

Low-voltage fuses —

Part 4: Supplementary requirements for fuse-links for the protection of semiconductor devices

The European Standard EN 60269-4:1996, with the incorporation of amendments A1:1997 and A2:2003, has the status of a British Standard

ICS 29.120.50

National foreword

This British Standard is the official English language version of EN 60269-4:1996, including amendments A1:1997 and A2:2003. It is identical with IEC 60269-4:1986, including amendments 1:1995 and 2:2002, published by the International Electrotechnical Commission (IEC). It supersedes BS 88-4:1976 which is withdrawn. Information on the sizes of fuses commonly employed in the UK is provided in National appendix Z.

The start and finish of text introduced or altered by amendment is indicated in the text by tags A1 A1. Tags indicating changes to CENELEC text carry the number of the CENELEC amendment. For example, text altered by CENELEC amendment A1 is indicated by A1 A1.

Corrigendum May 2003 was published to correct Table XIIA and Table XIIB of amendment A2:2003 to EN 60269-4:1996, which has been incorporated into this document.

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 Standard; 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.

There are no British Standards equivalent to IEC 60147-0, IEC 60269-2A or IEC 60269-3A. The nature of the reference to IEC 60147-0 is such that no reference to an equivalent British Standard is necessary. The alternative test arrangements mentioned in 8.1.4 as being in IEC 60269-2A and IEC 60269-3A (both of which are now withdrawn) are for information only and are to be found in BS 88-2.2:1988, Specification for fuses for use by authorized persons (mainly for industrial application) — Section 2.2: Additional requirements for fuses with fuse-links for bolted connections.

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.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Catalogue under the section entitled “International Standards Correspondence Index”, or by using the “Search” facility of the BSI Electronic Catalogue or of British Standards Online.

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

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Summary of pages

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Low-voltage fuses — Part 4: Supplementary requirements for fuse-links for the protection of semiconductor devices

(includes amendments A1:1997 and A2:2003)

(IEC 60269-4:1986 + A1:1995 + A2:2002)

Fusibles basse tension —

Partie 4: Prescriptions supplémentaires concernant les éléments de remplacement utilisés pour la protection des dispositifs à semi-conducteurs

(inclut les amendements A1:1997 et A2:2003)

(CEI 60269-4:1986 + A1:1995 + A2:2002)

Niederspannungssicherungen —

Teil 4: Zusätzliche Anforderungen an Sicherungseinsätze zum Schutz von Halbleiter-Bauelementen

(enthält Änderungen A1:1997 und A2:2003)

(IEC 60269-4:1986 + A1:1995 + A2:2002)

This European Standard was approved by CENELEC on 1996-07-02. Amendment A1 was approved by CENELEC on 1997-03-11 and amendment A2 was approved by CENELEC on 2003-02-01. 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.

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CENELEC

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Foreword

The text of the International Standard IEC 269-4:1986, prepared by SC 32B, Low-voltage fuses, of IEC TC 32, Fuses, was submitted to the Unique Acceptance Procedure and was approved by CENELEC as EN 60269-4 on 1996-07-02 without any modification.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1997-06-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dop) 1997-06-01

For products which have complied with the relevant national standard before 1997-06-01, as shown by the manufacturer or by a certification body, this previous standard may continue to apply for production until 2002-06-01.

Annexes designated “normative” are part of the body of the standard.

Annexes designated “informative” are given for information only.

In this standard, Annex ZA is normative and Appendix A and Appendix B are informative. Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 269-4:1986 was approved by CENELEC as a European Standard without any modification.

Foreword to amendment A1

The text of amendment 1:1995 to the International Standard IEC 269-4:1986, prepared by SC 32B, Low-voltage fuses, of IEC TC 32, Fuses, was submitted to the Unique Acceptance Procedure and was approved by CENELEC as amendment A1 to EN 60269-4:1996 on 1997-03-11 without any modification.

The following dates were fixed:

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- latest date by which the national standards conflicting with the amendment have to be withdrawn (dop) 1997-12-01

For products which have complied with EN 60269-4:1996 before 1997-12-01, as shown by the manufacturer or by a certification body, this previous standard may continue to apply for production until 2002-12-01.

Endorsement notice

The text of amendment 1:1995 to the International Standard IEC 269-4:1986 was approved by CENELEC as an amendment to the European Standard without any modification.

Foreword to amendment A2

The text of document 32B/412/FDIS, future amendment 2 to IEC 60269-4:1986, prepared by SC 32B, Low-voltage fuses, of IEC TC 32, Fuses, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A2 to EN 60269-4:1996 on 2003-02-01.

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Endorsement notice

The text of amendment 2:2002 to the International Standard IEC 60269-4:1986 and its corrigendum March 2003 was approved by CENELEC as an amendment to the European Standard without any modification.

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EXPLANATORY NOTE

A2 In view of the fact that this standard should be read together with IEC 60269-1: *Low-voltage fuses — Part 1: General requirements*, the numbering of its clauses, subclauses and tables is made to correspond to the latter. **A2**

1 General

Fuse-links for the protection of semiconductor devices shall comply with all requirements of IEC 60269-1, if not otherwise indicated hereinafter, and shall also comply with the supplementary requirements laid down below.

1.1 Scope

These supplementary requirements apply to fuse-links for application in equipment containing semiconductor devices for circuits of rated voltages up to 1 000 V a.c. or circuits of nominal voltages up to 1 500 V d.c. and also, in so far as they are applicable, for circuits of higher nominal voltages.

NOTE 1 Such fuse-links are commonly referred to as “semiconductor fuse-links”.

NOTE 2 In most cases, a part of the associated equipment serves the purpose of a fuse-base. Owing to the great variety of equipment, no general rules can be given; the suitability of the associated equipment to serve as a fuse-base should be subject to agreement between the manufacturer and the user. However, if separate fuse-bases or fuse-holders are used, they should comply with the appropriate requirements of IEC 60269-1.

1.2 Object

The object of these supplementary requirements is to establish the characteristics of semiconductor fuse-links in such a way that they can be replaced by other fuse-links having the same characteristics, provided that their dimensions are identical. For this purpose, this standard refers in particular to:

1.2.1 The following characteristics of fuses:

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

1.2.2 Type tests for verification of the characteristics of fuses.

1.2.3 The markings on fuses.

1.2.4 Availability and presentation of technical data (see Appendix B).

2 Definitions

2.2 General terms

A1 Text deleted **A1**

A2 2.2.14

semiconductor device [according to IEC 60050(521)]

a device whose essential characteristics are due to the flow of charge carriers within a semiconductor **A2**

A2 Footnote deleted **A2**

2.2.15

semiconductor fuse-link

a current-limiting fuse-link capable of breaking, under specific conditions, any current value within the breaking range (see Subclause 7.4)

A₂ 2.2.16

signalling device

a device forming part of the fuse and signalling the fuse operation to a remote place. A signalling device consists of a striker and an auxiliary switch. Electronic devices may also be used **A₂**

3 Conditions for operation in service

3.4 Voltage

3.4.1 Rated voltage

For a.c., the rated voltage of a fuse-link is related to the applied voltage; it is based on the r.m.s value of a sinusoidal a.c. voltage. It is further assumed that the applied voltage retains the same value throughout the operation of the fuse-link. All tests to verify the ratings are based on this assumption.

NOTE In many applications, the applied voltage will be sufficiently close to the sinusoidal form for the significant part of the operating time, but there are many cases where this condition is not satisfied.

The performance of a fuse-link subjected to a non-sinusoidal applied voltage can be evaluated by comparing, for the first approximation, the arithmetic mean values of the non-sinusoidal and sinusoidal applied voltages.

For d.c., the rated voltage of a fuse-link is related to the applied voltage. It is based on the mean value. When d.c. is obtained by rectifying a.c., the ripple is assumed not to cause a variation of more than 5 % above or 9 % below the mean value.

3.4.2 Applied voltage in service

Under service conditions, the applied voltage is that voltage which, in the fault circuit, causes the current to increase to such proportions that the fuse-link will operate.

For a.c., consequently, the value of the applied voltage in a single-phase a.c. circuit is usually identical to the power-frequency recovery voltage. For all cases other than the sinusoidal a.c. voltage, it is necessary to know the applied voltage as a function of time. For a unidirectional voltage, the important values are:

- the average value over the entire period of the operation of the fuse-link;
- the instantaneous value near the end of the arcing period.

For d.c., the value of the applied voltage is usually approximately the same as the mean recovery voltage.

3.5 Current

The rated current of a semiconductor fuse-link is based on the r.m.s. value of a sinusoidal a.c. current at rated frequency.

For d.c., the r.m.s. value of current is assumed not to exceed the r.m.s. value based on a sinusoidal a.c. current at rated frequency.

NOTE The thermal response time of the fuse-element may be so short that it cannot be assumed that operation under conditions which deviate much from sinusoidal current can be estimated on the basis of the r.m.s current alone. This is so, in particular, at lower frequency values and when the current presents salient peaks separated by appreciable intervals of insignificant current, for example in the case of frequency converters and traction applications.

3.6 Frequency, power factor and time constant

3.6.1 Frequency

The rated frequency refers to the frequency of the sinusoidal current and voltage that form the basis of the type tests.

NOTE In particular, where service frequency deviates significantly from rated frequency, the manufacturer should be consulted.

3.6.3 Time constant (τ)

For d.c., the time constants expected in practice are considered to correspond to those in A_2 Table XIIB A_2 .

NOTE Some service conditions may be found which exceed the specified performance shown in the table as regards time constant. In such a case, a design of fuse-link which has been tested and marked accordingly should be used, or the suitability of such a fuse-link be subject to agreement between manufacturer and user.

3.10 Temperature inside an enclosure

Since the rated values of the fuse-links are based on specified conditions that do not always correspond to those prevailing at the point of installation, including the local air conditions, the user may have to consult the manufacturer concerning the possible need for re-rating.

5 Characteristics of fuses

5.1 Summary of characteristics

5.1.2 Fuse-links

- a) Rated voltage (see Subclause 5.2).
- b) Rated current (see Subclause 5.3 of IEC 60269-1).
- c) Kind of current and frequency (see Subclause 5.4 of IEC 60269-1).
- d) Rated power dissipation (see Subclause 5.5 of IEC 60269-1).
- e) Time-current characteristics (see Subclause 5.6).
- f) Breaking range (see Subclause 5.7.1 of IEC 60269-1).
- g) Rated breaking capacity (see Subclause 5.7.2 of IEC 60269-1).
- h) Cut-off current characteristics (see Subclause 5.8.1).
- i) I^2t characteristics (see Subclause 5.8.2).
- j) Dimensions or size (if applicable).
- k) Arc voltage limits (see Subclause 5.9).

5.2 Rated voltage

A_2 For rated a.c. voltages up to 690 V and d.c. voltages up to 750 V, IEC 60269-1 applies; for higher voltages, the values shall be selected from the R5 series or, where not possible, from the R10 series of ISO 3. A_2

5.4 Rated frequency

The rated frequency is that frequency to which the performance data are related.

5.5 Rated power dissipation of the fuse-link

In addition to the requirements of IEC 60269-1, the manufacturer shall indicate the power dissipation as a function of current for the range 50 % to 100 % of the rated current or for 50 %, 63 %, 80 % and 100 % of the rated current.

NOTE In cases where the resistance of the fuse-link is of interest, this resistance should be determined from the functional relation between the power dissipation and the associated value of current.

5.6 Limits of time-current characteristics

5.6.1 Time-current characteristics, time-current zones

The time-current characteristics of a fuse-link vary according to its design and also, for a given fuse-link, depend on the ambient temperature and the cooling conditions.

The manufacturer shall provide time-current characteristics based on an ambient temperature of 20 °C to 25 °C in accordance with the conditions specified in Subclause 8.3. The time-current characteristics of interest are the pre-arcing characteristic and operating characteristics having voltage as a parameter. The time-current characteristics are stated for rated frequency.

For d.c. they are stated for time constants according to Table XIIB.

For some applications, and in particular for the higher values of prospective current (shorter times), the same information may be presented in the form of I^2t characteristics. It is recommended that in this region, I^2t characteristics shall be given as an alternative or in addition.

5.6.1.1 Pre-arcing time-current characteristics

For a.c., the pre-arcing time-current characteristic shall be based on a symmetrical a.c. current of a stated value of frequency (rated frequency).

NOTE This is of particular importance for the range of time between about ten cycles of rated frequency and a time so short that the heating is truly adiabatic.

For d.c., the pre-arcing time-current characteristic is of particular significance for times exceeding 15τ for the relevant circuit, and is identical to the a.c. pre-arcing time-current characteristic in this zone.

NOTE 1 Because of the wide range of circuit time constants likely to be experienced in service, the information for times shorter than 15τ is conveniently expressed as a pre-arcing I^2t characteristic.

NOTE 2 The value of 15τ has been chosen to avoid the effects which different rates of rise of current have on the pre-arcing time-current characteristic at shorter times.

5.6.1.2 Operating time-current characteristics

The operating time-current characteristics shall be given with applied voltage as a parameter and for a stated power-factor value. In principle, they shall be based on the moment of current initiation that leads to the highest operating I^2t value (see Subclause 8.7). The voltage parameters shall include at least 100 %, 50 % and 25 % of the rated voltage.

For d.c., the operating time-current characteristics are not applicable because they are not significant for times in excess of 15τ (see Subclause 5.6.1.1).

5.6.2 Conventional times and currents

5.6.2.1 Conventional times and currents for “aR” fuse-links

Not applicable.

5.6.2.2 Conventional times and currents for “gR” and “gS” fuse-links

The conventional times and currents are given in Table II.

Table II — Conventional times and currents for “gR” and “gS” fuse-links

Rated current A	Conventional current h	Conventional current			
		Type “gR”		Type “gS”	
		I_{nf}	I_f	I_{nf}	I_f
$I_n \leq 63$	1				
$63 < I_n \leq 160$	2				
$160 < I_n \leq 400$	3	1,1 I_n	1,6 I_n	1,25 I_n	1,6 I_n
$400 < I_n$	4				



5.6.3 Gates

Not applicable.

5.6.4 Overload curves

5.6.4.1 Verified overload capability

The manufacturer shall indicate sets of co-ordinate points along the time-current characteristics (see Subclause 5.6.1) for which the overload capability has been verified in accordance with the procedure indicated in Subclause 8.4.3.4.

The number and the location of the sets of co-ordinate points for which the overload capability shall be verified are to be selected at the discretion of the manufacturer. The time co-ordinates for the verification of the overload capability shall be selected within the range of 0.01 s to 60 s. Further sets of the co-ordinate points may be added according to agreement between manufacturer and user.

5.6.4.2 Conventional overload curve

The conventional overload curve is formed of straight-line sections emanating from the co-ordinate points of verified overload capability. From each set of co-ordinate points, two lines are drawn:

- one from the verified point and following points of constant values of current towards shorter times;
- the other from the verified point and following points of constant values of I^2t towards longer times.

These line sections, ending at the line representing rated current, form the conventional overload curve (see Figure 1, page 11).

NOTE For practical applications, a few points of verified overload capability are sufficient. As the number of points of verified overload capability increases, the conventional overload curve becomes more precise.

A2 5.7.1 Breaking range and utilization category

The first letter shall indicate the breaking range:

- “a” fuse-links (partial range breaking capacity, see 7.4);
- “g” fuse-links (full range breaking capacity).

The second letter “R” and “S” shall indicate the utilization category for fuse-links complying with this standard for the protection of semiconductor devices.

The type “R” is faster acting than type “S” and gives lower I^2t values.

The type “S” has lower power dissipation and gives enhanced utilization of cables compared to type “R”. **A2**

5.7.2 Rated breaking capacity

It is recommended to have a breaking capacity of at least 50 kA for a.c. and 8 kA for d.c.

For a.c., the rated breaking capacity is based on type tests performed in a circuit containing only linear impedance and with a constant sinusoidal applied voltage of rated frequency.

For d.c., the rated breaking capacity is based on type tests performed in a circuit containing only linear inductance and resistance with mean applied voltage.

NOTE The addition in practical applications of non-linear impedances and unidirectional voltage components may significantly influence the breaking severity either in a favourable or unfavourable direction.

5.8 Cut-off current and I^2t characteristics

5.8.1 Cut-off current characteristics

The manufacturer shall provide the cut-off current characteristics which shall be given, according to the example shown in Figure 2 of IEC 60269-1, in a double logarithmic presentation with the prospective current as abscissa and, if necessary, with applied voltage and/or frequency as a parameter.

For a.c., the cut-off current characteristics shall represent the highest values of current likely to be experienced in service. They shall refer to the conditions corresponding to the test conditions of this standard, for example given voltage, frequency and power-factor values. The cut-off current characteristics are verified by the tests specified in Subclause 8.6.

For d.c., the cut-off current characteristics shall represent the highest values of current likely to be experienced in service in circuits having a time constant of 15 ms to 20 ms. These values will be exceeded in circuits of smaller time constants. The manufacturer shall provide the relevant information to enable the determination of these higher cut-off current characteristics.

NOTE The cut-off current characteristic varies with the circuit time constant. The manufacturer should provide the relevant information to enable these variations to be determined at least for time constants of 5 ms and 10 ms.

5.8.2 I^2t characteristics

5.8.2.1 Pre-arcing I^2t characteristic

For a.c., the pre-arcing I^2t characteristic shall be based on a symmetrical a.c. current at a stated frequency value (rated frequency).

For d.c., the pre-arcing I^2t characteristic shall be based on r.m.s. d.c. current at a time constant of 15 ms to 20 ms.

NOTE For certain fuses, the pre-arcing I^2t characteristic varies with the circuit time constant. The manufacturer should provide the relevant information to enable these variations to be determined at least for time constants of 5 ms and 10 ms.