---

ICS 19.080

Võtmesõnad: definitions, determinations, electrical engineering, electrical testing, high voltage, high-voltage tests, measurement, specification (approval), specifications, test techniques, testing, testing conditions, testing voltages

UDC 621.3.027.3/.5:620.1:621.317.08

Descriptors: Electrical test, high-voltage tests, test requirements

ENGLISH VERSION

HIGH-VOLTAGE TEST TECHNIQUES
PART 1: GENERAL DEFINITIONS AND TEST REQUIREMENTS
(IEC 60-1:1989 + corrigendum 1990)

Techniques des essais à haute tension
Première partie: Définitions et
prescriptions générales
relatives aux essais
(CEI 60-1:1989 + corrigendum
mars 1990)

Hochspannungs-Prüftechnik
Teil 1: Allgemeine Festlegungen
und Prüfbedingungen
(IEC 60-1:1989 + Corrigendum
März 1990)

This Harmonization Document was approved by CENELEC on 1991-06-01.
CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations
which stipulate the conditions for implementation of this Harmonization Document
on a national level.

Up-to-date lists and bibliographical references concerning national implementation
may be obtained on application to the Central Secretariat or to any CENELEC member.

This Harmonization Document exists in three official versions (English, French,
German).

CENELEC members are the national electrotechnical committees of Austria, Belgium,
Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg,
Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

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

Central Secretariat: rue de Stassart 35, B-1050 Brussels

FOREWORD

The CENELEC questionnaire procedure, performed for finding out whether or not the International Standard IEC 60-1:1989, as corrected by its corrigendum March 1990, could be accepted without textual changes, has shown that no CENELEC common modifications were necessary for the acceptance as Harmonization Document.

The reference document was submitted to the CENELEC members for formal vote and was approved by CENELEC as HD 588.1 S1 on 1 June 1991 (confirmed by 68 BT).

The following dates were fixed:

- latest date of announcement
of the HD at national level (doa) 1992-01-01
- latest date of publication of
a harmonized national standard (dop) 1992-07-01
- latest date of withdrawal of
conflicting national standards (dow) 1992-07-01

ENDORSEMENT NOTICE

The text of the International Standard IEC 60-1:1989 with its corrigendum March 1990 was approved by CENELEC as a Harmonization Document without any modification.

Document is a preview generated by EVS

INTERNATIONAL STANDARD

IEC
60060-1

Second edition
1989-11

High-voltage test techniques –

**Part 1:
General definitions and test requirements**

*This **English-language** version is derived from the original **bilingual** publication by leaving out all French-language pages. Missing page numbers correspond to the French-language pages.*



Reference number
IEC 60060-1:1989(E)

Publication numbering

As from 1 January 1997 all IEC publications are issued with a designation in the 60000 series. For example, IEC 34-1 is now referred to as IEC 60034-1.

Consolidated editions

The IEC is now publishing consolidated versions of its publications. For example, edition numbers 1.0, 1.1 and 1.2 refer, respectively, to the base publication, the base publication incorporating amendment 1 and the base publication incorporating amendments 1 and 2.

Further information on IEC publications

The technical content of IEC publications is kept under constant review by the IEC, thus ensuring that the content reflects current technology. Information relating to this publication, including its validity, is available in the IEC Catalogue of publications (see below) in addition to new editions, amendments and corrigenda. Information on the subjects under consideration and work in progress undertaken by the technical committee which has prepared this publication, as well as the list of publications issued, is also available from the following:

- **IEC Web Site** (www.iec.ch)

- **Catalogue of IEC publications**

The on-line catalogue on the IEC web site (www.iec.ch/searchpub) enables you to search by a variety of criteria including text searches, technical committees and date of publication. On-line information is also available on recently issued publications, withdrawn and replaced publications, as well as corrigenda.

- **IEC Just Published**

This summary of recently issued publications (www.iec.ch/online_news/justpub) is also available by email. Please contact the Customer Service Centre (see below) for further information.

- **Customer Service Centre**

If you have any questions regarding this publication or need further assistance, please contact the Customer Service Centre:

Email: custserv@iec.ch
Tel: +41 22 919 02 11
Fax: +41 22 919 03 00

INTERNATIONAL STANDARD

IEC
60060-1

Second edition
1989-11

High-voltage test techniques –

Part 1: General definitions and test requirements

© IEC 1989 Copyright - all rights reserved

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 the publisher.

International Electrotechnical Commission, 3, rue de Varembe, PO Box 131, CH-1211 Geneva 20, Switzerland
Telephone: +41 22 919 02 11 Telefax: +41 22 919 03 00 E-mail: inmail@iec.ch Web: www.iec.ch



Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

PRICE CODE **XB**

For price, see current catalogue

CONTENTS

	Page
FOREWORD	13
PREFACE	13
Clause	
Section 1: General	15
1 Scope	15
2 Object	15
Section 2: General Definitions	17
3 Impulses	17
3.1 Lightning and switching impulses	17
4 Characteristics related to disruptive discharge and test voltages	17
4.1 Disruptive discharge	17
4.2 Characteristics of the test voltage	19
4.3 Disruptive discharge voltage of a test object	19
4.4 Statistical characteristics of disruptive discharge voltages	19
4.5 Withstand voltage of a test object	21
4.6 Assured disruptive discharge voltage of a test object	21
5 Classification of insulation in test objects	21
5.1 External insulation	21
5.2 Internal insulation	23
5.3 Self-restoring insulation	23
5.4 Non-self-restoring insulation	23
Section 3: General Requirements Relating to Test Procedures and Test Objects	25
6 General requirements for test procedures	25
7 General arrangement of the test object	25
8 Dry tests	27
9 Wet tests	27
9.1 Standard wet test procedure	27
9.2 Traditional procedures for wet tests with alternating voltages	31

10	Artificial pollution tests	31
10.1	Preparation of test object	33
10.2	Test procedures	33
10.3	Degree of pollution	35
11	Atmospheric conditions	37
11.1	Standard reference atmosphere	37
11.2	Atmospheric correction factors	37
11.3	Wet tests, tests under artificial pollution and combined tests	39
11.4	Conflicting requirements for testing internal and external insulation	41
11.5	Measurement of humidity	41
Section 4: Tests with Direct Voltage		43
12	Definitions for direct voltage tests	43
12.1	Value of the test voltage	43
12.2	Ripple	43
13	Test voltage	43
13.1	Requirements for the test voltage	43
13.2	Generation of the test voltage	43
13.3	Measurement of the test voltage	45
13.4	Measurement of the test current	47
14	Test procedures	47
14.1	Withstand voltage tests	47
14.2	Disruptive discharge voltage tests	49
14.3	Assured disruptive discharge voltage tests	49
Section 5: Tests with Alternating Voltage		51
15	Definitions for alternating voltage tests	51
15.1	Definitions for alternating voltage tests	51
15.2	Peak value	51
15.3	R.M.S. value	51
16	Test Voltage	51
16.1	Requirements for the test voltage	51
16.2	Generation of the test voltage	53
16.3	Measurement of the test voltage	55
17	Test procedures	57
17.1	Withstand voltage tests	57
17.2	Disruptive discharge voltage tests	57
17.3	Assured disruptive discharge voltage tests	59

Section 6: Tests with Lightning Impulse Voltage	61
18 Definitions for lightning impulse tests	61
18.1 Definitions of general applicability	61
18.2 Definitions applicable only to chopped impulses	63
18.3 Voltage/time curves	65
19 Test Voltage	65
19.1 Standard lightning impulse	65
19.2 Tolerances	65
19.3 Standard chopped lightning impulse	67
19.4 Special lightning impulses	67
19.5 Generation of the test voltage	67
19.6 Measurement of the test voltage and determination of impulse shape	67
19.7 Measurement of current during tests with impulse voltages	69
20 Test Procedures	69
20.1 Withstand voltage tests	69
20.2 Procedures for assured discharge voltage tests	73
Section 7: Tests with Switching Impulses	75
21 Definitions for switching impulse tests	75
21.1 Switching impulse	75
21.2 Value of the test voltage	75
21.3 Time to peak T_p	75
21.4 Time to half-value T_2	75
21.5 Time above 90% T_d	75
21.6 Time to zero T_0	75
21.7 Time to chopping T_c	77
21.8 Linearly rising impulse	77
22 Test voltage	77
22.1 Standard switching impulse	77
22.2 Tolerances	77
22.3 Special switching impulses	77
22.4 Generation of the test voltage	79
22.5 Measurement of test voltage and determination of impulse shape	79
23 Test procedures	79
Section 8: Tests with Impulse Current	81
24 Definitions for impulse current tests	81
24.1 Impulse current	81
24.2 Value of the test current	81
24.3 Front time T_1	81
24.4 Virtual origin O_1	81
24.5 Time to half-value T_2	81
24.6 Duration of peak of a rectangular impulse current T_d	81
24.7 Total duration of a rectangular impulse current T_i	83

25	Test current	83
25.1	Standard impulse currents	83
25.2	Tolerances	83
25.3	Measurement of the test current	85
25.4	Measurement of voltage during tests with impulse current	85
Section 9: Combined and Composite Tests		87
26	Combined voltage tests	87
26.1	Value of the test voltage U	87
26.2	Time delay Δt	87
26.3	Actual voltage shapes	87
26.4	Arrangement of the test object	89
26.5	Atmospheric correction factors	89
27	Composite tests	89
Appendix A: Statistical Treatment of Test Results		91
A.1	Classification of tests	91
A.1.1	Class 1: Multiple-level tests	91
A.1.2	Class 2: Up-and-down tests	91
A.1.3	Class 3: Successive Discharge Tests	91
A.2	Statistical Behaviour of Disruptive Discharge	93
A.2.1	Confidence limits and statistical error	93
A.3	Analysis of Test Results	95
A.3.1	Treatment of Results from Class 1 Tests	95
A.3.2	Treatment of Results from Class 2 Tests	97
A.3.3	Treatment of Results from Class 3 Tests	97
A.4	Application of likelihood methods	99
A.4.1	The likelihood function	99
A.4.2	Estimation of U_{50} and z	101
Appendix B: Pollution Test Procedures		103
B.1	Production of salt fog	103
B.1.1	Preparation of salt solution	103
B.1.2	Details of spraying system	103
B.2	Pre-deposition of pollution, coating and wetting procedure	103
B.2.1	Preparation of coating material	103
B.2.2	Main characteristics of the inert materials	105
B.2.3	Solid coating and wetting procedure	105
B.3	Measurement of the degree of pollution	107
B.3.1	Surface conductivity of the insulating surface	107

B.3.2 Equivalent amount of sodium chloride per square centimetre of the insulating surface
(S.D.D. mg/cm²). 107

Appendix C: Calibration of a Non-Approved Measurement Device with a Rod/Rod Gap 111

C.1 General arrangement of a rod/rod gap 111

C.2 Reference Values 111

C.3 Calibration Procedure 111

Figures 112

This document is a preview generated by EVS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

HIGH VOLTAGE TEST TECHNIQUES

Part 1: General definitions and test requirements

FOREWORD

- 1) The formal decisions or agreements of the IEC on technical matters, prepared by Technical Committees on which all the National Committees having a special interest therein are represented, express, as nearly as possible, an international consensus of opinion on the subjects examined.
- 2) They have the form of recommendations for international use and they are accepted by the National Committees in that sense.
- 3) In order to promote international unification, the IEC expresses the wish that all National Committees should adopt the text of the IEC recommendation for their national rules in so far as national conditions will permit. Any divergence between the IEC recommendation and the corresponding national rules should, as far as possible, be clearly indicated in the latter.

PREFACE

This standard has been prepared by IEC Technical Committee 42: High Voltage testing techniques .

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

Six Month's Rule	Report on Voting
42(CO)40	42(CO)41

Full information on the voting for the approval of this standard can be found in the Voting Report indicated in the above table.

HIGH VOLTAGE TEST TECHNIQUES

PART 1:
GENERAL DEFINITIONS AND TEST REQUIREMENTS

Section 1: General

1 Scope

This standard is applicable to:

- dielectric tests with direct voltage;
- dielectric tests with alternating voltage;
- dielectric tests with impulse voltage;
- tests with impulse current;
- tests with combinations of the above.

This standard is applicable only to tests on equipment having its highest voltage for equipment U_m above 1 kV.

This standard is not intended to be used for electromagnetic compatibility tests on electric or electronic equipment.

2 Object

The object of this standard is:

- to define terms of both general and specific applicability;
- to present general requirements regarding test objects and test procedures;
- to describe methods for generation and measurement of test voltages and currents;
- to describe test procedures;
- to describe methods for the evaluation of test results and to indicate criteria for acceptance or refusal.

Definitions and requirements concerning approved measuring devices and checking methods are given in IEC Publication 60-3: High Voltage Test Techniques — Measuring Devices.

Alternative test procedures may be required to obtain reproducible and significant results. The choice of a suitable test procedure should be made by the relevant Technical Committee.