



BSI Standards Publication

High-voltage fuses

Part 1: Current-limiting fuses

National foreword

This British Standard is the UK implementation of EN IEC 60282-1:2020. It is identical to IEC 60282-1:2020. It supersedes BS EN 60282-1:2009+A1:2014, which will be withdrawn on 19 May 2023.

The UK participation in its preparation was entrusted to Technical Committee PEL/32, Fuses.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2020
Published by BSI Standards Limited 2020

ISBN 978 0 580 97533 2

ICS 29.120.50

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 June 2020.

Amendments/corrigenda issued since publication

Date	Text affected
------	---------------

EUROPEAN STANDARD

EN IEC 60282-1

NORME EUROPÉENNE

EUROPÄISCHE NORM

May 2020

ICS 29.120.50

Supersedes EN 60282-1:2009 and all of its amendments
and corrigenda (if any)

English Version

**High-voltage fuses - Part 1: Current-limiting fuses
(IEC 60282-1:2020)**Fusibles à haute tension - Partie 1: Fusibles limiteurs de
courant
(IEC 60282-1:2020)Hochspannungssicherungen - Teil 1: Strombegrenzende
Sicherungen
(IEC 60282-1:2020)

This European Standard was approved by CENELEC on 2020-05-19. 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, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, 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: Rue de la Science 23, B-1040 Brussels

European foreword

The text of document 32A/347/FDIS, future edition 8 of IEC 60282-1, prepared by SC 32A "High-voltage fuses" of IEC/TC 32 "Fuses" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 60282-1:2020.

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) 2021-02-19
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2023-05-19

This document supersedes EN 60282-1:2009 and all of its amendments and corrigenda (if any).

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

Endorsement notice

The text of the International Standard IEC 60282-1:2020 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 60085:2007	NOTE	Harmonized as EN 60085:2008 (not modified)
IEC 62271-100:2008	NOTE	Harmonized as EN 62271-100:2009 (not modified)
IEC 62271-100:2008/A1:2012	NOTE	Harmonized as EN 62271-100:2009/A1:2012 (not modified)
IEC 62271-100:2008/A2:2017	NOTE	Harmonized as EN 62271-100:2009/A2:2017 (not modified)
IEC 62271-103	NOTE	Harmonized as EN 62271-103
ISO 179 (series)	NOTE	Harmonized as EN ISO 179 (series)

CONTENTS

FOREWORD	6
1 Scope	8
2 Normative references	8
3 Terms and definitions	8
3.1 Electrical characteristics	8
3.2 Fuses and their component parts	12
3.3 Additional terms	14
4 Normal and special service conditions	16
4.1 Normal service conditions	16
4.2 Special service conditions	17
4.2.1 General	17
4.2.2 Altitude	17
4.3 Environmental behaviour	18
5 Ratings and characteristics	18
5.1 General	18
5.2 Ratings and characteristics that are applicable to all fuses	18
5.2.1 Rated voltage (U_r)	18
5.2.2 Rated current of a fuse-base	19
5.2.3 Rated current of a fuse-link (I_r)	19
5.2.4 Rated insulation level (of a fuse-base)	19
5.2.5 Rated breaking capacity	21
5.2.6 Rated frequency	21
5.2.7 Temperature limits	21
5.2.8 Limits of switching voltage	22
5.2.9 Time-current characteristics	24
5.2.10 Cut-off characteristic	25
5.2.11 I^2t characteristics	25
5.2.12 Power dissipation	25
5.3 Ratings and characteristics of particular fuse-link types and applications	25
5.3.1 Fuse-links for transformer applications	25
5.3.2 Fuse-links for motor circuit applications	26
5.3.3 Fuse-links for capacitor protection	26
5.3.4 Fuses fitted with indicating devices	26
5.3.5 Back-Up fuses intended for use in a switch-fuse combination according to IEC 62271-105	28
5.3.6 Allowable continuous current of a fuse-link (I_a)	28
5.3.7 Maximum enclosure current (I_{fep})	28
6 Design, construction and performance	29
6.1 General requirements with respect to fuse operation	29
6.1.1 General	29
6.1.2 Standard conditions of use	29
6.1.3 Standard conditions of behaviour	30
6.2 Identifying markings	30
6.3 Dimensions	31
7 Type tests performed on all fuses	31
7.1 Conditions for making the tests	31

7.2	List of type tests	32
7.3	Common test practices for all type tests	32
7.3.1	General	32
7.3.2	Mounting of fuse-link	32
7.3.3	Condition of device to be tested.....	32
7.3.4	Mounting of fuses	32
7.4	Dielectric tests	32
7.4.1	Test practices	32
7.4.2	Application of test voltage for impulse and power-frequency test	33
7.4.3	Atmospheric conditions during test	33
7.4.4	Lightning impulse voltage dry tests	33
7.4.5	Power-frequency voltage dry tests	34
7.4.6	Power-frequency wet tests.....	34
7.5	Temperature-rise tests and power-dissipation measurement.....	34
7.5.1	Test practices	34
7.5.2	Measurement of temperature	35
7.5.3	Measurement of power dissipation.....	36
7.6	Breaking tests.....	36
7.6.1	Test practices	36
7.6.2	Test procedure	46
7.6.3	Alternative test methods for Test Duty 3	48
7.6.4	Breaking tests for fuse-links of a homogeneous series.....	51
7.6.5	Acceptance of a homogeneous series of Back-Up fuse-links by interpolation.....	53
7.6.6	Acceptance of a homogeneous series of fuse-links of different lengths	53
7.7	Tests for time-current characteristics	54
7.7.1	Test practices	54
7.7.2	Test procedures.....	54
7.8	Electromagnetic compatibility (EMC).....	54
8	Type tests for particular fuse-link types and applications	55
8.1	General.....	55
8.2	List of type tests	55
8.3	Tests required for a particular type of fuse or application	55
8.3.1	Indicator tests (for fuses fitted with indicators)	55
8.3.2	Striker tests (for fuses fitted with strikers).....	56
8.3.3	Tests for Back-Up fuses for use in switch-fuse combination of IEC 62271-105	58
8.3.4	Liquid-tightness tests.....	59
8.4	Tests performed at the request of a user.....	64
8.4.1	Thermal shock tests for outdoor fuses	64
8.4.2	Waterproof test (ingress of moisture) for outdoor fuses.....	65
9	Routine tests	65
Annex A (normative) Method of drawing the envelope of the prospective and transient recovery voltage of a circuit and determining the representative parameters.....		66
A.1	Introduction.....	66
A.2	Drawing the envelope	66
A.3	Determination of parameters	66
Annex B (informative) Reasons which led to the choice of TRV values for Test Duties 1, 2 and 3		68

Annex C (informative) Preferred arrangements for temperature-rise tests of liquid-tight fuse-links	70
Annex D (informative) Types and dimensions of current-limiting fuse-links specified in existing national standards	71
Annex E (normative) Requirements for certain types of fuse-links intended for use at surrounding temperatures above 40 °C	74
E.1 Types of fuse-link covered by this annex	74
E.1.1 General	74
E.1.2 Covered fuse-link types	74
E.1.3 Exempted fuse-links	74
E.1.4 Introduction	74
E.2 Definitions	75
E.3 Preferred MAT ratings	75
E.4 Specific service conditions	75
E.5 Additional breaking test requirements	75
E.5.1 Test practices	75
E.5.2 Test procedure	76
E.5.3 Full-Range fuse Test Duty 3 tests	76
E.6 Full-Range fuse: determination of I_3 current	77
Annex F (informative) Criteria for determining I_t testing validity	78
F.1 Introduction	78
F.2 Breaking processes	78
Bibliography	79
Figure 1 – Terminology	13
Figure 2 – Permissible switching voltages for fuse-links of small current ratings (Table 8)	24
Figure 3 – Various stages of the striker travel	27
Figure 4 – Representation of a specified TRV by a two-parameter reference line and a delay line	41
Figure 5 – Example of a two-parameter reference line for a TRV complying with the conditions of the type test	42
Figure 6 – Breaking tests – Arrangement of the equipment	46
Figure 7 – Breaking tests – Typical circuit diagram for Test Duties 1 and 2	46
Figure 8 – Breaking tests – Typical circuit diagram for Test Duty 3	47
Figure 9 – Breaking tests – Interpretation of oscillograms for Test Duty 1	49
Figure 10 – Breaking tests – Interpretation of oscillograms for Test Duty 2 (calibration traces as in a) of Figure 9)	50
Figure 11 – Breaking tests – Interpretation of oscillograms for Test Duty 3	50
Figure 12 – Test sequence for switchgear type applications	61
Figure 13 – Test sequence for transformer type applications	62
Figure 14 – Test sequence for series a) test for transformer type applications	63
Figure 15 – Test sequence for series b) test for transformer type applications	64
Figure A.1 – Example of a two-parameter reference line for a TRV whose initial portion is concave towards the left	67
Figure A.2 – Example of a two-parameter reference line for an exponential TRV	67
Figure C.1 – Test tank for temperature-rise tests of liquid-tight fuses	70

Figure C.2 – Details of clamping arrangement for fuse-link in the tank	70
Table 1 – Altitude correction factors – Dielectric withstand.....	17
Table 2 – Altitude correction factors – Current-carrying capability	17
Table 3 – Rated voltages	19
Table 4 – Fuse-base rated insulation levels – Series I	20
Table 5 – Fuse-base rated insulation levels – Series II	20
Table 6 – Limits of temperature and temperature rise for components and materials.....	22
Table 7 – Maximum permissible switching voltages.....	23
Table 8 – Maximum permissible switching voltages for certain fuse-links of small current ratings	23
Table 9 – Striker mechanical characteristics	27
Table 10 – Electrical connection to the test circuit – Conductor sizes.....	35
Table 11 – Breaking tests – Parameters	39
Table 12 – Standard values of rated TRV for I_1 – Series I rated voltages.....	43
Table 13 – Standard values of rated TRV for I_1 – Series II rated voltages.....	43
Table 14 – TRV for Test Duty 2 – Series I rated voltages	44
Table 15 – TRV for Test Duty 2 – Series II rated voltages.....	45
Table 16 – Breaking test requirements for fuse-links of a homogeneous series	52

INTERNATIONAL ELECTROTECHNICAL COMMISSION

HIGH-VOLTAGE FUSES –

Part 1: Current-limiting fuses

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 60282-1 has been prepared by subcommittee 32A: High-voltage fuses, of IEC technical committee 32: Fuses.

This eighth edition cancels and replaces the seventh edition published in 2009.

This edition includes the following significant technical changes with respect to the previous edition:

- additional information concerning thermally operated strikers;
- the division of ratings, characteristics and type tests into those applicable to all fuses and those applicable to particular fuse-link types and applications;
- adjustment of Series II voltages and tests to meet present North American standard system voltages and applications;
- clarification of requirements for fuse-links used in surrounding temperatures above 40 °C; and

- clarification of homogeneous requirements for fuse-links containing one element.

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

FDIS	Report on voting
32A/347/FDIS	32A/349/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 60282 series, published under the general title *High-voltage fuses*, can be found on the IEC website.

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.

HIGH-VOLTAGE FUSES –

Part 1: Current-limiting fuses

1 Scope

This part of IEC 60282 applies to all types of high-voltage current-limiting fuses designed for use outdoors or indoors on alternating current systems of 50 Hz and 60 Hz and of rated voltages exceeding 1 000 V.

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

IEC 60071-1, *Insulation coordination – Part 1: Definitions, principles and rules*

IEC 60549, *High-voltage fuses for the external protection of shunt capacitors*

IEC 60644, *Specification for high-voltage fuse-links for motor circuit applications*

IEC 62271-105, *High-voltage switchgear and controlgear – Part 105: Alternating current switch-fuse combinations for rated voltages above 1 kV up to and including 52 kV*

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 Electrical characteristics

3.1.1

rated value

value of a quantity used for specification purposes, established for a specified set of operating conditions of a component, device, equipment, or system

Note 1 to entry: Examples of rated value usually stated for fuses: voltage, current and breaking current.

[SOURCE: IEC 60050-441:2000, 441-18-35, modified – "used for specification purposes" and "system" added, "assigned, generally by the manufacturer" deleted.]