

SPECIFICATION FOR
CARTRIDGE FUSES FOR
A.C. CIRCUITS
IN DOMESTIC AND
SIMILAR PREMISES

BS 1361 : 1971
CONFIRMED JUNE 1986

Incorporating amendments issued January 1983 (AMD 4171)
and January 1985 (AMD 4795)

THIS BRITISH STANDARD, having been approved by the Electrical Industry Standards Committee, was published under the authority of the Executive Board on 21 April, 1971.

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First published, March 1947.

First revision, April 1971.

SBN: 580 06560 X

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This standard makes reference to the following British Standards:

- BS 88. Cartridge fuses of voltage ratings up to 660 volts.
Part 1. Performance and dimensions of fuse links.
- BS 1454. Consumers' electricity control units. Fuse and miniature circuit breaker types principally for use in domestic premises.
- BS 4000. Sizes of paper and board.

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The following BSI references relate to the work on this standard:
Committee references ELE/78 and ELE/78/1
Draft for comment 68/24467

Amendment No. 3
published and effective from 31 January 1991
to BS 1361 : 1971

**Specification for cartridge fuses for a.c. circuits in
domestic and similar premises**

Revised text

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.’

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CO-OPERATING ORGANIZATIONS

The Electrical Industry Standards Committee, under whose supervision this British Standard was prepared consists of representatives from the following Government departments and scientific and industrial organizations:

- Associated Offices' Technical Committee
- *Association of Consulting Engineers
- Association of Manufacturers of Domestic Electrical Appliances
- Association of Mining Electrical and Mechanical Engineers
- Association of Supervisory and Executive Engineers
- *British Electrical and Allied Manufacturers' Association
- British Radio Equipment Manufacturers' Association
- British Railways Board
- Crown Agents for Oversea Governments and Administrations
- *Department of Employment and Productivity
- Electric Cable Makers' Confederation
- Electrical Contractors' Association (Incorporated)
- Electrical Contractors' Association of Scotland
- *Electrical Research Association
- *Electricity Council, the Central Electricity Generating Board
and the Area Boards in England and Wales
- Electronic Engineering Association
- *Engineering Equipment Users' Association
- *Institution of Electrical Engineers
- Lighting Industry Federation Limited
- Ministry of Defence
- Ministry of Defence, Army Department
- *Ministry of Defence, Navy Department
- Ministry of Public Building and Works
- *Ministry of Technology
- Municipal Passenger Transport Association (Incorporated)
- National Inspection Council for Electrical Installation Contracting
- National Physical Laboratory (Ministry of Technology)
- *Oil Companies Materials Association
- *Post Office
- Public Transport Association (Incorporated)
- South of Scotland Electricity Board

The Government departments and scientific and industrial organizations marked with an asterisk in the above list, together with the following, were directly represented on the committee entrusted with the preparation of this British Standard:

- Association of Short-circuit Testing Authorities
- Electrical Power Engineers' Association
- Lloyd's Register of Shipping
- London Transport Board

BRITISH STANDARD SPECIFICATION FOR CARTRIDGE FUSES FOR A.C. CIRCUITS IN DOMESTIC AND SIMILAR PREMISES

FOREWORD

The principal changes in this revision of BS 1361 are the introduction of standard time/current zones and metric dimensions, and the subdivision of the fuse links into two types, as follows:

Type I fuse links, rated at 240 V and 5–45 A, which are intended for use in distribution boards where the fuses are replaced by the consumer.

Type II fuse links, rated at 415 V and having preferred current ratings of 60, 80 and 100 A, primarily intended for use by the supply authority in the incoming service unit of domestic and similar premises.

In addition, the specification has been split into three sections: the first containing definitions and general clauses; the second dealing with fuse links; and the third with fuse carriers and bases. Details are also given of standard test rigs for performing power loss and breaking capacity tests on fuse links.

The dimensions in this standard are now given in metric units. However, the dimensions of the actual fuse links are direct equivalents of the original inch dimensions given in the earlier edition of this standard. This was considered essential in order to maintain interchangeability with the existing fuse links already in use in a large number of installations.

SPECIFICATION

1. GENERAL

1.1 SCOPE

This British Standard specifies requirements for fuses for a.c. circuits of 240 V and current ratings of up to 45 A which are intended for use in consumers' distribution boards, including electricity control units complying with BS 1454*, in dwelling houses, blocks of flats and office buildings. It also covers fuses of 415 V rating and current ratings of up to 100 A for use by the supply authority in the incoming service units of such premises.

It specifies performance and as many of the dimensions and constructional details as are necessary to ensure interchangeability of fuse links of the same

* BS 1454, 'Consumers' electricity control units. Fuse and miniature circuit breaker types principally for use in domestic premises'.

current rating and to prevent unintended interchangeability of fuse links and carriers not of the same current rating.

The dimensions and performance of fuse links are dealt with in Section 2, whilst fuse carriers and bases to accommodate these fuse links are dealt with in Section 3.

1.2 SERVICE CONDITIONS

The service conditions for which fuses, fuse links, fuse carriers and bases complying with the requirements of this standard are suitable are as follows. (Attention is also drawn to Appendix J, dealing with the application of fuse links).

(1) *Voltage*. An a.c. system having a maximum voltage not exceeding 1.1 times the rated voltage of the fuse.

(2) *Current*

a. Fuse links. Carrying continuously any current not exceeding the current rating and breaking currents from the minimum fusing current up to the breaking capacity rating at power factors not lower than 0.3.

b. Fuse carriers and bases. Carrying any current not exceeding the rated current continuously, and the peak currents associated with the operation under fault conditions of any fuse link which the fuse carriers and bases are to accommodate.

(3) *Frequency of alternating current*. A frequency of 45–62 Hz.

(4) *Ambient air temperature*. The temperature of the surrounding air having a peak value not exceeding 35 °C, with an average value not exceeding 30 °C over 24 h periods. For fuses installed within an enclosure it is the temperature outside the enclosure.

(5) *Temperature inside an enclosure*. Since most fuses are used inside an enclosure, this specification is based on a temperature of the air surrounding the fuse inside the enclosure which is 15 °C above the ambient air temperature.

In cases where the temperature conditions vary significantly from this value, e.g. in small or congested enclosures, this should be taken into consideration from the points of view of both operation and temperature rise.

(6) *Altitude*. An altitude not exceeding 1000 m above sea level.

(7) *Atmosphere*. An atmosphere not subject to excessive pollution, e.g. pollution from smoke, chemical fumes, or salt-laden spray; such pollution occurs in some industrial areas and in some coastal districts.

1.3 DEFINITIONS

For the purposes of this British Standard the following definitions apply. (Further explanation of some of the terms defined in this clause is given in Appendix A).

(1) *Fuse*. A device that, by the fusion of one or more of its specially designed and proportioned components, opens the circuit in which it is inserted and

breaks the current when this exceeds a given value for a sufficient time. The fuse comprises all the parts that form the complete device.

(2) *Fuse element*. An individual current-carrying component extending between end connections within a cartridge and designed to melt in total or in part upon the operation of the fuse.

(3) *Form of fuse element*. The shape and the material of the fuse element, the variations (increase or decrease) of cross-sectional dimensions and the changes, if any, in the material along the length of the fuse element, including the material of joints and/or time lag devices.

(4) *Cartridge*. A totally enclosing fuse element container consisting of insulating material, tubular in form, and having its ends closed by metallic caps.

(5) *Cartridge fuse link* (hereinafter referred to as fuse link). A device comprising a fuse element or several fuse elements connected in parallel, enclosed in a cartridge usually filled with arc-extinguishing media and connected to terminations.

(6) *Fuse contact*. A contact suitable for engaging with a fixed contact and capable of having a fuse link attached to it or forming an integral part of a fuse link.

(7) *Fuse carrier*. A removable holder serving to carry a fuse link and fitted with fuse contacts, if necessary, for this purpose. A cartridge or other container of a fuse element, if suitable, may form a fuse carrier or part of a fuse carrier.

(8) *Fixed contact*. A contact for engaging with a fuse contact and connected to a fixed terminal.

(9) *Fuse base*. That part of the fuse which carries the fixed contacts.

(10) *Rated minimum fusing current*. The current stated as being that current which will cause the fuse link to operate in the specified time under the prescribed conditions.

(11) *Current rating*. A current stated by the manufacturer as the current that the fuse link, fuse carrier and base will carry continuously without deterioration, in accordance with the relevant clauses of this specification.

(12) *Fusing factor*. The ratio, greater than unity, of the minimum fusing current to the current rating, namely:

$$\text{fusing factor} = \frac{\text{rated minimum fusing current}}{\text{current rating}}$$

(13) *Prospective current (of a circuit)*. The current (the r.m.s. value of the alternating component of an alternating current) that would flow on the making of the circuit when the circuit is equipped for the insertion of a fuse but the fuse is replaced by a link of negligible impedance.

(14) *Loop*. That part of an alternating wave which extends from one zero to the next.

NOTE 1. As Figs. 6 and 7 show, successive loops may have different durations and amplitudes in the region of initiation of current. The larger loops are called major loops, and the smaller loops are called minor loops.

NOTE 2. For the purpose of indicating the number of current zeros during arcing time arcing time may be referred to as including a stated number of loops.

(15) *Cut-off*. If the melting of the fuse element(s) prevents the current through the fuse link from reaching the otherwise attainable maximum (the peak current of the first major loop in an a.c. circuit), the fuse link is said to cut off and the instantaneous maximum current attained is called the cut-off current.

NOTE 1. In an a.c. circuit the numerical value of the cut-off current may be greater than the numerical value of the prospective current.

NOTE 2. A fuse link only exhibits cut-off at prospective currents greater than a particular value; the transition point varies with different fuse links.

(16) *Breaking capacity rating*. A prospective current stated by the manufacturer as the greatest prospective current that may be associated with the fuse link under prescribed conditions of voltage and of power factor.

(17) *Rated voltage*. The voltage assigned by the manufacturer to indicate the nominal system voltage with which the fuse or fuse link may normally be associated.

(18) *Arc voltage*. The voltage that exists across a fuse link during the arcing time.

NOTE. The maximum value of the arc voltage may exceed the peak value of the a.c. recovery voltage.

(19) *Pre-arcing time*. The time between the commencement of a current large enough to cause a break in the fuse element(s) and the instant when the arc is initiated.

NOTE. In practice the instant of arc initiation is marked by sudden rise in voltage across the fuse link.

(20) *Arcing time*. The time between the end of the pre-arcing time and the instant when the circuit is broken and the current becomes permanently zero.

(21) *Total operating time*. The sum of the pre-arcing time and the arcing time.

(22) *Recovery voltage (of a circuit opened by a fuse link)*. The r.m.s. value of the normal frequency alternating voltage that exists across the fuse link after opening of the circuit.

(23) *Operation (of a fuse link)*. The process in the fuse link between the beginning of the pre-arcing time and the end of the arcing time. Operation is sometimes called blowing.

(24) *Discrimination*. Discrimination between two or more circuit interrupting devices in series is said to occur when, on the incidence of a short circuit or an overcurrent, only the device which is required to operate does so, and the other remains unimpaired.

(25) *Duty of a fuse link.* The satisfactory opening of the circuit or circuits protected by the fuse link at system voltages having maximum values not exceeding 1.1 times its rated voltage, under conditions which produce for the requisite length of time any prospective current greater than its minimum fusing current, but which does not exceed its breaking capacity rating.

(26) *Total I^2t (let through).* The specific energy to which a protected circuit is subjected during the operation of a fuse link.

(27) *Pre-arcing I^2t .* The specific energy to which a protected circuit is subjected during the pre-arcing time.

(28) *Arcing I^2t .* The specific energy to which a protected circuit is subjected during the arcing time.

NOTE. For the above three definitions, the specific energy is that energy which would be produced in a unit resistance by a current flowing for an interval of time. This energy is given by the time integral of the square of the instantaneous current for the interval of time t and is referred to as I^2t , where I is the r.m.s. value of the current during the interval of time t .

(29) *Time/current zone.* The zone contained by the minimum pre-arcing characteristic and the maximum operating characteristic applying to specified conditions.

2. FUSE LINKS

2.1 RATINGS

2.1.1 Rating of fuse link. The fuse link shall be rated in terms of:

- (1) voltage,
- (2) breaking capacity,
- (3) current,
- (4) fusing factor,
- (5) type reference.

2.1.2 Rated voltages. The rated voltages are 240 V a.c. for Type I fuse links and 415 V a.c. for Type II fuse links.

2.1.3 Breaking capacity rating. The breaking capacity rating of the fuse link shall be the appropriate value given in Column 2 of Table 1.

TABLE 1. BREAKING CAPACITY AND POWER FACTOR

Type	Breaking capacity rating	Power factor lagging (nominal)
	A	
I	16 500	0.3
II	33 000	0.3

The power factor associated with breaking capacity rating shall be the corresponding nominal value given in Column 3 of Table 1. Tolerances for test purposes are given in 2.5.5.

2.1.4 Current rating. The current ratings of Type I fuse links shall be as given in Table 2.

TABLE 2. CURRENT RATINGS

Type	Current rating
I	A
	5
	15
	20
	30
	45
IIa	60
	80
IIb	80
	100

The current ratings for Type II fuse links given in Table 2 are preferred values; other current ratings shall not exceed 80 A for Type IIa, or 100 A for Type IIb.

2.1.5 Fusing factor. The fusing factor shall be not greater than 1.5 and shall be determined in accordance with the requirements of 2.2.4.

2.2 PERFORMANCE

2.2.1 Power loss. Fuse links shall be so designed that when they are tested for power loss in accordance with the method described in 2.5.2, the loss in watts shall not exceed the values given in Table 3.

*As amended
Jan., 1985*

2.2.2 Time/current zones. The standard time/current zones for fuse links below 60 A rating are indicated in Figs. 5a and 5b.

The standard time/current zones for fuse links of 60 A rating and above are indicated in Figs. 5c and 5d.

2.2.3 Time/current characteristic. The manufacturer shall hold available time/current characteristic curves which shall be supplied on request. These shall be prepared with logarithmic scales on both axes (see Appendix B) and shall give current values for pre-arcing times down to 0.01 s. These nominal time/current characteristic curves, together with a tolerance of $\pm 10\%$ in terms of current,