
British Standard

Cartridge fuses for voltages up to and including 1 000 V a.c. and 1 500 V d.c.

Part 1. Specification of general requirements

[IEC title: Low-voltage fuses Part 1. General requirements]

Coupe-circuit pour des tensions inférieures ou égales à 1 000 V en courant alternatif et 1 500 V
en courant continu

Partie 1. Prescriptions générales

Patronensicherungen für Gleichspannung bis 1 500 V und Wechselspannung bis 1 000 V

Teil 1. Allgemeine Anforderungen

National foreword

This Part of BS 88 has been prepared under the direction of the Power Electrical Engineering Standards Committee and supersedes BS 88 : Part 1 : 1975, which is withdrawn.

This Part of BS 88 is identical with the English text of IEC Publication 269-1 'Low-voltage fuses' Part 1 : 1986 'General requirements', published by the International Electrotechnical Commission (IEC).

Terminology and conventions

The text of the international standard has been approved as suitable for publication as a British Standard without deviation. Some terminology and certain conventions are not identical with those used in British Standards; attention is drawn especially to the following.

The comma has been used as a decimal marker. In British Standards it is current practice to use a full point on the baseline as the decimal marker.

Wherever page numbers are quoted, they are IEC page numbers.

Cross-references

International standard	Corresponding British Standard
IEC 50(441) : 1984	BS 4727 Glossary of electrotechnical, power, telecommunication, electronics, lighting and colour terms Part 2 Terms particular to power engineering Group 06 : 1985 Switchgear and controlgear terminology (including fuse terminology) (Technically equivalent)
IEC 127 : 1974	BS 4265 : 1977 Specification for cartridge fuse links for miniature fuses (Identical)
IEC 269-2 : 1973	BS 88 Cartridge fuses for voltages up to and including 1000 V a.c. and 1500 V d.c. Part 2 Specification for fuses for use by authorized persons (mainly for industrial application) Section 2.1 : 1988 Supplementary requirements
IEC 408 : 1972	BS 5419 : 1977 Specification for air-break switches, air-break disconnectors, air-break switch disconnectors and fuse-combination units for voltages up to and including 1000 V a.c. and 1200 V d.c. (Identical)
IEC 417 : 1973	BS 6217 : 1981 Guide to graphical symbols for use on electrical equipment (Identical)
IEC 529 : 1976	BS 5490 : 1977 Specification for classification of degrees of protection provided by enclosures (Identical)
IEC 548 : 1976	BS 5788 : 1979 Method for expression of the properties of sampling oscilloscopes (Identical)
IEC 695-2-1 : 1980	BS 6458 Fire hazard testing for electrotechnical products Part 2 Methods of test Section 2.1 : 1984 Glow-wire test (Identical)
ISO 3-1973	BS 2045 : 1965 Preferred numbers (Technically equivalent)
ISO 478-1974 } ISO 593-1974 }	BS 4000 : 1983 Specification for sizes of paper and board (Technically equivalent)
ISO 4046-1978	BS 3203 : 1979 Glossary of paper, board, pulp and related terms (Identical)

The Technical Committee has reviewed the provisions of IEC 38 and has decided that they are acceptable for use in conjunction with this British Standard. References to IEC 257, IEC 291 and IEC 364-5-523 are for information only.

The UK equivalent to IEC 364 is the Regulations for the Electrical Installations of Buildings published by the Institution of Electrical Engineers. The definitions from IEC 364-3 quoted in this British Standard are technically equivalent to the corresponding ones in the Regulations.

Compliance with a British Standard does not of itself confer immunity from legal obligations.



Amendment No. 1
published and effective from 28 February 1991
to BS 88 : Part 1 : 1988 (IEC 269-1 : 1986)

Cartridge fuses for voltages up to and including
1000 V a.c. and 1500 V d.c.

Part 1. Specification of general requirements

NOTE. This amendment has been issued to implement the endorsement of IEC 269-1 by CENELEC as EN 60 269-1.

Revised text

AMD 6448
February 1991

Front and back covers

In the top right-hand corner of the front cover, and twice on the back cover, immediately below 'IEC 269-1 : 1986' insert 'EN 60 269-1 : 1989'.

On the front cover, at the foot of the page, insert the following.

'This European Standard EN 60 269-1 has the status of a British Standard'.

AMD 6448
February 1991

National foreword

Insert the following two paragraphs at the end of the existing text.

'Fuses within the scope of this standard are not sensitive to normal electromagnetic disturbances, and therefore no immunity tests are required.

Significant electromagnetic disturbance generated by a fuse is limited to the instant of its operation. Provided that the maximum arc voltages during operation in the type test comply with the requirements of the clause in this standard specifying maximum arc voltage, the requirements for electromagnetic compatibility are deemed to be satisfied.'

AMD 6448
February 1991

New EN title page, brief history and technical text page

Insert the attached new EN page immediately before the list of contents (i.e. before page 1 of BS 88 : Part 1).

AMD 6448
February 1991

New annex ZA

Insert the attached page at the end of the existing text, i.e. after appendix D.

UDC: 621.316.923.027.2

Key words: Low-voltage fuse; definition; classification; characteristic; operation; breaking capacity; test

English version

Low-voltage fuses Part 1 : General requirements

Fusibles basse tension
Première partie: Règles générales

Niederspannungssicherungen
Teil 1: Allgemeine Anforderungen

This European Standard was ratified by CENELEC on 24 June 1988.

CENELEC members are bound to comply with the requirements of the 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 CENELEC Central Secretariat or to any CENELEC member.

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

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 Bréderode 2, B-1000 Brussels

Brief history

The CENELEC Questionnaire Procedure, performed for finding out whether or not IEC 269-1 (2nd edition – 1986) could be accepted without textual changes, has shown that no common modifications were necessary for the acceptance as European Standard (EN). The Reference Document was submitted to the CENELEC members for formal vote and acceptance by CENELEC.

Technical text

The text of the International Standard IEC 269-1 (2nd edition – 1986) was approved by CENELEC on 28 June 1988 as a European Standard.

Annexes designated 'normative' are part of the body of the standard. Annexes designated 'informative' are given only for information.

In this standard annex ZA, added by CENELEC, is normative.

The following dates were fixed:

- date of announcement (doa) : 1 January 1989
- date of publication (dop) : 1 July 1989
- date of withdrawal of conflicting national standard (dow) : 1 January 1990

Annex ZA (normative)

Other international publications quoted in this standard.

*This publication is under revision or a revised version has been issued.

1 IEC publications	EN/HD	Date of publication of EN/HD
38 (1983) IEC standard voltages	—	—
50 (441) (1984)* International Electrotechnical Vocabulary Chapter 441: Switchgear, controlgear and fuses	—	—
127 (1974) Cartridge fuse-links for miniature fuses	HD 109 S3	04.83
257 (1968) Fuse-holders for miniature cartridge fuse-links	HD 119	05.74
269-2 (1973)* Low-voltage fuses Part 2: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application)	—	—
291 (1969) Fuse definitions	—	—
364-3 (1977) Electrical installations of buildings Part 3: Assessment of general characteristics	HD 384.3	10.85
364-5-523 (1983) Electrical installations of buildings Part 5: Selection and erection of electrical equipment Chapter 52: Wiring systems Section 523 — Current-carrying capacities	—	—
408 (1972)* Low-voltage air-break switches, air-break disconnectors, air-break switchdisconnectors and fuse-combination units	HD 422	06.82
417 (1973)* Graphical symbols for use on equipment Index, survey and compilation of the single sheets	HD 243 S6	06.84
529 (1976)* Classification of degrees of protection provided by enclosures	HD 365 S3	05.85
584-1 (1977) Thermocouples Part 1: Reference tables	HD 466.1	03.84
695-2-1 (1980) Fire hazard testing Part 2: Test methods. Glow-wire test and guidance	HD 444.2.1	03.83
2 ISO publications	EN/HD	Date de publication des EN/HD
3 (1973) Preferred numbers Series of preferred numbers	—	—
478 (1974) Paper — Untrimmed stock sizes for the ISO A series; ISO primary range	—	—
593 (1974) Paper — Untrimmed stock sizes for the ISO A series; ISO supplementary range	—	—
4046 (1978) Paper, board, pulp and related terms — Vocabulary — Bilingual edition	—	—

Amendment No. 2
published and effective from 15 October 1994
to BS 88 : Part 1 : 1988

Cartridge fuses for voltages up to and including 1000 V a.c. and
1500 V d.c.
Part 1. Specification of general requirements

NOTE. This amendment implements Amendment A1, published in April 1994 to EN 60269-1 : 1989, which includes Amendment 1 : 1994 to IEC 269-1 : 1986.

This amendment together with EN 60269-1 : 1989 has the status of a British Standard.

Revised text

Front and back covers (as amended by Amendment No. 1)

In the top right hand corner on the front cover, and twice on the back cover, immediately above 'BS 88 : Part 1 : 1988' insert 'BS EN 60269-1 : 1994'. Delete 'EN 60 269-1 : 1989' as inserted by Amendment No. 1 : 1991.

On the front cover delete 'Cartridge fuses for voltages up to and including 1000 V a.c. and 1500 V d.c. Part 1. Specification of general requirements' and substitute 'Low-voltage fuses Part 1. General requirements'.

Delete the IEC title and the French and German titles.

AMD 8310/October 1994

National foreword

At the end of paragraph 2 insert the following new paragraphs.

'In 1989 the European Committee for Electrotechnical Standardization (CENELEC) accepted IEC 269-1 : 1986 as European Standard EN 60269-1 : 1989. As a consequence of implementing the European Standard this British Standard is renumbered as BS EN 60269-1 : 1994 but retaining 'BS 88 : Part 1 : 1988' as a secondary reference number. Any reference to BS 88 : Part 1 : 1988 should be read as a reference to BS EN 60269-1 : 1994.

CENELEC have accepted Amendment 1 : 1994 to IEC 269-1 : 1986 as Amendment A1 : 1994 to EN 60269-1 : 1989 and this is included in this British Standard.'

AMD 8310/October 1994

EN title page and foreword

Immediately after the national foreword, insert the attached new EN title page and foreword.

AMD 8310/October 1994

Contents

Insert the title of subclause 7.14 as follows:

'7.14 Electromagnetic compatibility'

AMD 8310/October 1994

New subclause 7.14

Insert, after subclause 7.13, the following new subclause:

'7.14 Electromagnetic compatibility

Fuses within the scope of this standard are not sensitive to normal electromagnetic disturbances, and therefore no immunity tests are required.

Significant electromagnetic disturbance generated by a fuse is limited to the instant of its operation. Provided that the maximum arc voltages during operation in the type tests comply with the requirements of 7.5, the requirements for electromagnetic compatibility are deemed to be satisfied.'

AMD 8310/October 1994

UDC 621.316.923.027.2 : 621.37.001.365

Descriptors: Electrical equipment, low-voltage switchgear, low voltage fuses, characteristics, test

Amendment A1 to the English version of EN 60269-1

Low-voltage fuses Part 1: General requirements

(IEC 269-1 : 1986/A1 : 1994)

Fusibles basse tension
Première partie: Règles générales
(CEI 269-1 : 1986/A1 : 1994)

Niederspannungssicherungen
Teil 1: Allgemeine Anforderungen
(IEC 269-1 : 1986/A1 : 1994)

This amendment A1 modifies the European Standard EN 60269-1 : 1989. It was approved by CENELEC on 1993-09-22. 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 Central Secretariat or to any CENELEC member.

This amendment 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 Central Secretariat has the same status as the official versions.

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 text of document 32B(CO)94, as prepared by Sub-Committee 32B : Low-voltage fuses, of IEC Technical Committee 32: Fuses, was submitted to the IEC-CENELEC parallel vote in November 1992.

The reference document was approved by CENELEC as amendment A1 to EN 60269-1 on 22 September 1993.

The following dates were fixed:

- latest date of publication of
an identical national standard (dop) 1995-03-01
- latest date of withdrawal of
conflicting national standards (dow) 1995-03-01

For products which have complied with EN 60269-1 : 1989 before 1995-03-01, as shown by the manufacturer or by a certification body, this previous standard may continue to apply for production until 2000-03-01.

NOTE. The UDC and descriptors of this amendment replace those given for EN 60269-1 : 1989.

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British Standard

Cartridge fuses for voltages up to and including 1 000 V a.c. and 1 500 V d.c.

Part 1. Specification of general requirements

1. General

1.1 Scope

This standard is applicable to fuses incorporating enclosed current-limiting fuse-links with rated breaking capacities of not less than 6 kA, intended for protecting power-frequency a.c. circuits of nominal voltages not exceeding 1 000 V or d.c. circuits of nominal voltages not exceeding 1 500 V.

Subsequent parts of this standard, referred to herein, cover supplementary requirements for such fuses intended for specific conditions of use or applications.

Fuse-links intended to be included in fuse-switch combinations according to IEC Publication 408: Low-voltage Air-break Switches, Air-break Disconnectors, Air-break Switch Disconnectors and Fuse-combination Units, should also comply with the following requirements.

Notes 1. – For “a” fuse-links, details of performance (see Sub-clause 2.2.4) on d.c. circuits should be subject to agreement between user and manufacturer.

2. – Modifications of, and supplements to, this standard required for certain types of fuses for particular applications – for example certain fuses for rolling stock, or fuses for high-frequency circuits – will be covered, if necessary, by separate standards.
3. – This standard does not apply to miniature fuses, these being covered by IEC Publication 127: Cartridge Fuse-links for Miniature Fuses, and IEC Publication 257: Fuse-holders for Miniature Cartridge Fuse-links.

1.2 Object

The object of this standard is to establish the characteristics of fuses or parts of fuses (fuse-base, fuse-carrier, fuse-link) in such a way that they can be replaced by other fuses or parts of fuses having the same characteristics provided that they are interchangeable as far as their dimensions are concerned. For this purpose, this standard refers in particular to:

1.2.1 The following characteristics of fuses:

- a) their rated values;
- b) their insulation;
- c) their temperature rises in normal service;
- d) their power dissipation and acceptance;
- e) their time/current characteristics;
- f) their breaking capacity;
- g) their cut-off current characteristic and their I^2t characteristics.

1.2.2 Type test for verification of the characteristics of fuses

1.2.3 The marking on fuses

2. Definitions

Note. – For general definitions concerning fuses, see also IEC Publication 291: Fuse Definitions, and IEC Publication 50 (441): International Electrotechnical Vocabulary (IEV), Chapter 441: Switchgear, Controlgear and Fuses.

For the purpose of this standard, the following definitions shall apply.

2.1 *Fuses and their component parts*

2.1.1 *Fuse*

A device that by the fusing of one or more of its specially designed and proportioned components opens the circuit in which it is inserted by breaking the current when this exceeds a given value for a sufficient time. The fuse comprises all the parts that form the complete device.

2.1.2 *Fuse-holder*

The combination of the fuse-base with its fuse-carrier. (Where in this standard the term “fuse-holder” is used, it covers fuse-bases and/or fuse-carriers, if no clearer distinction is necessary.)

2.1.2.1 *Fuse-base* (fuse-mount)

The fixed part of a fuse provided with contacts, terminals and covers, where applicable.

2.1.2.2 *Fuse-carrier*

The movable part of a fuse designed to carry a fuse-link.

2.1.3 *Fuse-link*

The part of a fuse including the fuse-element(s), intended to be replaced after the fuse has operated.

2.1.4 *Fuse-contact*

Two or more conductive parts designed to ensure circuit continuity between a fuse-link and the corresponding fuse-holder.

2.1.5 *Fuse-element*

A part of a fuse-link designed to melt when the fuse operates. The fuse-link may comprise several fuse-elements in parallel.

2.1.6 *Indicating device* (indicator)

A device provided to indicate whether the fuse has operated.

2.1.7 *Striker*

A mechanical device forming part of a fuse-link which, when the fuse operates, releases the energy required to cause operation of other apparatus or indicators or to provide interlocking.

2.1.8 *Terminal*

A conductive part of a fuse provided for electric connection to external circuits.

Note. – Terminals may be distinguished according to the kind of circuits for which they are intended (e.g. main terminal, earth terminal, etc.) and also according to their design (e.g. screw terminal, plug terminal, etc.).

2.1.9 *Dummy fuse-link*

A test fuse-link with defined power dissipation and dimensions.

2.1.10 *Test rig*

A defined test fuse-base.

2.1.11 *Gauge-piece*

An additional part of a fuse-base intended to achieve a degree of non-interchangeability.

2.2 *General terms*

2.2.1 *Enclosed fuse-link*

A fuse-link in which the fuse-element(s) is (are) totally enclosed, so that during operation within its rating it cannot produce any harmful external effects, e.g. due to development of an arc, the release of gas or the ejection of flame or metallic particles.

2.2.2 *Current-limiting fuse-link*

A fuse-link that during and by its operation in a specified current range, limits the current to a substantially lower value than the peak value of the prospective current.

2.2.3 “g” fuse-link (formerly general purpose fuse-link)

A current-limiting fuse-link capable of breaking under specified conditions all currents which cause melting of the fuse-element up to its rated breaking capacity.

2.2.4 “a” fuse-link (formerly back-up fuse-link)

A current-limiting fuse-link capable of breaking under specified conditions all currents between the lowest current indicated on its operating time-current characteristic ($k_2 I_n$ in Figure 2, page 101) and its rated breaking capacity.

Note. – “a” fuse-links are generally used to provide short-circuit protection. Where protection is required against over-currents less than $k_2 I_n$ in Figure 2, they are used in conjunction with another suitable switching device designed to interrupt such small overcurrents.

2.2.5 *Temperatures*

2.2.5.1 *Ambient air temperature (T_a)*

The ambient air temperature T_a is that of the air surrounding the fuse (at a distance of about 1 m from the fuse or its enclosure, if any).

2.2.5.2 *Fluid environment temperature (T_e)*

The fluid environment temperature T_e is the temperature of the fluid cooling the fuse-components (contact, terminal, etc.). It is the sum of the ambient air temperature T_a and the tem-

perature rise ΔT_e with respect to the ambient temperature of the internal fluid in contact with the fuse-components (contact, terminal, etc.) if the latter is in an enclosure. If it is not in an enclosure, it is assumed that T_e is equal to T_a .

2.2.5.3 Fuse-component temperature (T)

The fuse-component (contact, terminal, etc.) temperature T is that of the relevant part.

2.2.6 Overcurrent discrimination

Co-ordination of the relevant characteristics of two or more overcurrent protective devices such that, on the occurrence of overcurrents within stated limits, the device intended to operate within these limits does so, while the other(s) do(es) not.

2.2.7 Fuse-system

A family of fuses following the same physical design principles with respect to the shape of the fuse-links, type of contacts, etc.

2.2.8 Size

Specified set of dimensions of fuses within a fuse-system. Each individual size covers a given range of rated currents for which the specified dimensions of the fuses remain unchanged.

2.2.9 Homogeneous series of fuse-links

A series of fuse-links, within a given size, differing from each other only in such characteristics that for a given test, the testing of one or a reduced number of particular fuse-links of that series may be taken as representative for all the fuse-links of the series itself (see Sub-clause 8.1.5.2).

Note. – The characteristics by which the fuse-links of a homogeneous series may differ and details on which of the fuse-links shall be tested are specified in association with the tests concerned (see Tables VIIB and VIIC).

2.2.10 Utilization category (of a fuse-link)

A combination of specified requirements related to the conditions in which the fuse-link fulfils its purpose, selected to represent a characteristic group of practical applications (see Sub-clause 5.7.1).

2.2.11 Fuses for use by authorized persons (formerly called fuses for industrial application)

Fuses intended to be used in installations where the fuse-links are accessible to and intended to be replaced by authorized persons only.

Notes 1. – Non-interchangeability and protection against accidental contact with live parts need not necessarily be ensured by constructional means.

2. – Authorized person is understood to have the meaning defined for categories BA4 “Instructed”^{*} and BA5 “Skilled”^{**} in IEC Publication 364-3: Electrical Installations of Buildings, Part 3: Assessment of General Characteristics.

^{*}Instructed: Persons adequately advised or supervised by skilled persons to enable them to avoid dangers which electricity may create (operating and maintenance staff).

^{**}Skilled: Persons with technical knowledge or sufficient experience to enable them to avoid dangers which electricity may create (engineers and technicians).

2.2.12 *Fuses for use by unskilled persons* (formerly called fuses for domestic and similar applications)

Fuses intended to be used in installations where the fuse-links are accessible to and can be replaced by unskilled persons.

Note. – For these fuses protection against direct contact with live parts is recommended and non-interchangeability may be required, if necessary.

2.2.13 *Non-interchangeability*

Limitations on shape and/or dimensions with the object of avoiding in a specific fuse-base the inadvertent use of fuse-links having electrical characteristics other than those ensuring the desired degree of protection.

2.3 *Characteristic quantities*

2.3.1 *Rating*

A general term employed to designate the characteristic values that together define the working conditions upon which the tests are based and for which the equipment is designed.

Note. – Rated values usually stated for low-voltage fuses are: voltage, current, breaking capacity, power dissipation and acceptance and frequency, where applicable. In the case of a.c., rated voltage and rated current are stated as r.m.s. symmetrical values; in the case of d.c., when ripple is present, the rated voltage is stated as a mean value, the rated current as an r.m.s. value. The above applies to any value of voltage and current, if not indicated otherwise.

2.3.2 *Prospective current of a circuit* (with respect to a fuse)

The current that would flow in a circuit if a fuse situated therein were replaced by a link of negligible impedance.

The prospective current is the quantity to which the breaking capacity and characteristics of the fuse are normally referred, e.g. I^2t and cut-off current characteristics (see Sub-clause 8.5.7).

2.3.3 *Gate*

Limiting values within which the characteristics, for example time-current characteristics, shall be contained.

2.3.4 *Breaking capacity of a fuse-link*

A value (for a.c. the r.m.s. value of the a.c. component) of prospective current that a fuse-link is capable of breaking at a stated voltage under prescribed conditions of use and behaviour.

2.3.5 *Breaking range*

Breaking range is a range of prospective currents within which the breaking capacity of a fuse-link is assured.

2.3.6 *Cut-off current*

The maximum instantaneous value reached by the current during the breaking operation of a fuse-link when it operates in such a manner as to prevent the current from reaching the otherwise attainable maximum.

2.3.7 *Cut-off current characteristic*

A curve giving the cut-off current as a function of the prospective current under stated conditions of operation.

Note. – In the case of a.c., the values of the cut-off currents are the maximum values reached whatever the degree of asymmetry.
In the case of d.c., the values of the cut-off currents are the maximum values reached related to the time constant as specified.

2.3.8 *Peak withstand current (of a fuse-holder)*

The value of cut-off current that the fuse-holder can withstand.

Note. – The peak withstand current is not less than the highest cut-off current of any fuse-link with which the fuse-holder is intended to be associated.

2.3.9 *Pre-arcing time*

The time between the commencement of a current large enough to cause the fuse-element(s) to melt and the instant when an arc is initiated.

2.3.10 *Arcing time*

The interval of time between the instant of the initiation of the arc and the instant of final arc extinction.

2.3.11 *Operating time*

The sum of the pre-arcing time and the arcing time.

2.3.12 *I²t (Joule integral)*

The integral of the square of the current over a given time:

$$I^2t = \int_{t_0}^{t_1} i_1^2 dt$$

Notes 1. – The pre-arcing *I²t* is the *I²t* integral extended over the pre-arcing time of the fuse.

2. – The operating *I²t* is the *I²t* integral extended over the operating time of the fuse.

3. – The energy in joules released in 1 Ω of resistance in a circuit protected by a fuse is equal to the value of the operating *I²t* expressed in A² s.

2.3.13 *I²t characteristic*

A curve giving *I²t* values (pre-arcing *I²t* and/or operating *I²t*) as a function of prospective current under stated conditions of operation.

2.3.14 *I²t zone*

The range contained by the minimum pre-arcing *I²t* characteristic and the maximum operating *I²t* characteristic, under specified conditions.

2.3.15 *Rated current of a fuse-link (I_n)*

A value of current that the fuse-link can carry continuously without deterioration under specified conditions.

2.3.16 *Time-current characteristic*

A curve giving the pre-arcing time or operating time as a function of the prospective current under stated conditions of operation.

Note. – For times longer than 0.1 s for practical purposes the difference between pre-arcing and operating time is negligible.

2.3.17 *Time-current zone*

The range contained by the minimum pre-arcing time-current characteristic and the maximum operating time-current characteristic, under specified conditions.

2.3.18 *Conventional non-fusing current (I_{nf})*

A value of current specified as that which the fuse-link is capable of carrying for a specified time (conventional time) without melting.

2.3.19 *Conventional fusing current (I_f)*

A value of current specified as that which causes operation of the fuse-link within a specified time (conventional time).

2.3.20 *Overload curve of an “a” fuse-link*

A curve showing the time for which an “a” fuse-link shall be able to carry the current without deterioration (see Sub-clause 8.4.3.4 and Figure 2, page 101).

2.3.21 *Power dissipation of a fuse-link*

The power released in a fuse-link carrying rated current under specified conditions.

2.3.22 *Power acceptance of a fuse-holder*

The maximum value of power released in a fuse-link which a fuse-holder is designed to tolerate under specified conditions.

2.3.23 *Recovery voltage*

The voltage which appears across the terminals of a fuse after the breaking of the current.

Note. – This voltage may be considered in two successive intervals of time, one during which a transient voltage exists (Sub-clause 2.3.23.1) followed by a second one during which only the power frequency or d.c. recovery voltage (Sub-clause 2.3.23.2) exists.

2.3.23.1 *Transient recovery voltage*

The recovery voltage during the time in which it has a significant transient character.

Notes 1. – The transient voltage may be oscillatory or non-oscillatory or a combination of both, depending on the characteristics of the circuit and the fuse. It includes the voltage shift of the neutral of a polyphase circuit.

2. – The transient recovery voltage in three-phase circuits is, unless otherwise stated, that which appears across the first pole to clear because this voltage is generally higher than that which appears across each of the other two poles.

2.3.23.2 *Power-frequency or d.c. recovery voltage*

The recovery voltage after the transient voltage phenomena have subsided.

Note. – The power-frequency or d.c. recovery voltage may be referred to as a percentage of the rated voltage.

2.3.24 *Arc voltage*

The instantaneous value of the voltage which appears across the terminals of a fuse during the arcing time.

3. **Conditions for operation in service**

Where the following conditions apply, fuses complying with this standard are deemed capable of operating satisfactorily without further qualification. These conditions also apply for tests except those otherwise specified in Clause 8.

3.1 *Ambient air temperature (T_a)*

The ambient air temperature T_a (see Sub-clause 2.2.5.1) does not exceed 40 °C, its mean value measured over a period of 24 h does not exceed 35 °C and its mean value measured over a period of one year is lower.

The minimum value of the ambient air temperature is –5 °C.

Notes 1. – The time-current characteristics given are related to a reference ambient air temperature of 20 °C. These time-current characteristics also approximately apply to a temperature of 30 °C.

2. – In cases where the temperature conditions vary significantly from these values, this should be taken into consideration from the points of view of operation, temperature rises, etc. See Appendix D.

3.2 *Altitude*

The altitude of the site of installation of the fuses does not exceed 2000 m above sea level.

3.3 *Atmospheric conditions*

The air is clean and its relative humidity does not exceed 50% at the maximum temperature of 40 °C.

Higher relative humidities are permitted at lower temperatures, e.g. 90% at 20 °C.

Under these conditions, moderate condensation may occasionally occur due to variation in temperature.

Note. – Where fuses are to be used under conditions different from those mentioned in Sub-clauses 3.1, 3.2 and 3.3, in particular outdoors without protection, the manufacturer should be consulted. This applies also in cases where deposits of sea salt or abnormal deposits of industrial origin may occur.

3.4 *Voltage*

The system voltage has a maximum value not exceeding 110% of the rated voltage of the fuse. For d.c. when obtained by rectifying a.c., the ripple shall not cause a variation of more than 5% above or 9% below the mean value of 110% of the rated voltage.

Note. – Attention is drawn to the fact that the indicating device or striker of a fuse may not operate if the fuse-link operates at a voltage which is considerably lower than its rated voltage (see Sub-clause 8.4.3.6).