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Low-voltage fuses –
Part 2: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) – Examples of standardized systems of fuses A to K

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This consolidated version of the official IEC Standard and its amendments has been prepared for user convenience.

IEC 60269-2 edition 5.2 contains the fifth edition (2013-07) [documents 32B/611/FDIS and 32B/615/RVD], its amendment 1 (2016-08) [documents 32B/641/CDV and 32B/648/RVC] and its amendment 2 (2024-06) [documents 32B/743/FDIS and 32B/755/RVD].

In this Redline version, a vertical line in the margin shows where the technical content is modified by amendments 1 and 2. Additions are in green text, deletions are in

strikethrough red text. A separate Final version with all changes accepted is available in this publication.

International Standard IEC 60269-2 has been prepared by subcommittee 32B: Low-voltage fuses, of IEC technical committee 32: Fuses.

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

a) fuse systems A and B: modified values for the power dissipation of NH aM fuse-links;

b) fuse systems A and B: introduction of dimension r for NH fuse-links;

c) addition of new fuse system K: gK fuse-links with contacts for bolted connections.

This part is to be used in conjunction with IEC 60269-1:2006, *Low-voltage fuses – Part 1: General requirements* and its Amendment 1 (2009).

This Part 2 supplements or modifies the corresponding clauses or subclauses of Part 1.

Where no change is necessary, this Part 2 indicates that the relevant clause or subclause applies.

Tables and figures which are additional to those in Part 1 are numbered starting from 101 in fuse system A, from 201 in fuse system B, etc. Additional annexes are numbered AA, BB, etc.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 60269 series, published under the general title *Low-voltage fuses*, can be found on the IEC website.

The committee has decided that the contents of this document and its amendments will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

IMPORTANT – The *'colour inside'* logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

IEC 60269 consists of the following parts, under the general title *Low-voltage fuses*:

Part 1: General requirements

Part 2: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) – Examples of standardized systems of fuses A to K

Part 3: Supplementary requirements for fuses for use by unskilled persons (fuses mainly for household or similar application) – Examples of standardized systems of fuses A to F

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

Part 5: Guidance for the application of low-voltage fuses

Part 6: Supplementary requirements for fuse-links for the protection of solar photovoltaic energy systems

LOW-VOLTAGE FUSES –

Part 2: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) – Examples of standardized systems of fuses A to K

1 General scope

1.1 Scope

Fuses for use by authorized persons are generally designed to be used in installations where the fuse-links are accessible to, and may be replaced by, authorized persons only.

Fuses for use by authorized persons according to the following fuse systems also comply with the requirements of the corresponding subclauses of IEC 60269-1, unless otherwise defined in this standard.

This standard is divided into fuse systems, each dealing with a specific example of standardized fuses for use by authorized persons:

Fuse system A:	Fuses with fuse-links with blade contacts (NH fuse system)
Fuse system B:	Fuses with striker fuse-links with blade contacts (NH fuse system)
Fuse system C:	Fuse-rails (NH fuse system)
Fuse system D:	Fuse-bases for busbar mounting (NH fuse system)
Fuse system E:	Fuses with fuse-links for bolted connections (BS bolted fuse system)
Fuse system F:	Fuses with fuse-links having cylindrical contact caps (NF cylindrical fuse system)
Fuse system G:	Fuses with fuse-links with offset blade contacts (BS clip-in fuse system)
Fuse system H:	Fuses with fuse-links having "gD" and "gN" characteristic (class J class L and class T time delay and non time delay fuse types)
Fuse system I:	gU fuse-links with wedge tightening contacts
Fuse system J:	Fuses with fuse-links having "gD class CC" and "gN class CC" characteristics (class CC time delay and non-time delay fuse types)
Fuse system K:	gK fuse-links with blade for bolted connections – High fuse-link ratings from 1 250 A up to 4 800 A (master fuse-links)

NOTE The above-mentioned fuse systems are standardized systems in respect to their safety aspects. The National Committees can select from the examples of standardized fuses one or more systems for their own standards.

1.2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60112, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

IEC 60269-1, *Low-voltage fuses – Part 1: General requirements*

IEC 60664-1, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 60999 (all parts), *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units*

IEC 60999-1, *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 1: General requirements and particular requirements for clamping units for conductors from 0,2 mm² up to 35 mm² (included)*

IEC 60999-2, *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 2: Particular requirements for clamping units for conductors above 35 mm² up to 300 mm² (included)*

~~ISO 6988, *Metallic and other non organic coatings – Sulfur dioxide test with general condensation of moisture*~~

ISO 22479, *Corrosion of metals and alloys – Sulfur dioxide test in a humid atmosphere (fixed gas method)*

**Fuse system A –
Fuses with fuse-links with blade contacts
(NH fuse system)**

1 General

IEC 60269-1 applies with the following supplementary requirements and modified requirements.

1.1 Scope

The following additional requirements apply to fuses with fuse-links having blade contacts intended to be replaced by means of a device, for example, replacement handle (see Figure 103), which complies with the dimensions specified in Figures 101 and 102. Such fuses have rated currents up to and including ~~1 250~~ 1 600 A and rated voltages up to and including 1 000 V a.c. or 1 500 V d.c.

The following characteristics of the fuses are specified in addition to IEC 60269-1:

- minimum rated breaking capacities;
- time-current characteristics;
- I^2t characteristics;
- standard conditions of construction;
- power dissipation and acceptable power dissipation.

2 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60269-1, as well as the following, apply.

2.1.101
gripping-lugs
parts of a fuse-link which are engaged with the replacement handle or the fuse-carrier

Note 1 to entry: Gripping-lugs may be made of metal or insulating material. Metal gripping-lugs may be live or not live under service conditions.

2.1.102
live gripping-lugs
metal gripping-lugs electrically connected to the blade contacts of the fuse-link

Note 1 to entry: Metal gripping-lugs without electrical contact to the blade contacts are also deemed to be live in case of inadequate creepage distances and clearances according to this standard.

2.1.103
isolated gripping-lugs
not-live gripping-lugs made of insulating material or metal

Note 1 to entry: If they are made of metal the required creepage distances and clearances according to the relevant overvoltage category should be met between the gripping-lugs and the blade contacts as well as between the gripping-lugs and the fuse-base contacts.

3 Conditions for operation in service

IEC 60269-1 applies.

4 Classification

IEC 60269-1 applies.

5 Characteristics of fuses

IEC 60269-1 applies with the following supplementary requirements.

5.2 Rated voltage

For a.c., the standard values of rated voltage are 400 V, 500 V and 690 V. For d.c., the rated voltages are 250 V and 440 V. The standard values of d.c. rated voltage are not related to the standard values of a.c. rated voltage. For example, the following standard combinations are possible: 500 V a.c. and 250 V d.c., 500 V a.c. and 440 V d.c., 500 V a.c., etc.

The rated voltage of fuse-bases according to Figure 102 is 690 V or higher.

5.3.1 Rated current of the fuse-link

For each size the maximum rated currents are given in Figure 101. These values depend upon the utilization categories and rated voltages.

~~A rated current of 224 A is added to the values as given in 5.3.1 of IEC 60269-1.~~

5.3.2 Rated current of the fuse-holder

The rated current for the different sizes of the fuse-bases is given in Figure 102.

5.5 Rated power dissipation of a fuse-link and rated acceptable power dissipation of a fuse-holder

The maximum values of rated power dissipation for the different sizes of fuse-links are specified in Figure 101. The values apply to the maximum rated currents of the fuse-links. The values of rated acceptable power dissipation of fuse-bases are given in Figure 102.

5.6 Limits of time-current characteristics

5.6.1 Time-current characteristics, time-current zones and overload curves

The tolerance on time-current characteristics given by the manufacturer shall not deviate by more than ±10 % in terms of current. The time-current zones given in Figure 104, including manufacturing tolerances shall be met by all pre-arcing and total times measured at the test voltage according to 8.7.4.

5.6.2 Conventional times and currents

The conventional times and currents, in addition to the values of IEC 60269-1, are given in Table 101.

Table 101 – Conventional time and current for "gG" fuse-links with rated current lower than 16 A

Rated current I_n A	Conventional time h	Conventional current	
		I_{nf}	I_f
$I_n \leq 4$	1	1,5 I_n	2,1 I_n
$4 < I_n < 16$	1	1,5 I_n	1,9 I_n

5.6.3 Gates

For "gG" fuse-links the gates given in Table 102 apply in addition to the gates of IEC 60269-1.

Table 102 – Gates for specified pre-arcing and operating times of "gG" fuse-links

I_n A	I_{min} (10 s) A	I_{max} (5 s) A	I_{min} (0,1 s) A	I_{max} (0,1 s) A
2	3,7	9,2	6,0	23,0
4	7,8	18,5	14,0	47,0
6	11,0	28,0	26,0	72,0
8	16,0	35,2	41,6	92,0
10	22,0	46,5	58,0	110,0
12	24,0	55,2	69,6	140,4
~~224~~	~~680~~	~~1 450~~	~~2 240~~	~~3 980~~

5.7.2 Rated breaking capacity

The minimum rated breaking capacities are specified in Table 103.

Table 103 – Minimum rated breaking capacities

Rated voltage	Minimum rated breaking capacities
≤ 690 V AC	50 kA
690 V AC < U ≤ 1 000 V AC	20 kA
≤ 750 V DC	25 kA
750 V < U ≤ 1 500 V DC	10 kA

6 Markings

IEC 60269-1 applies with the following supplementary requirements.

Fuse-links and fuse-holders which meet the requirements and tests of fuse system A of this standard may be marked with IEC 60269-2.

6.1 Markings of fuse-holders

In addition to IEC 60269-1, the following marking applies:

– size.

The marking of the rated current and the rated voltage shall be discernible from the front when a fuse-link has not been fitted.

6.2 Markings of fuse-links

In addition to IEC 60269-1, the following marking applies:

– size or reference;

– rated breaking capacity.

The marking of the rated current and the rated voltage shall be discernible from the front. Furthermore, fuse-links shall be marked as described in Table 104.

Table 104 – Marking of fuse-links

Characteristic	gG		aM	
Colour of marking	Black		Green	
Kind of print	Strip with inverse print	Normal print	Strip with inverse print	Normal print
Voltage				
400 V [a]	X		X	
500 V		X		X
690 V	X		X	

[a] For 400 V gG, a blue colour is also permitted.

Fuse-links with isolated gripping-lugs may be marked in a place easily visible from the front with the graphical symbol of a gripping-lug in a square. If marked, conformity of these fuse-links is verified according to 7.2.

NOTE See Figure 112 for detailed dimensions of the symbol.

7 Standard conditions for construction

IEC 60269-1 applies with the following supplementary requirements.

7.1 Mechanical design

The dimensions of fuse-links and fuse-bases are given in Figures 101 and 102.

7.1.2 Connections, including terminals

There are different kinds of terminals. As far as lug terminals are concerned, the range of cross-sections which the terminals shall be capable of accepting results from the following ranges of rated currents of fuse-links of each size.

Terminals designed for unprepared conductors shall be capable of accepting as a minimum three consecutive sizes of conductors within the cross-sectional ranges given in Table 105. In case the terminal is a lug terminal (see IEC 60999 series), the torques which shall be applied are given in Table 111. Torque values for other terminals should be given in the manufacturer's instructions.

Table 105 – Minimum cross-sectional ranges of unprepared conductors

Size	Range of the rated currents of the fuse-links A	Cross-sectional area ranges mm²	
		Copper	Aluminium
000	2 to 160	6 to 70	25 to 95
00	2 to 160	6 to 70	25 to 95
~~0 ᵃ~~	~~2 to 160~~	~~6 to 70~~	~~25 to 95~~
1	80 to 250	25 to 120	35 to 150
2	125 to 400	50 to 240	70 to 300
3	315 to 630	50 to 2 × 185	70 to 2 × 240
4	500 to ~~1 000~~ 1 250	~~No values available~~ stated in the manufacturer's literature	
4a	500 to ~~1 250~~ 1 600	stated in the manufacturer's literature	
~~ᵃ Not allowed for new installations except for fuse-links with strikers.~~			

Connections of larger and/or smaller cross-sectional area may be necessary. This can be achieved either by the construction of the terminal or by additional means of connection as recommended by the manufacturer.

Whether the terminals for unprepared conductors are suitable for copper, aluminium or copper and aluminium shall be marked accordingly. Furthermore, the range of cross-sections shall be marked on or near to the clamping saddle or given in the manufacturer's literature.

7.1.3 Fuse-contacts

The contact surfaces of fuse-links and fuse-bases should be silver-plated;~~ otherwise, it shall be verified that contacting is not impaired in normal operation.~~ If the surface plating of the blade contacts of a fuse-link or the contacts of the fuse-base is other than silver, the test according to 8.10 shall be~~ passed~~ conducted with~~ dummies~~ dummy fuse-links as described in 8.10.1. Permissable combinations of surface plating shall be defined by the manufacturer.

If fuse-links are intended to be removed or inserted under load, the construction of the fuse, in particular the fuse-contacts, should be suitable for this purpose.

7.1.6 Construction of fuse-bases

The dynamic short-circuit withstand of the fuse shall – whenever needed – meet the cut-off currents as given in Table 112.

Fuse-bases shall meet the temperature rise test according to 8.3 including all protective covers intended to be used.

7.1.7 Construction of a fuse-link

The preferred construction is as follows: the blade contacts shall be made of solid material. If any other construction of blade contacts is used the manufacturer shall demonstrate that this construction is adequate for the purpose.

With the exception of the attachment for the replacement handle, the endplates are not permitted to protrude radially from the insulation body. For some applications it is preferable to insulate the gripping-lugs from live parts.

Fuse-links shall have an indicator. Electrically conductive parts of indicators shall not be ejected from the fuse-link during operation.

7.2 Insulating properties and suitability for insulation

The creepage distances and clearances of the fuses and fuse-accessories shall meet the requirements of IEC 60664-1 for overvoltage category III and pollution degree 3. The minimum clearances are also applicable to metal parts which are not permanently live but may be touched. They shall not be diminished during replacement of the fuse-link. The creepage distances between isolated metal gripping-lugs and live parts are chosen according to the rated voltage divided by $\sqrt{3}$.

For insulation stressed only for a short time, the creepage distances of isolated metal gripping-lugs corresponding to two voltage steps lower may be used.

Insulating parts of the fuse-base supporting live parts have to pass the test at PTI 400 carried out according to IEC 60112 using test solution A.

7.7 I^2t characteristics

For the fuse-links covered by this fuse system, the maximum pre-arcing I^2t values given in Table 7 of IEC 60269-1 apply for the maximum operating I^2t values. Values for rated currents lower than 16 A and for 224 A are given in Table 106.

Table 106 – Pre-arcing and operating I^2t values at 0,01 s for "gG" fuse-links

I_n A	I^2t_{min} A^2s	I^2t_{max} A^2s
2	1	23
4	6,25	90,25
6	24	225
8	49	420
10	100	576
12	160	750
224	200 000	520 000

The maximum operating I^2t values for “aM” fuse-links are specified in Table 107 on the test voltage of 1,1 × U_n and the test no. 2 of the largest rated current of each homogeneous series (Table 20 of IEC 60269-1).

The maximum operating I^2t values are given in Table 107 for the stated test value.

Table 107 – Maximum operating I^2t values for "aM" fuse-links

Rated voltage U_n V a.c.	I^2t max A^2s
$U_n \leq 400$	18 I_n^2
$400 < U_n \leq 500$	24 I_n^2
$500 < U_n \leq 690$	35 I_n^2
NOTE For a voltage of 230 V a.c. the maximum operating I^2t value is 12 I_n^2	

These values apply for the prospective currents corresponding to pre-arcing times less than 0,01 s.

7.8 Overcurrent discrimination of fuse-links

gG fuse-links in series with rated current ratio of 1:1,6 and rated currents 16 A and above have to discriminate up to the values specified in 8.7.4.

With regard to discrimination when circuit-breakers are used, the following I^2t values in Table 108 shall be followed.

Table 108 – Pre-arcing I^2t values for discrimination of gG fuse-links

I_n A	I^2t_{min} A^2s	at I_p A
16	250	500
20	450	670
25	810	900
32	1 400	1 180
40	2 500	1 580
50	4 000	2 000
63	6 300	2 510
80	10 000	3 160
100	16 000	4 000
125	24 000	4 900
160	42 500	6 520
200	78 000	8 830

7.9 Protection against electric shock

The protection against electric shock can be increased by means of partition walls and covers of the fuse-contacts.

Operation of the fuse-links is considered safe when carried out by authorized persons, instructed in electrical matters, using replacement handles according to this fuse system or linked fuse-carriers. Insulating covers and/or phase separators may be used where applicable.

8 Tests

IEC 60269-1 applies with the following supplementary requirements.

8.1.4 Arrangement of the fuse and dimensions

The requirements of 7.2 are verified on fuse-bases. The fuse-bases are connected to conductors having the minimum and maximum cross-sections of the range as given in Table 105.

In the case of isolated metal gripping-lugs, the creepage distances and clearances of the fuse-link according to 7.2 are verified. The clearances are also verified on a fuse-link inserted into a ~~model~~ reference fuse-base according to Figure 111.

8.1.6 Testing of fuse-holders

In addition to the test given in IEC 60269-1, the fuse-holders shall be subjected to the tests according to Table 109.

Table 109 – Survey of tests on fuse-holders and number of fuse-holders to be tested

Test according to subclause		Number of fuse-holders				
		3	1	1	1	5
8.5.5.1	Verification of the peak withstand current of a fuse-base		X	X		
8.9	Verification of resistance to heat				X	
8.10.1.2	Direct terminal clamps					X
8.11.1.2	Mechanical strength of the fuse-base	X				
8.11.2.4	Non-deterioration of insulating parts of fuse-link and fuse-base	X				

8.2.2.1 Points of application of the test voltage

In addition to IEC 60269-1 the following applies:

e) between isolated metal gripping-lugs and the terminals of the ~~test~~ reference fuse-base.

8.2.3.2 Value of test voltage

The insulating properties of isolated metal gripping-lugs may optionally be verified by an impulse withstand voltage test. The relevant rated impulse withstand voltage is given in Table 110 with reference to the rated voltage of the fuse-link.

Table 110 – Rated impulse withstand voltage

Rated voltage V	Rated impulse withstand voltage kV
400	4
500	4
690	6

8.2.3.3 Test method

Five impulses of both polarities and of the shape 1,2/50 µs according to IEC 60060-1 and at the rated withstand voltage level according to Table 110 are applied to the test object. The minimum period between the impulses shall be 1 s.

If not otherwise specified, the impedance of the impulse generator should not exceed 500 Ω.

NOTE See IEC 60060-1, IEC 60060-2 and IEC 60060-3 for a detailed description of the test equipment.

8.2.4 Acceptability of test results

8.2.4.3 No flash-over or puncture shall occur during the test. Partial discharges are ignored.

Fuse-links with metal gripping-lugs without electrical contact to the blade contacts which do not comply with the requirements of 7.2 are not considered as isolated in service. They need, however, to fulfil the requirements of 8.9.2 and 8.11.1.8.

8.2.5 Resistance to tracking

The test of insulating parts supporting live parts of the fuse-links (fuse body) and fuse-bases is carried out according to IEC 60112 using test solution A. Five specimens shall be tested and shall pass at PTI 400. Ceramic isolators need not to be tested.

8.3 Verification of temperature rise and power dissipation

8.3.1 Arrangement of the fuse and dimensions

If the manufacturer specifies values of torque, they shall be used for the tests of 8.3 and 8.10. If not, the screws or nuts of the terminals shall be fastened in accordance with Table 111.

In case the test arrangement contains more than one fuse, the test specimens are mounted in the conventional service position on a wooden plate or other insulating material at a distance between centre lines of 3 times ~~e_2~~ e_2 according to Figure 101.

Copper bars as used for 500 A to ~~1 250~~ 1 600 A test currents ~~are~~ shall be painted mat black.

Table 111 – Torque to be applied to the terminal screws

I_n A	Size	Size of screws	Torque Nm
160	000	M 8	10
160	00	M 8	10
~~160~~	~~0 [a]~~	~~M 8~~	~~10~~
250	1	M 10	32
400	2	M 10/12	32/40
630	3	M 10/12	32/40
~~1 000~~ 1 250	4	M 12	~~56~~40
~~1 250~~ 1 600	4a	2 × M 12/~~16~~ or 1 × M16	40 56
~~[a] Not allowed for new installations except for fuse-links with strikers.~~			

8.3.2 Measurement of the temperature rise

Protective covers and fuse-carriers as provided by the manufacturer shall be mounted.

8.3.4.1 Temperature rise of the fuse-holder

The dummy is given in Figure 105. The point at which the temperature rise is measured is marked with E in Figure 106.

8.3.4.2 Power dissipation of a fuse-link

The points between which the power dissipation of a fuse-link is measured are marked with S in Figure 106.

8.4.3.1 Verification of conventional non-fusing and fusing current

In the case where the non-fusing current test is also used for the verification of the time current characteristic, a second test specimen shall be used for b) (see Table 11 – Survey of complete tests on fuse-links and number of fuse-links to be tested of IEC 60269-1:2024).

8.4.3.5 Conventional cable overload protection test (for "gG" fuse-links only)

NOTE The tests in IEC 60269-1 are deemed to give satisfactory results at 1,45 I_n in typical three-phase applications at an ambient temperature of 30 °C. A special test can be required by some countries to prove that fuses and miniature circuit-breakers (MCBs) are equivalent protective devices. Details of the special test are given in Annex AA.

8.5.5 Test method

Subclause 8.5.5 of IEC 60269-1 applies with the following additions.

8.5.5.1 Verification of the peak withstand current of a fuse-base

The verification of the peak withstand current of a fuse-base need not be carried out, if this has already been verified during the breaking capacity test of the fuse-links with the highest rating of the size.

8.5.5.1.1 Arrangement of the fuse

The test shall be of the single-phase type. The test set-up for the fuse-base shall be in line with 8.5.1 of IEC 60269-1.

The current shall be limited by a fuse-link of the highest rating for the particular size. The peak values of the test currents attained shall lie in the ranges shown in Table 112.

Table 112 – Test currents

Size	Cut-off current kA
000	22…24
00	22…24
~~0~~	~~22…24~~
1	34…37
2	44…48
3	65…70

The maximum values may be exceeded as long as the requirements stated under 8.5.5.1.3 are met.

If the cut-off current range cannot be attained with the highest rating of the size, correspondingly higher series connected fuse shall be used. In this case the test specimen shall be equipped with a dummy fuse-link. Its external dimensions correspond to the dimensions given in Figure101.

8.5.5.1.2 Test method

The test shall be performed on two fuse-bases. In the case of fuse-base no. 1, a hardened and polished test knife of steel, shown in Figure 107, shall be inserted by hand in order to open up the contacts to a certain extent. The purpose of this test is to ensure that the resilient spring travel is limited to the elastic range. The contacts shall be opened up three times. This test will be dispensed with if a mechanical stop limits the gap to less than 7 mm so that the test blade cannot be correctly fitted by hand. Fuse-base no. 2 is tested in accordance with 8.11.1.2. The values of F_{max} according to Table 118 shall be adhered to. After these pre-tests the above-mentioned current test shall be performed.

8.5.5.1.3 Acceptability of test results

The fuse-links shall not be ejected. There shall be no signs of arcing or welding or other damage likely to prevent further use of the fuse-bases. Pitting marks on the contacts are permissible. The fuse or the circuit-breaker of the source shall not operate.

~~8.5.8 Acceptability of test results~~

~~The fuse or circuit-breaker for protection of the source shall not operate during this test.~~

8.7.4 Verification of overcurrent ~~discrimination~~ selectivity

The overcurrent discrimination for fuses with rated current up to 12 A and the overcurrent discrimination ratio of 1:1,6 for fuses with rated currents higher than 12 A is verified by the I^2t values evaluated from the recorded test results.

The samples are arranged as for the breaking capacity tests ~~no. 1 and no. 2~~ according to 8.5 ~~and Table 20, column No.2, of IEC 60269-1:2014 regarding the test circuit and tolerance of current~~. Regarding the power factor Table 20, Test No.2, of IEC 60269-1:2024 applies.

The tolerances for prospective currents for minimum pre-arcing I^2t and maximum operating I^2t tests are +/–5 %.

Four samples are tested, two samples are tested at the r.m.s. prospective test current I, corresponding to the minimum pre-arcing I^2t values, the other samples at the r.m.s. prospective test current I, corresponding to the operating I^2t values.

~~The test voltage for 690 V a.c. is 1,05 × $\frac{U_n}{\sqrt{3}}$.~~

~~The test voltage for all other fuses is 1,1 × $\frac{U_n}{\sqrt{3}}$.~~

The test voltage for all fuses is $\frac{1{,}1 \cdot U_n}{\sqrt{3}}$ with tolerances of –3 % / +2 %.

~~Prospective currents for minimum pre-arcing I^2t and maximum operating I^2t are +/–5 %.~~

Table 113 – Test currents and I^2t limits for ~~discrimination~~ selectivity test

I_n	Minimum pre-arcing I^2t		Maximum operating I^2t		~~Discrimination~~ Selectivity ratio
	Prospective I RMS	I^2t	Prospective I RMS	I^2t	
A	kA	A²s	kA	A²s	
2	0,013	0,67	0,064	16,4	Can be calculated
4	0,035	~~4,90~~	~~0,130~~	67,6	
6	0,064	~~16,40~~	~~0,220~~	193,6	
8	0,1	40	0,31	390	
10	0,13	67,6	0,4	640	
12	0,18	130	0,45	820	
13	0,18	190	0,55	950	
16	0,27	291	0,55	1 210	1:1,6
20	0,4	640	0,79	2 500	
25	0,55	1 210	1	4 000	
32	0,79	2 500	1,2	5 750	
35	0,79	3 000	1,5	7 000	
40	1	4 000	1,5	9 000	
50	1,2	5 750	1,85	13 700	
63	1,5	9 000	2,3	21 200	
80	1,85	13 700	3	36 000	
100	2,3	21 200	4	64 000	
125	3	36 000	5,1	104 000	
160	4	64 000	6,8	185 000	
200	5,1	104 000	8,7	302 000	
224	5,9	139 000	10,2	412 000	
250	6,8	185 000	11,8	557 000	
~~315~~300	8,7	302 000	15	900 000	
315	8,7	302 000	15	900 000	
355	10,2	412 000	20	1 200 000	
400	11,8	557 000	20	1 600 000	
425	11,8	650 000	26	1 900 000	
500	15	900 000	26	2 700 000	
630	20	1 600 000	37	5 470 000	
800	26	2 700 000	50	10 000 000	
1 000	37	5 470 000	66	17 400 000	
1 250	50	10 000 000	90	33 100 000	
1 600	66	17 400 000	120	50 000 000	

The evaluated I^2t values shall lie within the corresponding I^2t limits specified in Table 113.

8.9 Verification of resistance to heat

These tests apply to fuse-links and fuse-bases.

Fuse-holders fitted with fuse-links having the maximum power dissipation corresponding to the acceptable power dissipation of the fuse-holder shall be cyclically loaded as pre-treatment. The pre-treatment is specified in 8.4.3.2 of IEC 60269-1. After cooling to normal temperature the breaking capacity shall be tested at I_1 in accordance with 8.5 of IEC 60269-1.

Fuse-links containing organic material in the body or filler shall be subjected to the same test as described above. These fuse-links shall interrupt the test currents I_1 and I_5.

8.9.1 Fuse-base

The test given below should be applied if it is not obvious that the components are not affected adversely by the given temperature and withdrawal forces.

8.9.1.1 Test arrangement

A dummy fuse-link according to Figure 105 is fitted into a fuse-base and also suspended from a measuring device as shown, for example, in Figure 108. The manner in which the dummy is fitted and secured (for example, by locking pins), in fuse-bases shall ensure that heat dissipation is not seriously affected. The conductor cross-section depends upon the rated current (see IEC 60269-1, Table 17), and the connections outside the heating chamber shall be at least 1 m long. The test set-up is installed in such a heating chamber or below a heatable cowl of at least 50 l capacity, care being taken to see that the bushings etc. for the measuring facility and connections are suitably sealed. The heaters shall be such as to ensure that during the test sequence described below a temperature of (80^{+5}_{0}) °C is maintained with or without the test current, the temperature being measured at a horizontal distance of 150 mm from the dummy centre point.

8.9.1.2 Test method

The temperature in the heating chamber is raised to (80^{+5}_{0}) °C, and maintained for 2 h. The dummy is then loaded with approximately 160 % rated current with a tolerance of ±2 % for 2 h. The test may be carried out at reduced voltage.

After loading and 3 min after switching off, a tensile force F_{max} (see Table 118) is applied smoothly to the dummy. The force F_{max} is exerted for a period of 15 s.

8.9.1.3 Acceptability of test results

After this test the contact pieces of the fuse-base shall not have moved to such an extent as to affect the further use of the fuse-base. After pulling out of the dummy the dimensions of Figure 102 are to be considered. The insulating mounting part of the fuse-base shall neither be broken nor shall it show any signs of cracks.

8.9.2 Fuse-links with gripping-lugs of moulded material or of metal fixed in moulded material

8.9.2.1 Test arrangement

A fuse-link of the highest rating for a size is fitted into a fuse-base; it shall be arrested there and also suspended from a measuring device as shown in Figure 108.

8.9.2.2 Test method

The temperature in the heating chamber is raised to (80^{+5}_{0}) °C and maintained for 2 h. The fuse-link is then loaded with 150 % rated current until it operates, but the test is restricted to the conventional time. A reduced test voltage may be used. Three minutes after the fuse-link has operated or the conventional testing time has expired, a tensile force F_{max} (see

Table 118) is applied smoothly to the gripping-lugs. The force is exerted for a period of about 15 s.

8.9.2.3 Acceptability of test results

The gripping-lugs shall remain fully operational, and the length of the neck ($2{,}5^{+0{,}5}_{0}$) mm in particular shall not be exceeded by more than 2 mm, in keeping with the dimensions d of Figure 101. The same applies to the maximum values of dimension c_2.

8.10 Verification of non-deterioration of contacts

8.10.1 Arrangement of the fuse

The dummy fuse-link is given in Figure 105. The dummy fuse-link shown with silver-plated blade contacts is representative for fuse-links with silver-plated blade contacts. If the non-deterioration test proves that a surface plating of the blade contacts of a fuse-link other than silver fulfils the requirements, then the surface of the blade contacts of the dummy fuse-link shall be plated accordingly.

For lug terminals, the torques are given in Table 111.

The insulation of the conductors shall be removed over the whole length. All covers of contacts and terminals shall be removed for this test only.

8.10.1.1 Contacts

Subclause 8.10.1 of IEC 60269-1 applies.

8.10.1.2 Direct terminal clamps

Subclause 8.10.1 of IEC 60269-1 applies with the following additions:

The test shall be performed on 10 direct terminal clamps of five fuse-bases.

The test arrangement shall be as follows: the fuse-bases shall be mounted in a vertical position, side by side with a distance between the fuse-base centres of at least three times e_2, shown in Figure 101. The test of direct terminal clamps which can be used for copper as well as aluminium conductors shall be made with aluminium conductors.

If there is no information given by the manufacturer, the screws of the direct terminal clamps shall be tightened with a torque according to Table 114.

NOTE 1 The torques are based on a friction coefficient of μ = 0,12 for thread and head of the screw and a maximum elongation of $R_{P\,0,2}$ according to ISO 898-1. The shaft of the screws will be stressed up to 90 % of these values during tightening. The torques are based on class 5.6 screws.

NOTE 2 Torques for lug terminals are given in Table 111.

Table 114 – Torques to be applied when no values are given by the manufacturer

Thread	Torque Nm
M5	2,6
M6	4,5
M8	11
M10	21
M12	38

Direct terminal clamps only for copper conductors are tested like direct terminal clamps for aluminium with the exception that cleaning and storage are not necessary. Furthermore, for copper clamps, the test can be part of the test of contacts. If the requirements for the contacts after 250 cycles (see 8.10.2.1) are met, the clamps for copper have satisfied this requirement.

The conductor cross-section depends upon the rated current (for copper conductors see Table 17 of IEC 60269-1).

The relevant cross-sections for aluminium conductors are given in Table 115.

Table 115 – Cross-sectional area of aluminium conductors for tests corresponding to 8.10

Rated current A	Cross-sectional area mm^2
40	25
50	25
63	35
80	50
100	70
125	95
160	95
200	150
250	185
315	240
400	300

In case of insulation piercing clamping units, only the insulation outside the clamping area will be removed.

The contact area of six conductors shall be prepared as follows.

The conductors shall be cleaned with a suitable abrasive and connected within a time not greater than 5 min.

The remaining four conductors, after removing only the insulation and the grease, shall be stored indoors for 14 days. These uncleaned conductors shall not be treated before being connected.

The bolts of the clamps shall be fixed as stated by the manufacturer. A readjustment of the bolts during the tests is not allowed.

For stranded aluminium conductors, it shall be ensured that the test current goes into the cross-section as equally as possible. This can be achieved by welding or compressing the conductor in the middle of its length.

8.10.2 Test method

A test cycle consists of a load period and a no-load period referred to as the conventional time. The test currents for the load period and the no-load period are specified as follows.

Test current: conventional non-fusing current I_{nf}

Load period: 25 % of the conventional time see Table 2 of IEC 60269-1

No-load period: 10 % of the conventional time

A test voltage lower than the rated voltage may be used.

During the no-load period the samples are cooled down to a temperature lower than 35 °C; additional cooling (for example, a fan) is allowed.

The temperature rise is measured in accordance with 8.10.2 of IEC 60269-1at rated current.

The voltage drop shall be measured after 50 cycles and 250 cycles and, if necessary, after 500 cycles and 750 cycles.

The voltage drop is measured at direct current of I_m = (0,05 to 0,20) I_{nf}. However, measuring the current I_m shall be chosen so as to give a voltage drop of at least 100 µV. If it is necessary, the upper limit of I_m may be increased to 0,30 I_{nf}.

The tolerance of I_m during the measurement shall not be greater than $^{+1}_{0}$ %.

The voltage drop shall be changed into the resistance of the contacts. Before measurement, the sample shall be cooled down to room temperature. If the room temperature T during the measurement deviates from 20 °C, the following formula may be applied:

$$R_{20} = \frac{R_T}{1 + \alpha_{20}(T - 20)}$$

The relevant coefficient α_{20} according to the conductor material (aluminium or copper) shall be used.

8.10.2.1 Contacts

The points between which the voltage drop is measured are marked as A and B in Figure 106.

At the conclusion of the test after 250 cycles and 750 cycles, the withdrawal forces are measured. For this purpose a hardened and polished steel test knife as shown in Figure 107 shall be inserted in order, if possible, to open the contacts up, to a certain extent (see 8.5.5.1.2).

Afterwards, the withdrawal forces are measured with a test link made of hardened steel as described in 8.11.1.2. The test link is inserted three times in the fuse-base. The withdrawal forces shall be within the limits of Table 118. If the measured values are too low, the dynamic test in accordance with 8.5.5.1 shall be performed.

8.10.2.2 Direct terminal clamps

The points between which the voltage drop ΔU of the test sample is measured are given in Figure 110. The point of measurement on the conductor F shall be a centre punch point where solid conductors are concerned or a bare wire wrapped around stranded conductors. For aluminium conductors, special precautions shall be implemented by use, for example, of a welded equalizer (the aluminium cable is cut; the conductors of each part are welded together, then the two parts are welded and the measure can be carried out in a hole drilled in a welded part).

Additionally, for aluminium conductors the voltage drop before starting the cycle test shall be measured. In any case for aluminium conductors, the test shall be performed for 750 cycles.

The test sequence for all types of conductors (aluminium and copper) is given in Table 116.

Table 116 – Test sequence for direct terminal clamps

Verification of temperature rise at I_n
Measurement of $R_{cl\ 0}$
50 cycles
Measurement of $R_{cl\ 50}$
200 cycles
Measurement of $R_{cl\ 250}$
Verification of temperature rise at I_n
250 cycles
Measurement of $R_{cl\ 500}$
250 cycles
Measurement of $R_{cl\ 750}$
Verification of temperature rise at I_n

At the end of the cycle test, the verification of the temperature rise shall be performed in accordance with 8.3.4.1. The conductor with removed insulation used for the cycle test remains fastened. The point F at which the temperature rise is measured on the conductor is at a distance of 10 mm from the clamp (see Figure 110).

8.10.3 Acceptability of test results

The permissible changes given are based on laboratory experience. The final criterion shall be met; it is not the summation of the intermediate criteria.

8.10.3.1 Contacts

If at the end of the 250th cycle the measured values do not exceed the following limit, the fuse-base is considered to have passed the test and the test may be stopped:

$$\frac{R_{250} - R_{50}}{R_{50}} \leq 15\%$$

If at the end of the 250th cycle the above limit is exceeded, the test is continued. After 500 cycles the following limit shall not be exceeded:

$$\frac{R_{500} - R_{250}}{R_{250}} \leq 30\%$$

If the limit is exceeded, the test is not satisfied. If the limit is not exceeded, the test is continued up to 750 cycles. At the end of the 750th cycle the following limit shall not be exceeded:

$$\frac{R_{750} - R_{50}}{R_{50}} \leq 40\%$$

The difference of the temperature rise between the last and the first measurement shall be less than 20 K.

8.10.3.2 Direct terminal clamps

The permissible tolerance for the resistance $R_{\text{cl 0}}$ for test samples with cleaned aluminium conductors is the following:

$$R_{\text{cl 0 max}} \leq 2\ R_{\text{cl 0 min}}$$

The changes of the resistance from $R_{\text{cl 50}}$ to $R_{\text{cl 750}}$ shall meet the following values in Table 117.

Table 117 – Permissible changes of the resistance

	Permissible changes %	
	Copper conductors or cleaned aluminium conductors	**Uncleaned aluminium conductors**
$\frac{R_{\text{cl 250}} - R_{\text{cl 50}}}{R_{\text{cl 50}}} \times 100$	15	30
$\frac{R_{\text{cl 500}} - R_{\text{cl 250}}}{R_{\text{cl 250}}} \times 100$	20	40
$\frac{R_{\text{cl 750}} - R_{\text{cl 500}}}{R_{\text{cl 500}}} \times 100$	15	30
$\frac{R_{\text{cl 750}} - R_{\text{cl 50}}}{R_{\text{cl 50}}} \times 100$	40	80

The temperature rise measured at test spot F shall be lower than 75 K.

8.11 Mechanical and miscellaneous tests

8.11.1.1 Mechanical strength of fuse-holders

The fuse-holder, fitted with a dummy fuse-link of Figure 105 or fitted with a fuse-link of the largest rated current and power dissipation that can be accommodated by the fuse-holder, shall be subjected to a temperature rise test at rated current.

At the conclusion of the temperature-rise test, the fuse-link or the fuse-carrier as appropriate, shall be withdrawn and inserted into the fuse-base 100 times.

At the conclusion of these tests, all parts shall be intact and shall function normally.

Compliance shall be verified by a further temperature-rise test at rated current at the conclusion of which the values obtained shall be not more than 5 K or 15 % (whichever is greater) above the values obtained from the temperature rise test prior to the commencement of the mechanical test.

8.11.1.2 Mechanical strength of the fuse-base

The mechanical strength of the fuse-bases and their components is verified by the following tests.

The test to verify the contact force of fuse-bases is performed with three unused fuse-bases as supplied. A test-link made of hardened steel with polished and chrome-plated surfaces is inserted three times in the fuse-base. The dimensions of the blade contacts of the fuse-link are identical with the dimensions according to Figure 101.

When pulling steadily by means of suitable test equipment, the withdrawal force F measured (see Figure 108) shall be found to lie within the limits as specified in Table 118.

Table 118 – Force to withdraw the fuse-link from the fuse-base contacts

Size	Withdrawal force	
	F_{min} N	F_{max} N
00	60	250
~~0~~	~~80~~	~~300~~
1	110	350
2	150	400
3	210	400
4[1)]	Not applicable	Not applicable
4a[2)]	Not applicable	Not applicable

1) Fuse-link is fixed with screws in the fuse base

2) This fuse-base is locked in the on position

In order to verify that the fuse-base contacts are firmly seated, steel screws (class 8.8) are fastened at the terminals. They are fastened three times by applying a torque of 1,2 times the value specified by the manufacturer or, where no value is specified, 1,2 times the value of Table 111. For flat connections requiring a nut, steps shall be taken to prevent, by suitable means, the nut from turning round.

After this test the contact pieces of the fuse-base shall not have moved to such an extent as to affect the further use of the fuse-base. The insulating mounting part of the fuse-base shall neither be broken nor shall it show any signs of cracks.

If the measured values are too low, the dynamic test in accordance with 8.5.5.1 (fuse system C) shall be performed.

8.11.1.8 Impact resistance of gripping-lugs of moulded material or of metal fixed in moulded material

8.11.1.8.1 Test arrangement

The facility to verify impact resistance is given in Figure 109. The weight of the drop hammer is 300 g, the height of fall between the impact-mandrel and the gripping-lug is 300 mm.

8.11.1.8.2 Test method

One fuse-link is exposed to (150 ± 5) °C for 168 h and another one to –15 °C for 72 h. The fuse-link exposed to heat is to be cooled off to room temperature before being subjected to the dynamic stress. For the sample exposed to cooling, the time interval between the taking out and the dynamic stress shall not be longer than 1 min.

The samples are placed in the test facility of Figure 109 in such a way that the direction of the stroke is parallel to the longitudinal axis of the fuse-link. Each of the gripping-lugs is only once exposed to stress at which the place of impact shall be the middle of the gripping-lug-neck. It shall be guaranteed that each time only the upper gripping-lug is stressed by the impact.

8.11.1.8.3 Acceptability of test results

The gripping-lugs shall show no damage capable of hindering their further use. Each of the gripping-lugs shall not be bent out by more than 3 mm measured before and after the impact; furthermore, the coupling with a handle according to Figure 103, shall not be hindered.

8.11.2.3 Verification of resistance to rusting

8.11.2.3.1 The test shall be carried out according to ISO 6988 with cyclic moist atmosphere containing 0,2 % SO_2 (SFW 0,2 S); number of cycles: 1.

For reasons of test economy this test may be carried out on the test samples used for the non-deterioration test of contacts according to 8.10 after completion of the test.

8.11.2.3.2 The following test is an optional test to be agreed between manufacturer and customer. It considers severe environmental conditions.

Fuse-links and fuse-bases intended to be used in an environment of pollution degree ≥ 3 according to IEC 60664-1 shall be tested with SFW 2,0 S for 5 cycles. They shall be marked accordingly.

8.11.2.4 Non-deterioration of insulating parts of fuse-link and fuse-base

8.11.2.4.1 Test method

Three fuse-links and three fuse-bases to be tested shall be exposed to the following temperatures:

for a period of 168 h

(150 ± 5) °C for fuse-links and fuse-bases comprising moulded elements intended to support live parts,

(100 ± 5) °C for covers,

for a period greater than 1 h

(150 ± 5) °C over 1 h for sealing compounds; stability of the marking.

After cooling to ambient temperature the following shall be tested.

Fuse-links: verification of the breaking capacity with I_1 and I_2 in accordance with 8.5 of IEC 60269-1.

Fuse-base: verification of the mechanical strength in accordance with 8.11.1.2.

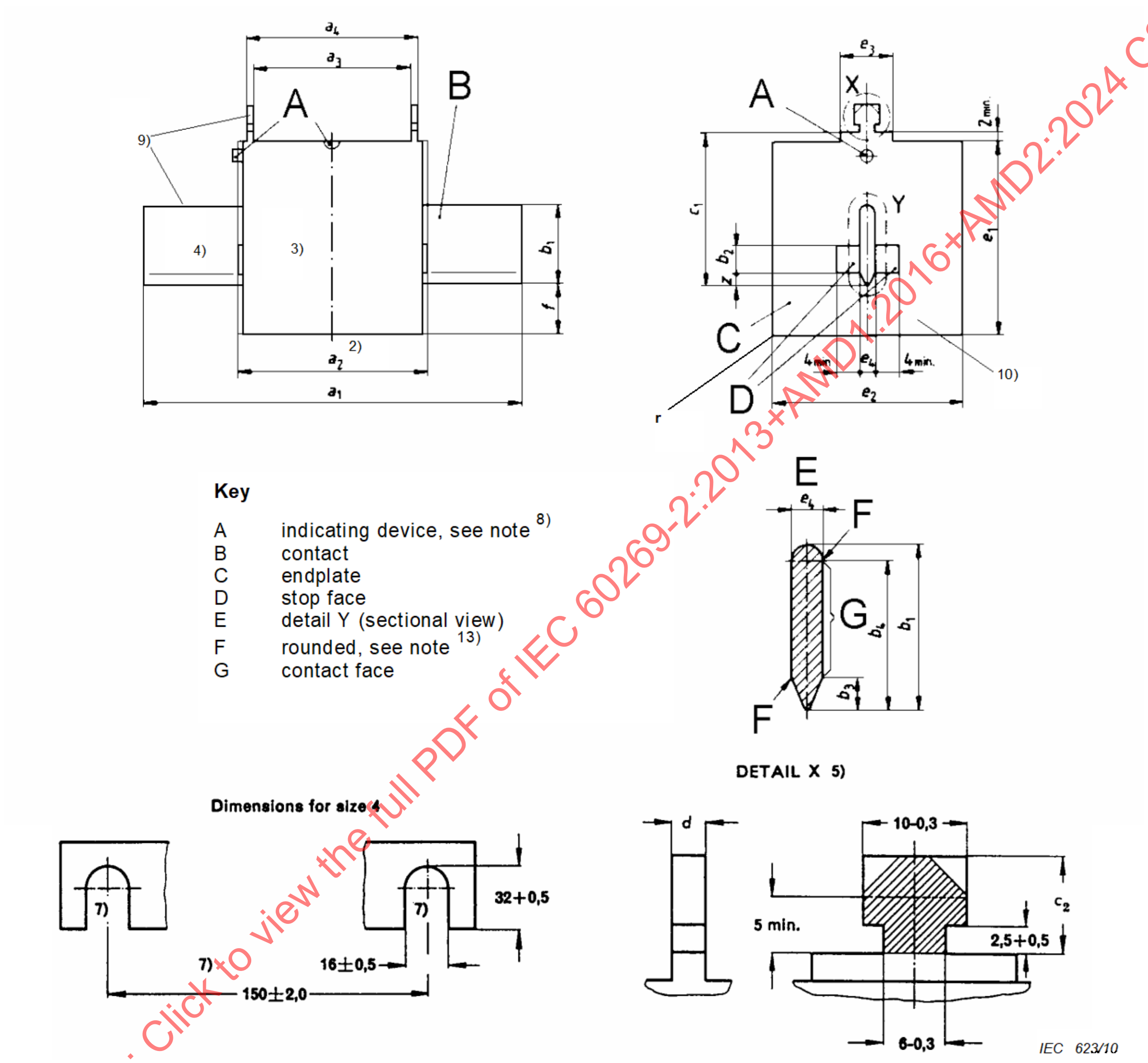
8.11.2.4.2 Acceptability of test results

The positions of the fuse-base contacts taking the fuse-link shall not have changed in a manner likely to affect its correct functioning. The insulating body on which the terminals are fixed shall neither fracture nor show any signs of a fracture. The mechanical strength of cemented joints shall not have been impaired. Sealing compounds shall not have shifted to an extent permitting live parts to be exposed. The fuse-links shall operate correctly.

The marking shall be durable and easily legible.

FIGURES

Dimensions in millimetres



The drawings are not intended to govern the design except as regards the notes and dimensions shown.

Figure 101 – Fuse-links with blade contacts *(1 of 3)*

Maximum values of the rated power dissipation P_n

Size	gG						aM			
	400 V a.c.		500 V a.c.		690 V a.c.		400 and 500 V a.c.		690 V a.c.	
	I_n A	P_n W	I_n A	P_n W	I_n A	P_n W	I_n A	P_n W	I_n A	P_n W
000	100 160	6 10	100 125	7,5 9	63	12	100	7	80	6,5
00	160	12	160	12	100	12	100/160	7/11	160	11
0	160	12	160	16	100	25	160	13	100	10
1	250	18	250	23	200	32	250	18	250	22
2	400	28	400	34	315	45	400	35	400	40
3	630	40	630	48	500	60	630	50	630	53
4	-	-	1 000	90	800	90	1 000	80	1 000	80
4a	1 250	90	1 250	110	1 000	110	1 250	110	1 250	110

Figure 101 *(2 of 3)*

Size	a_1 1)	a_2 2)	a_3 1)	a_4 1)	b_1 min. 12)	b_2 min. 12)	b_3 max. 12)	b_4 min. 12)	c_1 ±0,8	c_2	d 5)	e_1 max. 6)	e_2 max. 6)	e_3	e_4 ±0,2	f max.	r min.	z max.
000	78,5 ±1,5	54 −6	45 ±1,5	49 ±1,5	15	4,5	5	12	35	10 −1	$2^{+1}_{-0,5}$	41	21	16^{+5}_{-2}	6	8	1	3
00	78,5 ±1,5	54 −6	45 ±1,5	49 ±1,5	15	4,5	5	12	35	10 −1	$2^{+1}_{-0,5}$	48	30	20 ±5	6	15	2	3
0	125 ±2,5	68 −8	$62^{+3}_{-1,5}$	$68^{+1,5}_{-3}$	15	4,5	5	12	35	11 −2	$2^{+1,5}_{-0,5}$	48	40	20 ±5	6	15	2	3
1	135 ±2,5	75 −10	62 ±2,5	68 ±2,5	20	5	6	17	40	11 −2	$2,5^{+1,5}_{-0,5}$	53	52	20^{+5}_{-2}	6	15	4	5
2	150 ±2,5	75 −10	62 ±2,5	68 ±2,5	25	8	6	22	48	11 −2	$2,5^{+1,5}_{-0,5}$	61	60	20^{+5}_{-2}	6	15	5	5
3	150 ±2,5	75 −10	62 ±2,5	68 ±2,5	32	11	6	29	60	11 −2	$2,5^{+1,5}_{-0,5}$	76	75	20^{+5}_{-2}	6	18	7	5
4 7)	200 ±3	90 max.	62 ±2,5	68 ±2,5	49	19,5	8	45	87	11 −2	$2,5^{+1,5}_{-0,5}$	110	105	20^{+5}_{-2}	8	25	10	5
4a 11)	200 ±3	100 max.	84 ±3	90 ±3	49	–	8	45	84 ±3	11 −2	$2,5^{+1,5}_{-0,5}$	110	102	30 ±10	6	30	10	–

1) The centres of the dimensions a_1, a_3 and a_4 shall not deviate from the centre of a_2 by more than 1,5 mm.

2) The dimension a_2 shall be observed within the total area of the stop faces (b_2 × 4 min.) on both sides of the blades. Outside of these areas the maximum dimension a_2 applies.

3) Insulating material.

4) The blade contacts shall be axially aligned and contact surfaces shall be plane.

5) Attachment for replacement handle (detail X).

6) Maximum dimensions of the enclosure of the fuse-link with the radiuses r. Within these limits, the fuse-links may be of any form, for example, square, rectangular, circular, oval polygonal, etc.

7) The slots are mandatory for size 4 fuse-links.

8) Indicating device. Position of the indicating device as chosen by the manufacturer.

9) Live parts, gripping-lugs can be insulated.

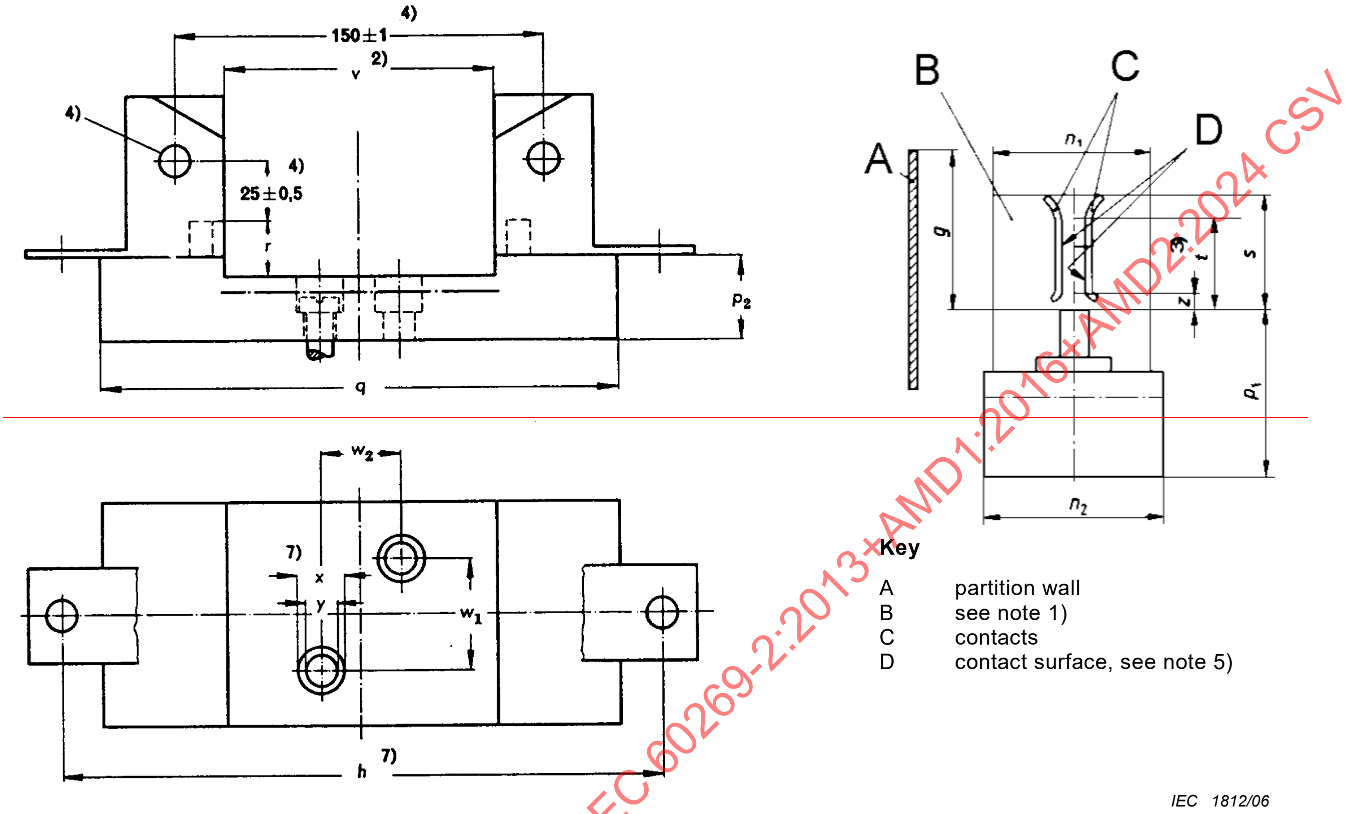
10) With the exception of the attachment for the replacement handle (detail X), the endplates are not permitted to protrude radially from the insulation body.

11) Only to be used with a swivel unit having an interlocking device.

12) As far as overlapping of rated currents exists within the sizes 0, 1, 2 and 3 the dimension of the smaller size is permitted.

13) All corners shall be rounded to prevent damage to the contact surface of the base contacts.

Figure 101 *(3 of 3)*



Key

A partition wall
B see note 1)
C contacts
D contact surface, see note 5)

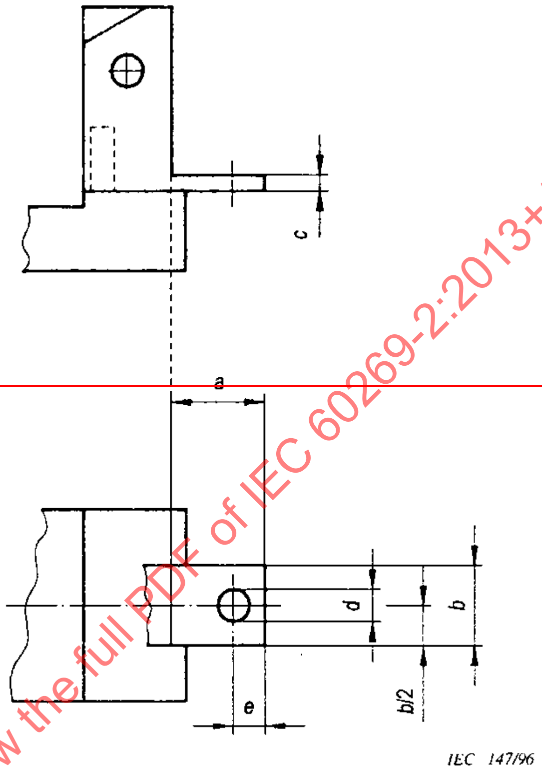
Dimensions in millimetres

The drawings are not intended to govern the design except as regards the notes and dimensions shown.

Size	g ±1	h ±1,5	n_1 max.	n_2 max.	p_1 max.	p_2 ±1,5	r min.	s max.	t min.	v	w_1	w_2	x min.	y ±0,5	z max.
	8)	7)									7)	7)	7)	7)	
00 14)	47	100	30	38	40	–	17	21	15	56,5 ± 1,5	0 ± 0,7	25 ± 0,7	14	7,5	3
0 13)	52	150	40	48	48	–	17	25	15	74 ± 3	0 ± 0,7	25 ± 0,7	14	7,5	3
1	53	175	52	60	55	35	17	38	21	80 ± 3	30 ± 0,7	25 ± 0,7	20	10,5	5
2	61	200	60	68	60	35	17	46	27	80 ± 3	30 ± 0,7	25 ± 0,7	20	10,5	5
3	73	210	75	83	68	35	20	58	33	80 ± 3	30 ± 0,7	25 ± 0,7	20	10,5	5
4	100	–	–	–	–	–	27	84	50	97 min.	–	–	–	–	5
4a 6)	100	270	102	115	–	40	32	84	50	110 ± 15	45 ± 0,7	30 ± 0,7	36	14	6

Figure 102 – *(1 of 3)*

Size	Rated current A	Rated acceptable power dissipation W
00[14)]	160	12
0[13)]	160	25
1	250	32
2	400	45
3	630	60
4	1 000	90
4a	1 250	110



Dimensions in millimetres

Size	a 9)12) min.	b 9) min.	c 11) min.	$d \pm 0,25$ Hole diameter	Thread	$e \pm 0,5$
00[14)]	20	20	3	9	M8	10
0[13)]	23	20	3	9	M8	10
1	24	25	4	11	M10	12,5
2	28	25	4	11[10)]	M10[10)]	12,5
3	35	30	5	11[10)]	M10[10)]	15
4	45	40	8	14	M12	20
4a	45	40	10	18	M16	20

Figure 102 *(2 of 3)*

1) This area is considered to be live.

2) The maximum value of dimension *v* is intended to define a point of contact. It shall at least be observed at one point of contact within the two areas $b_2 \times 4$ min. of the fuse-link. Dimension *v* may also be met by means of insulating contact covers.

3) Height of contact surface. It shall also be possible to insert fuse-links with blade contacts according to Figure 101, even if the contact surface is not smooth but grooved or divided.

4) Dimensions for size 4. Fixing bolts are mandatory for size 4; M12 when threaded.

5) Resilient contact surface, except for size 4. Contact force by auxiliary means.

6) Only to be used with a swivel unit having an interlocking device.

7) These values are only mandatory if interchangeability of fuse-bases is required.

8) When constructing multipole or assemblies of single-pole fuse-bases, it is necessary, for reasons of safety, to fit insulating barriers (for example, partition walls with recommended dimension "*g*") compatible with the maximum dimension prescribed for n_1.

9) Greater dimensions for "*a*" and "*b*" or deviating shapes, for example, rounded or circular, observing the dimensions "*d*" and "*e*" are permitted in relation to the peculiarity of the construction.

10) M12 with through hole 14 permitted.

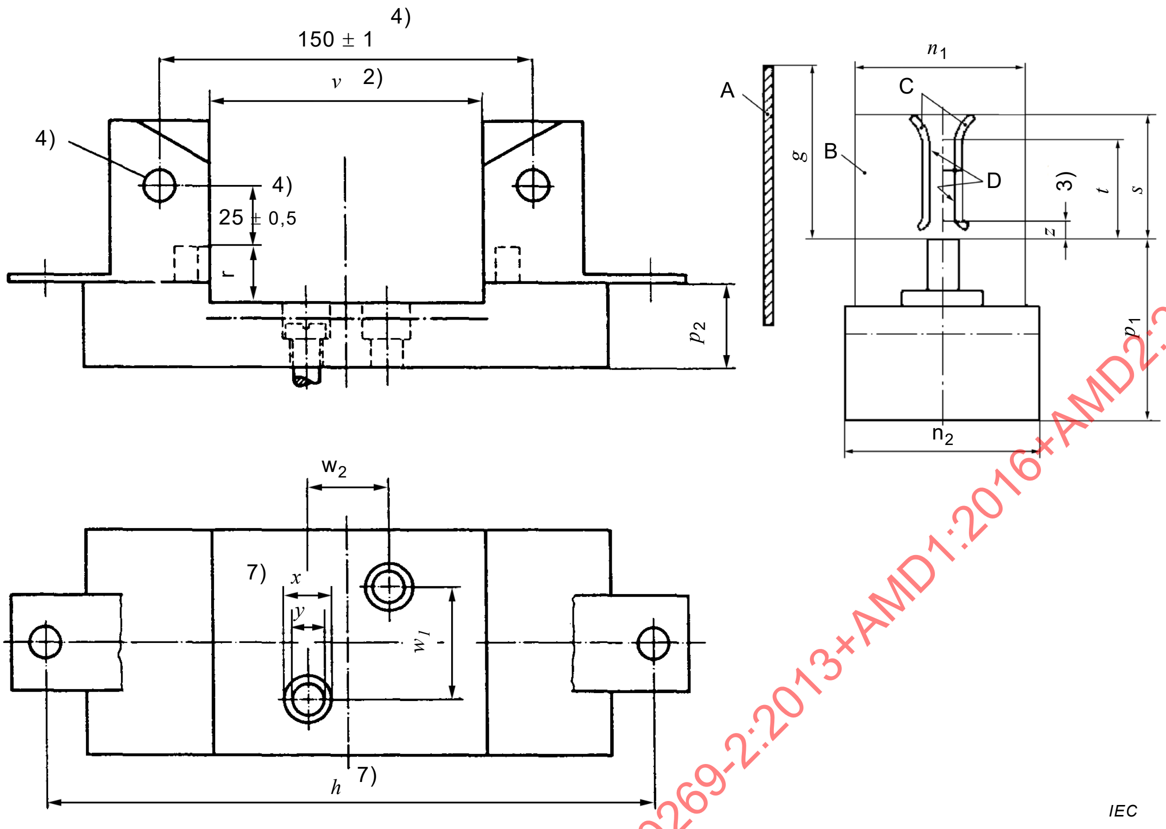
11) Dimension "*c*" may be lower provided the mechanical stress when connecting the conductors can be withstood without deformation of the connection. Types with thread shall comply with test-torque requirements.

12) Dimension "*a*" shall be measured on the top side of the connection.

13) Not allowed for new installations except for fuse-links with strikers.

14) Fuse-bases of size 00 shall be used for fuse-links of size 000 and size 00.

Figure 102 *(3 of 3)*



Key

A partition wall

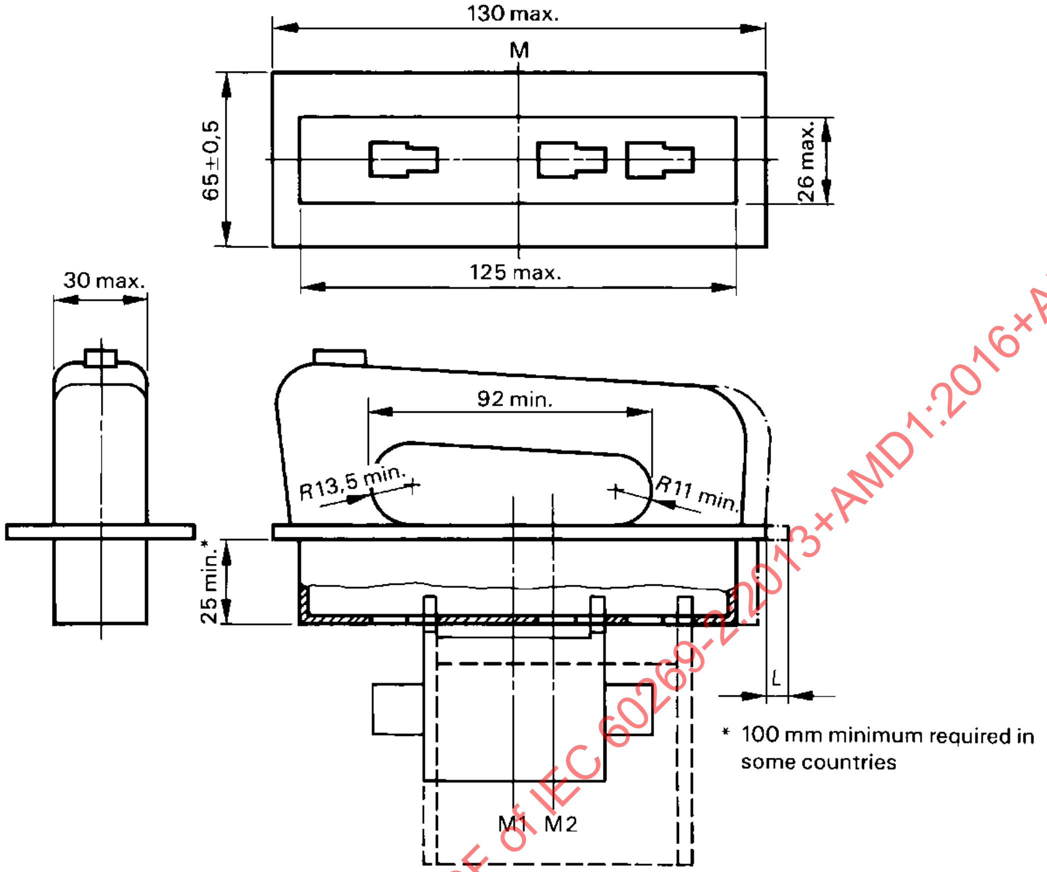
B see note 1)

C contacts

D contact surface, see note 5)

Figure 102 – Fuse-bases for fuse-links with blade contacts

Dimensions in millimetres



The drawings are not intended to govern the design of the handle except as regards the notes and dimensions shown.

Size	*L* mm	Distance	
		M – M1 mm	**M – M2** mm
000/00	14	0 ± 3	
~~0~~1 3	16		9 ± 5
The basic position of the fuse-link for measurement of the handle is defined by the manufacturer.			

Centre of the set-in and blocked-up fuse-link:

M1 for sizes 000/00

M2 for the sizes ~~0~~1…3

M = centre of the coupling

L = permitted lift for setting in and taking out of the fuse-link

Figure 103 – Replacement handle

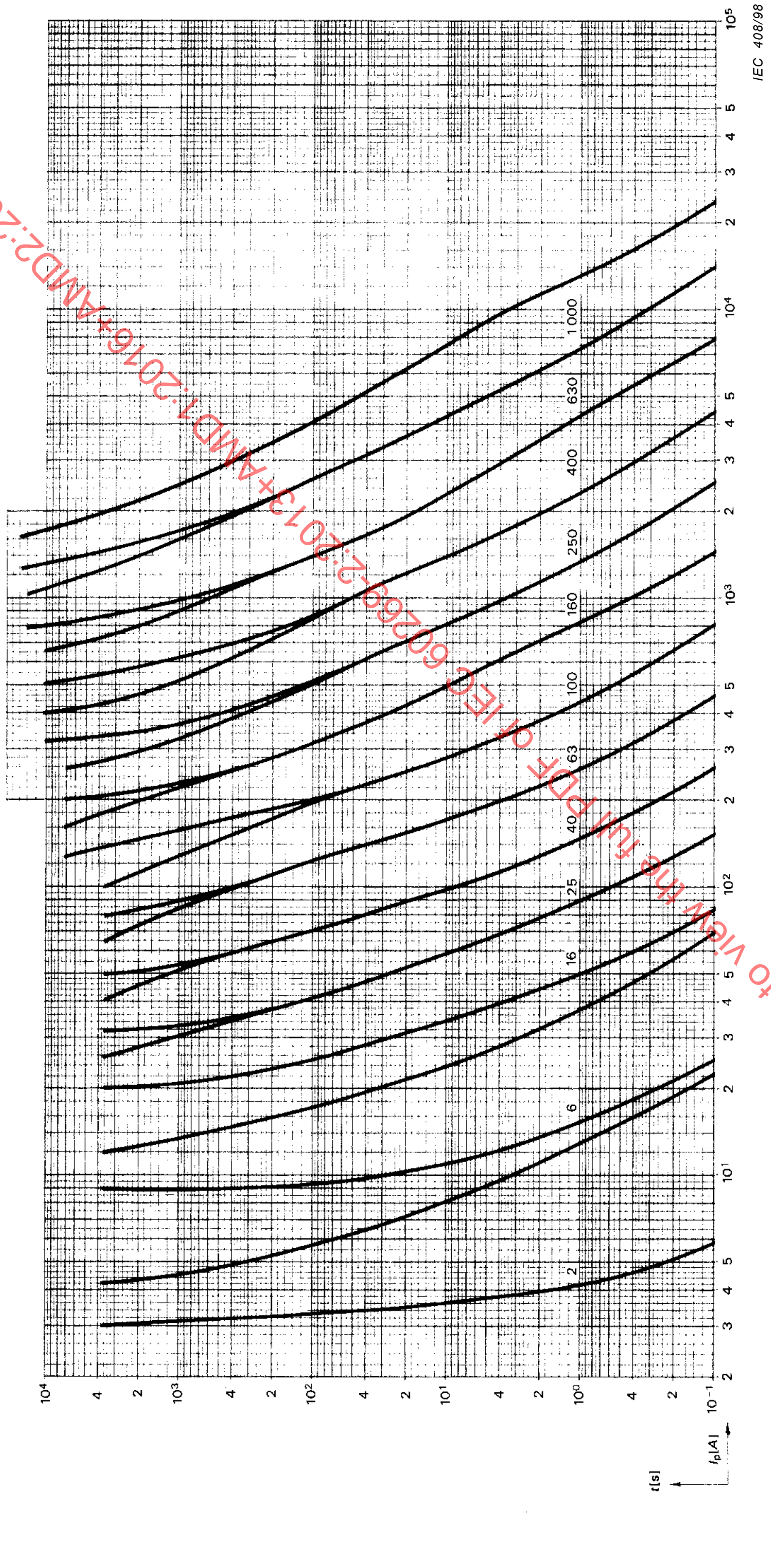


Figure 104 – Time-current zones for "gG" fuse-links *(1 of 5)*

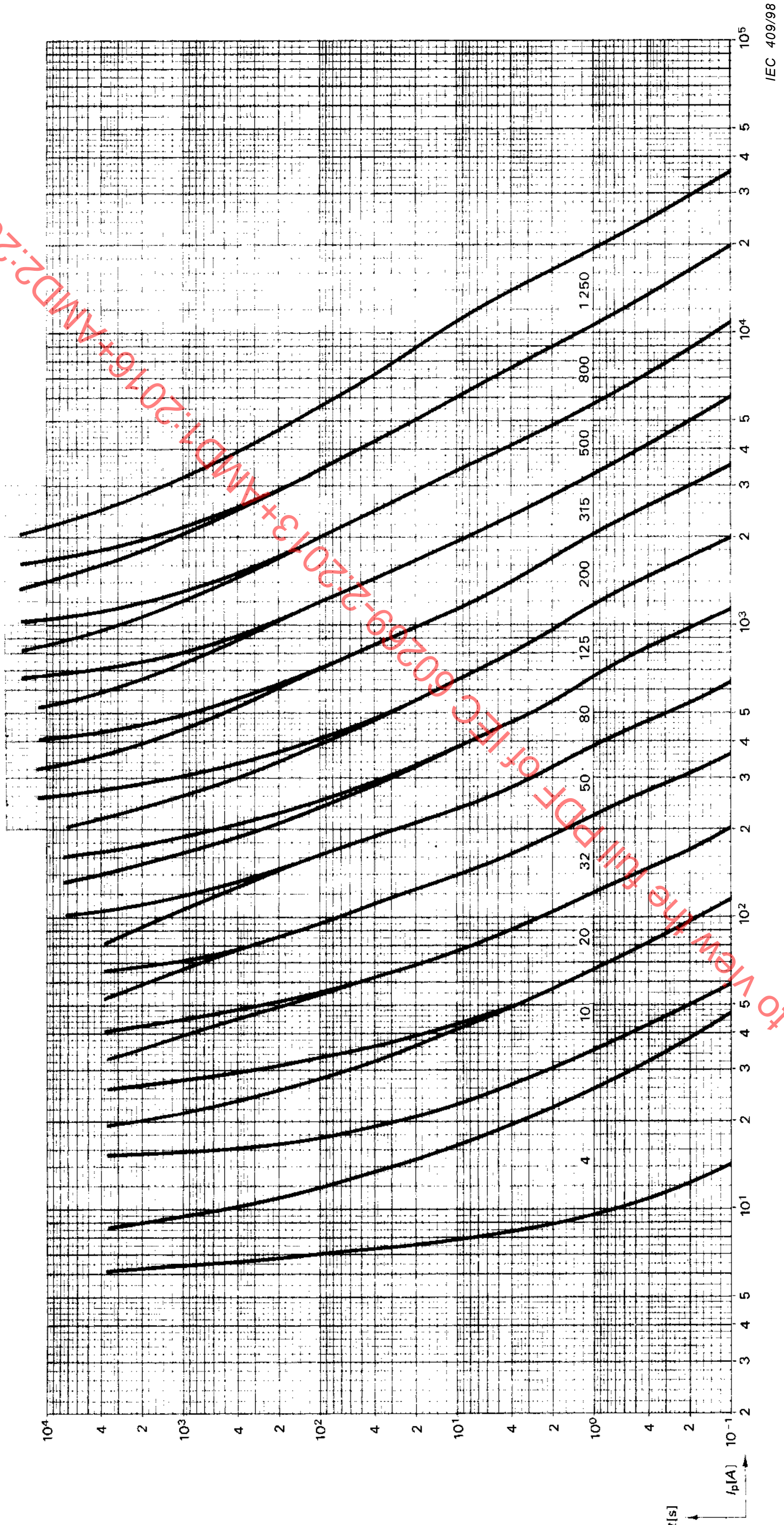


Figure 104 *(2 of 5)*

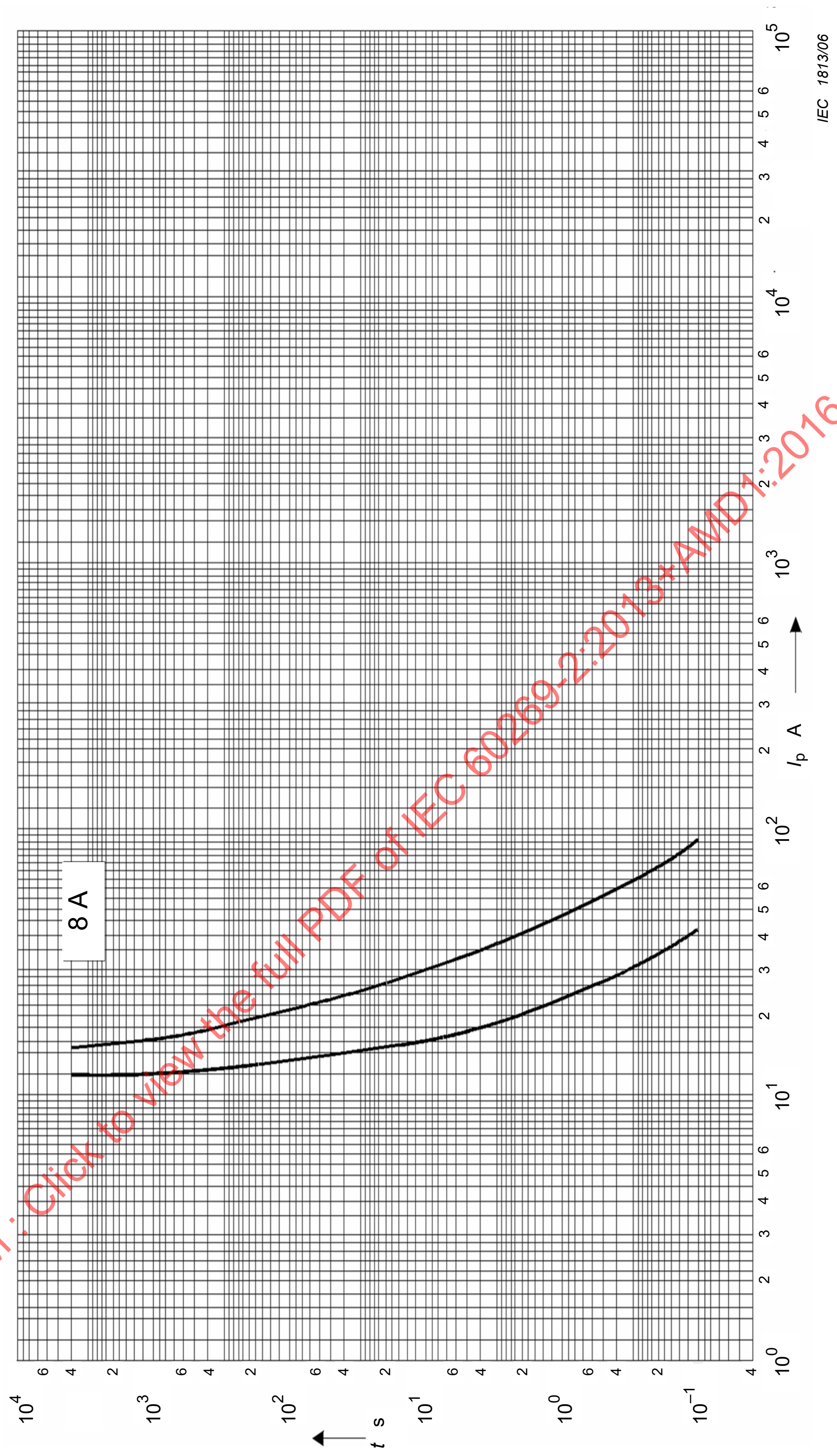


Figure 104 *(3 of 5)*

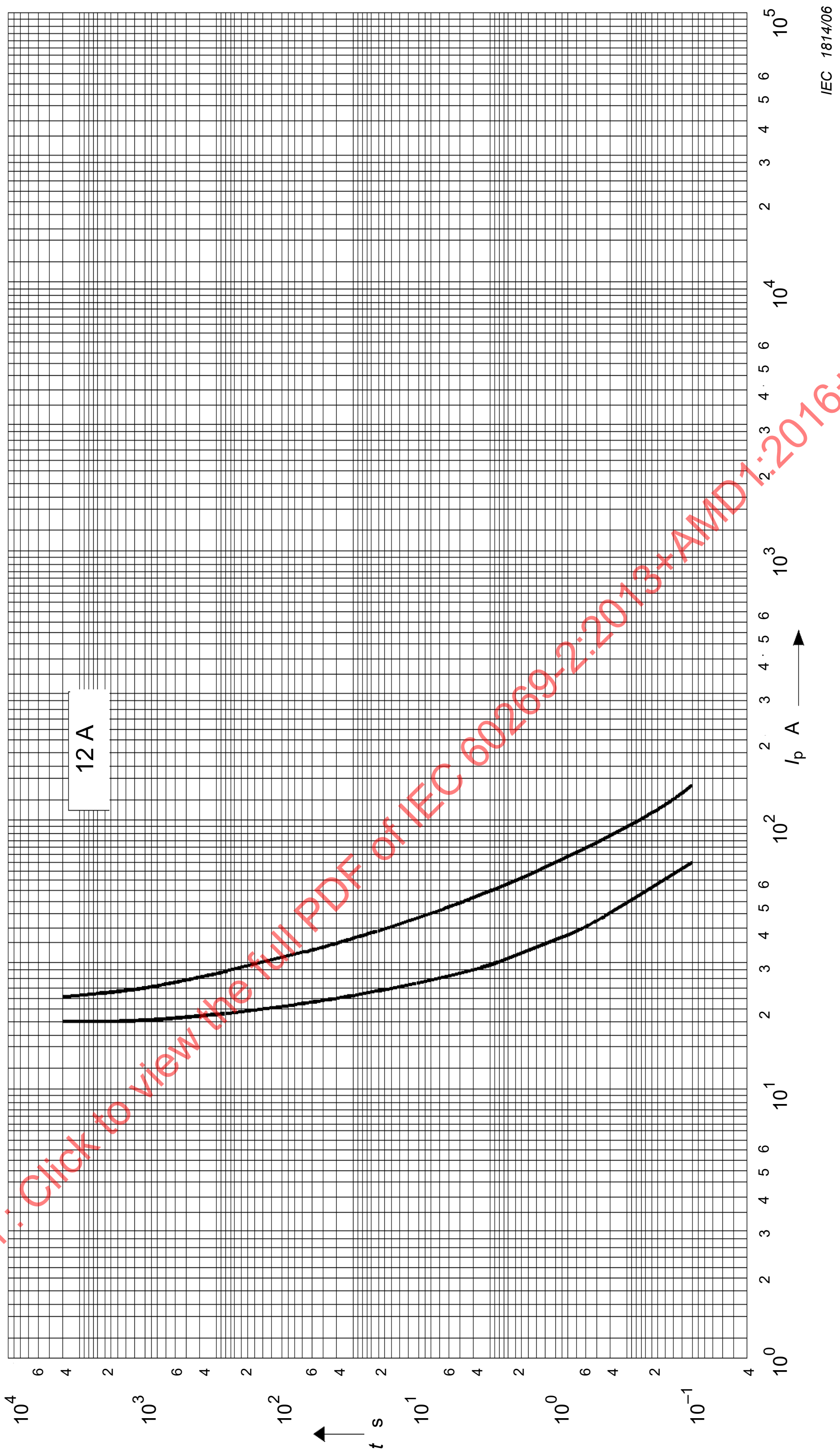


Figure 104 *(4 of 5)*

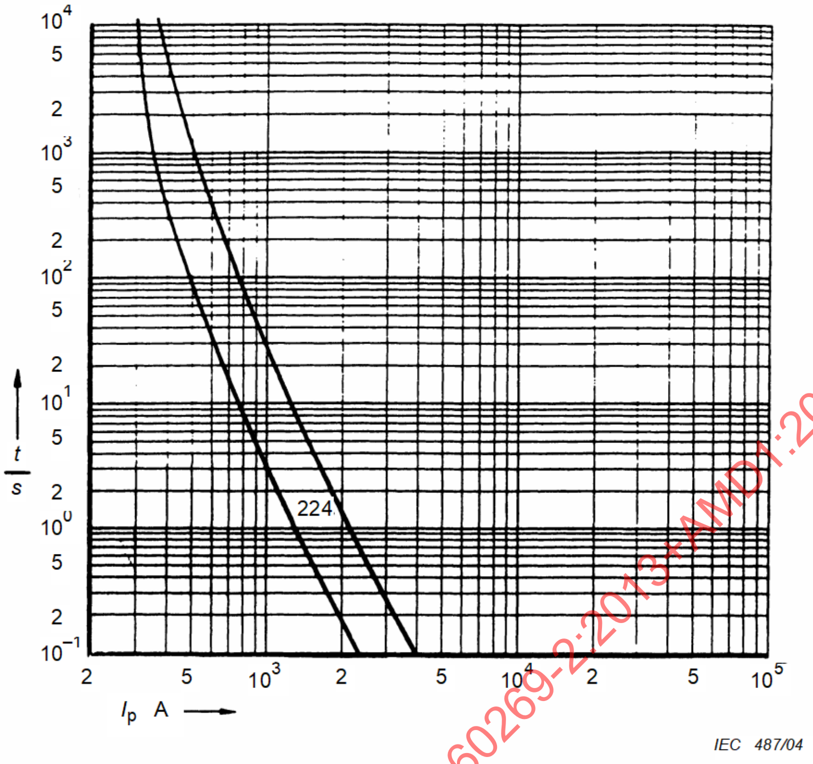
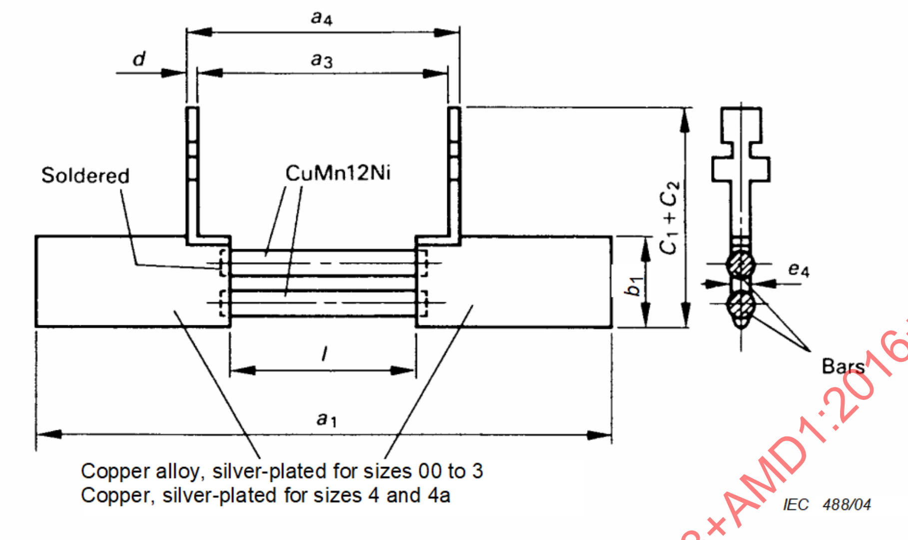


Figure 104 *(5 of 5)*

Dimensions in millimetres

For dimensions of the gripping-lugs, see Figure 101.



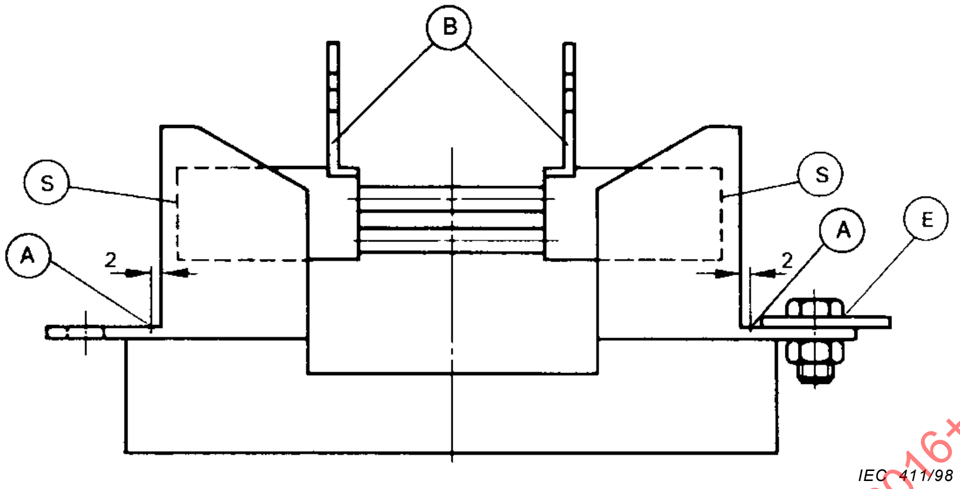
For other dimensions, see Figure 101.

Size	*l*	*P*[a)] W	*R*[b)] mΩ	Bars Number	Bars Diameter
00	$30{,}5\ ^{0}_{-3}$	12	0,47	1	7
~~0~~	~~$46\ ^{0}_{-4}$~~	~~25~~	~~0,97~~	~~1~~	~~6~~
1	$46\ ^{0}_{-4}$	32	0,51	1	8
2	$46\ ^{0}_{-4}$	45	0,281	2	8
3	$46\ ^{0}_{-4}$	60	0,151	3	9
4	$54\ ^{0}_{-6}$	90	0,09	3	12
4a	$54\ ^{0}_{-6}$	110	0,07	4	12

a) At the largest rated current of the size.

b) Measured at the gripping-lugs; equalized with a tolerance of ±2 %.

Figure 105 – Dummy fuse-link according to 8.3.4.1, 8.9.1 and 8.10



Dimensions in millimetres

Figure 106 – Measuring points according to 8.3.4 of IEC 60269-1, 8.3.4.1, 8.3.4.2 and 8.10.2 of fuse system A

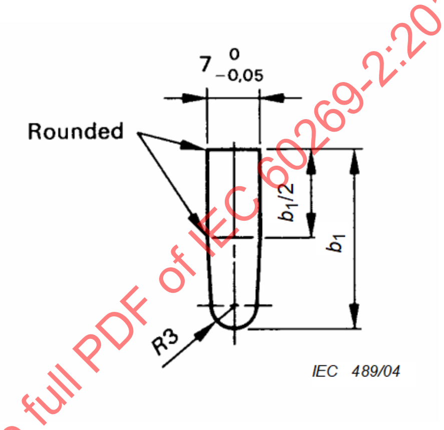
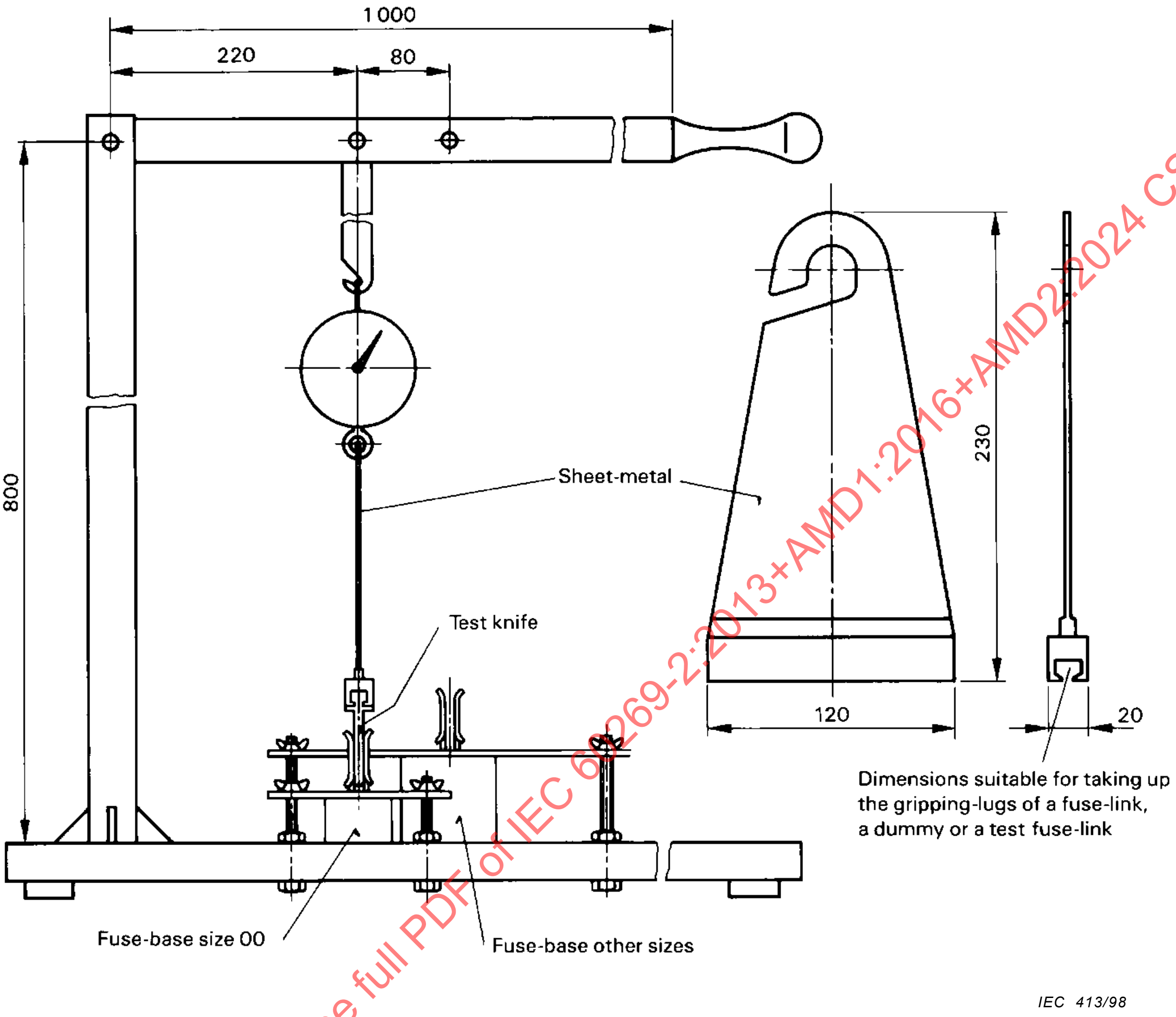
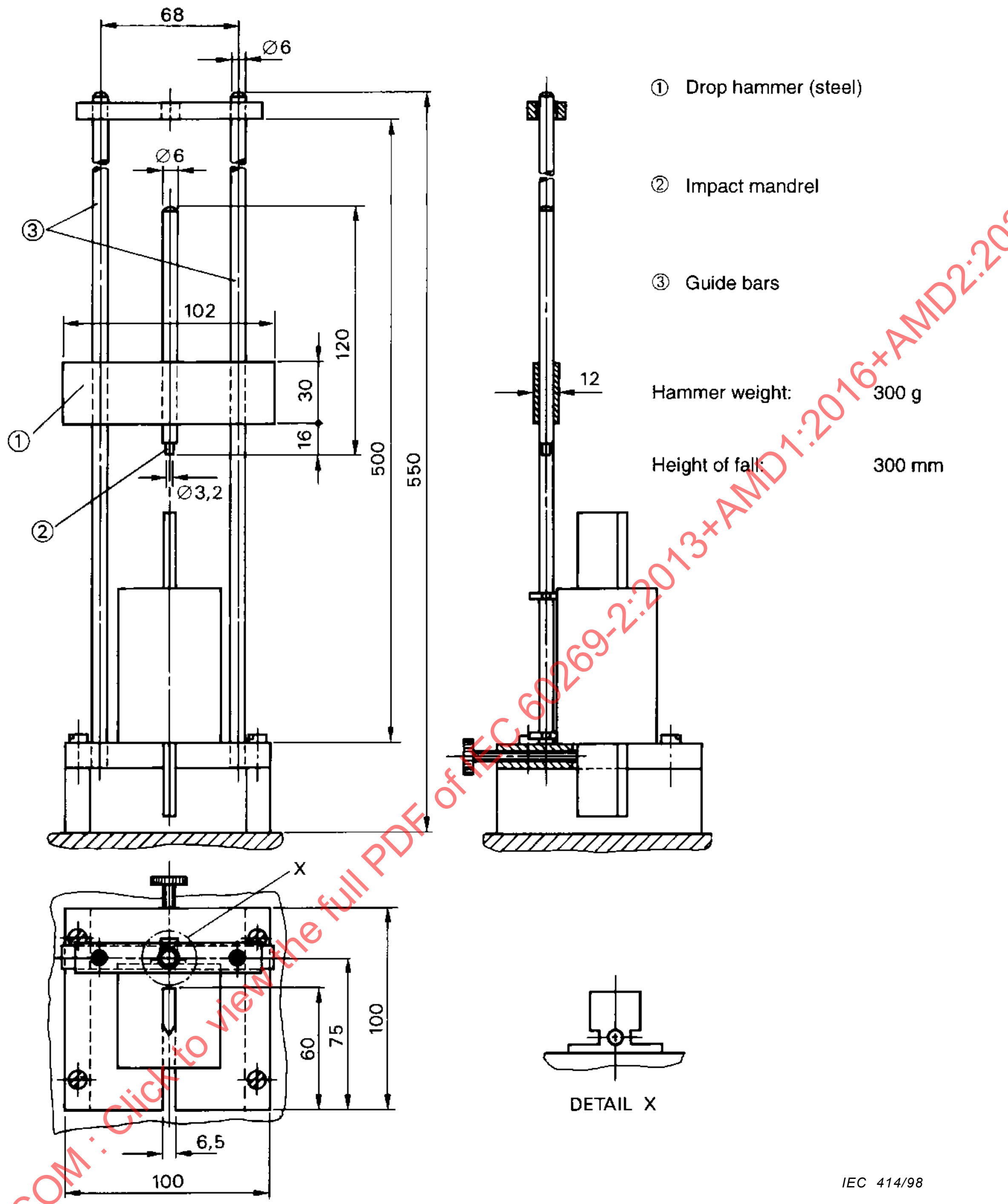


Figure 107 – Test knife according to 8.5.5.1.2



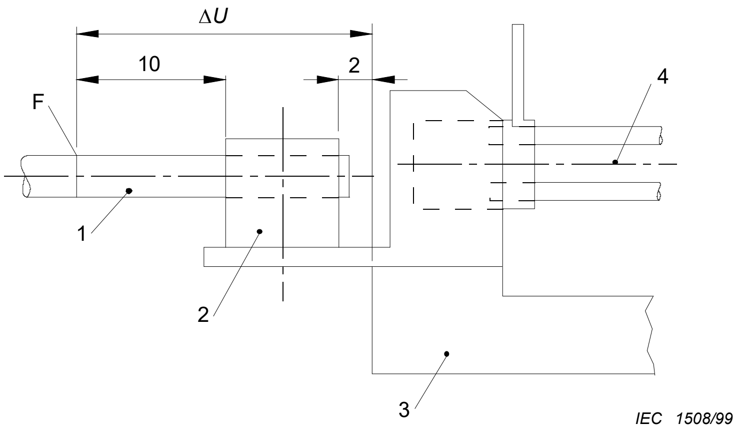
Dimensions in millimetres

Figure 108 – Example of a measuring device for determining the withdrawal forces according to 8.9.1 and 8.11.1.2



Dimensions in millimetres

Figure 109 – Facility for verifying the mechanical strength of gripping-lugs (see 8.11.1.8)



Dimensions in millimetres

Key

1 conductor
2 clamp
3 fuse-base
4 dummy fuse-link

Figure 110 – Measuring points according to 8.10.2

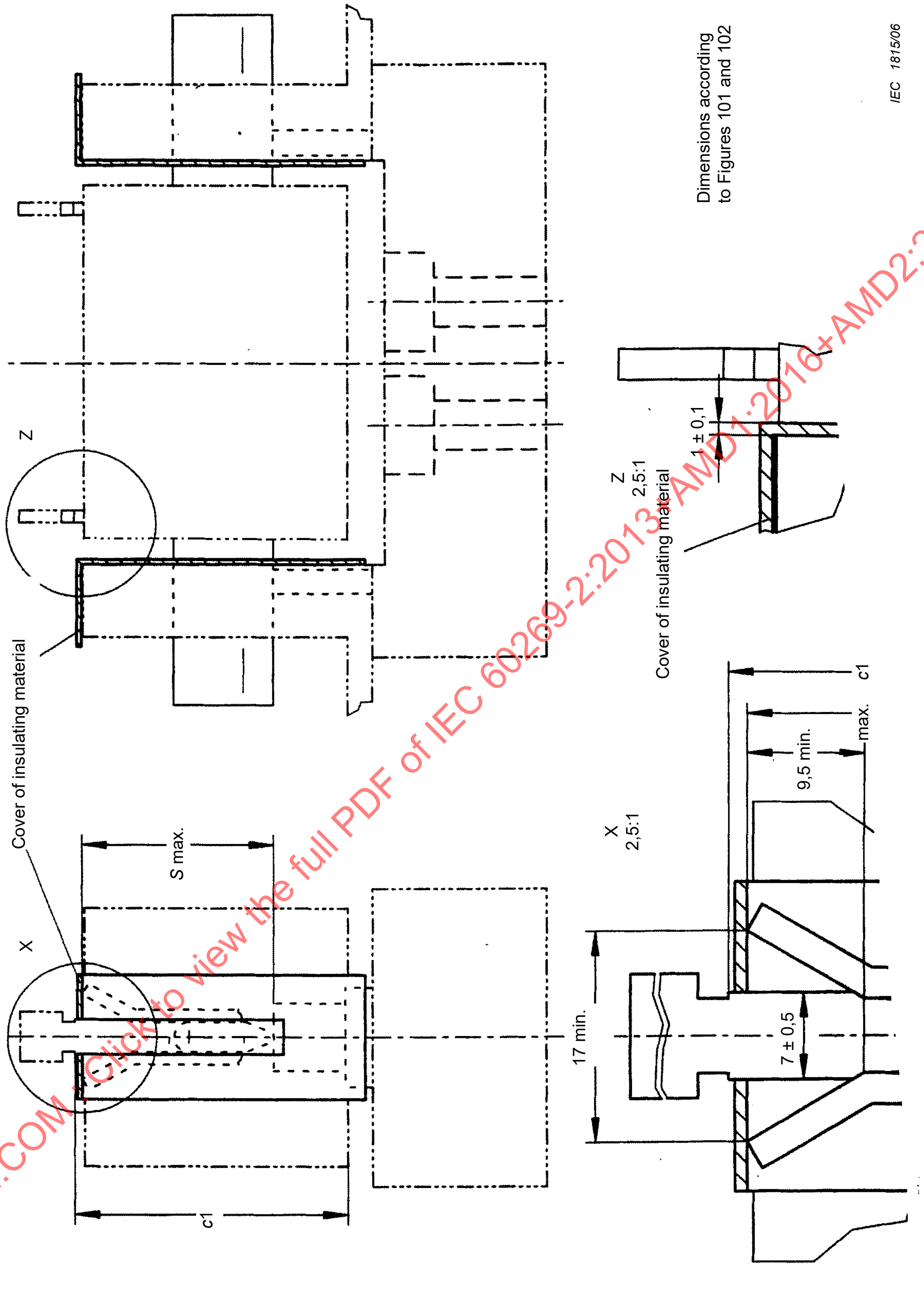
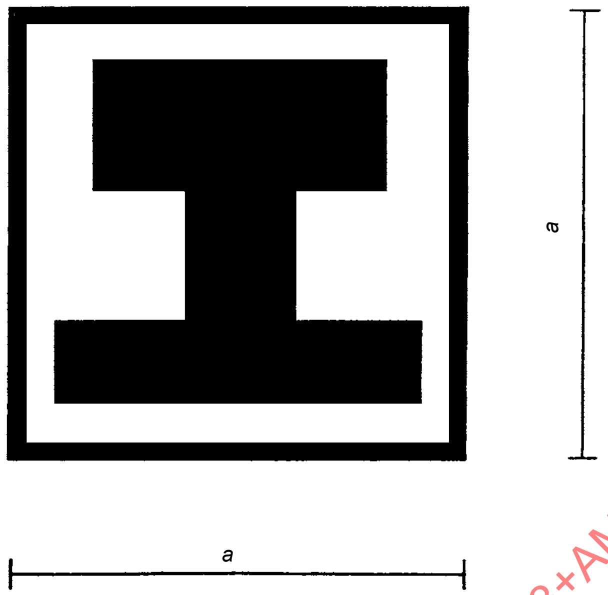


Figure 111 – Reference fuse-base



a ≥ 3 mm

Figure 112 – Design mark for isolated gripping-lugs

Annex AA
(informative)

Special test for cable overload protection

NOTE See note in 8.4.3.5 of fuse system A.

Fuses with $I_n > 16$ A of the sizes 000, 00, 0, 1 and 2 shall be tested as follows.

AA.1 Arrangement of the fuse

Three fuse-links of the same rated current and the same size are tested in fuse-bases according to Figure 102, mounted in a box at a distance between pole centres corresponding to the dimension $n_{2\ max}$ according to Figure 102.

The connection is determined by the rated current of the fuse-link (see Table 19 of IEC 60269-1). The connecting cables are made of black PVC insulated copper conductors. The fuses are connected in series to one power source (stabilized). The ambient air temperature outside the fuse box shall be $(30\ ^{+5}_{\ 0})$ °C.

NOTE A lower temperature can be used with the manufacturer's consent.

The box walls shall consist of 10 mm thick insulating material. Openings for the connecting cables shall be sealed during the test. The inside volume of the box is:

$2,5 \times 10^{-3}$ m^3 for size 000/00;

~~6×10^{-3} m^3 for size 0;~~

9×10^{-3} m^3 for size 1;

12×10^{-3} m^3 for size 2.

The dimension of the boxes shall correspond to the enveloping dimensions of the fuse-bases.

AA.2 Test method and acceptability of test results

A test current equal to 1,13 I_n flows through the fuse-links during the conventional time, as given in Table 2 of IEC 60269-1. None of the fuse-links shall operate. The test current is then raised without interruption within 5 s to I_t = 1,45 I_n. One fuse-link shall operate within the conventional time.

**Fuse system B –
Fuses with striker fuse-links with blade contacts
(NH fuse system)**

1 General

IEC 60269-1 applies with the following supplementary requirements.

1.1 Scope

The following additional requirements apply to fuses with striker fuse-links with blade contacts, intended to be replaced by means of a device, such as a replacement handle, which comply with the dimensions specified in Figures 201 and 202. Such fuses have rated currents up to and including 1 250 A and rated voltages up to and including 1 000 V a.c. or 1 500 V d.c.

Owing to the different operating features of fuses with strikers a distinction is made in this fuse system between references A and B.

The following characteristics of the fuses are specified in addition to IEC 60269-1:

- minimum rated breaking capacities;
- time-current characteristics;
- I^2t characteristics;
- standard conditions of construction;
- power dissipation and acceptable power dissipation.

2 Terms and definitions

IEC 60269-1 applies.

3 Conditions for operation in service

IEC 60269-1 applies.

4 Classification

IEC 60269-1 applies.

5 Characteristics of fuses

IEC 60269-1 applies with the following supplementary requirements.

5.2 Rated voltage

See 5.2 of fuse system A.

5.3.1 Rated current of the fuse-link

For each size, the maximum rated currents are given in Figure 201. These values depend upon the utilization categories and rated voltages.

5.3.2 Rated current of the fuse-holder

The rated current for the different sizes of the fuse-bases is given in Figure 202.

5.5 Rated power dissipation of a fuse-link and rated acceptable power dissipation of a fuse-holder

The maximum values of rated power dissipation for the different sizes of fuse-links are specified in Figure 201. The values apply to the maximum rated current of the fuse-links. The values of rated acceptable power dissipation of fuse-bases are given in Figure 202.

5.6 Limits of time-current characteristics

See 5.6 of fuse system A.

5.7.2 Rated breaking capacity

See 5.7.2 of fuse system A.

6 Markings

IEC 60269-1 applies with the following supplementary requirements.

See Clause 6 of fuse system A.

7 Standard conditions for construction

IEC 60269-1 applies with the following supplementary requirements.

7.1 Mechanical design

The dimensions of fuse-links and fuse-bases are given in Figures 201 and 202.

The control devices and the contacts acted by the striker are fixed on the fuse-base in such a way that

– the fuse-base can receive any fuse-link with striker of the same reference complying with this fuse system, as well as any fuse-link of the same size without striker complying with fuse system A;
– minimum clearances between the surface from the protruding of the striker considered as a live part and all metallic parts shall comply with IEC 60664-1 (see Figure 201).

7.1.2 Connections, including terminals

See 7.1.2 of fuse system A.

7.1.3 Fuse-contacts

See 7.1.3 of fuse system A.

7.1.7 Construction of a fuse-link

Subclause 7.1.7 of fuse system A applies with the following addition:

The striker of a fuse-link is considered an indicator.

7.2 Insulating properties and suitability for insulation

See 7.2 of fuse system A.

7.7 I^2t characteristics

See 7.7 of fuse system A.

7.8 Overcurrent discrimination of "gG" fuse-links

See 7.8 of fuse system A.

7.9 Protection against electric shock

See 7.9 of fuse system A.

8 Tests

IEC 60269-1 applies with the following supplementary requirements.

8.1.6 Testing of fuse-holders

See 8.1.6 of fuse system A.

8.3 Verification of temperature rise and power dissipation

See 8.3 of fuse system A.

8.4.3.6 Operation of indicating devices and striker, if any

Subclause 8.4.3.6 of IEC 60269-1 applies with the following addition:

After operation, the striker shall remain captive.

Table 201 shows the position and the force of the striker for both references.

Table 201 – Position and force of the striker

Size		Reference A	Reference B	
		0 to 4	1 to 4a	000/00
$S_{0\ max}$	mm	1	1	1
S_1	mm	13 to 20	10 min.	5,5 min.
F_{min} between positions 0 and 1	N	8	1	1
F_{max} in position 1	N	20	20	20
S_0 : projection of the striker before operation (position 0) S_1 : projection of the striker after operation (position 1) F : force of the striker				

8.5.5.1 Verification of the peak withstand current of a fuse-base

See 8.5.5.1 of fuse system A.

8.7.4 Verification of overcurrent discrimination

See 8.7.4 of fuse system A.

8.9 Verification of resistance to heat

See 8.9 of fuse system A.

8.9.1 Fuse-base

See 8.9.1 of fuse system A.

8.9.1.1 Test arrangement

See 8.9.1.1 of fuse system A.

8.9.1.2 Test method

See 8.9.1.2 of fuse system A.

8.9.1.3 Acceptability of test results

After this test, the contact pieces of the fuse-base shall not have moved to such an extent as to affect the further use of the fuse-base. After extracting the dummy, the dimensions of Figure 202 shall be considered. The insulating mounting part of the fuse-base shall neither be broken nor shall it show any signs of cracks.

8.9.2.1 Test arrangement

See 8.9.2.1 of fuse system A.

8.9.2.2 Test method

See 8.9.2.2 of fuse system A.

8.9.2.3 Acceptability of test results

The gripping-lugs shall remain fully operational, and the length of the neck (2,5 + 0,5/0) mm in particular shall not be exceeded by more than 2 mm, in keeping with the dimensions d of Figure 201. The same applies to the maximum values of dimension c_2.

8.11.1.1 Mechanical strength of fuse-holder

See 8.11.1.1 of fuse system A.

8.11.1.2 Mechanical strength of the fuse-base

The mechanical strength of the fuse-bases and their components is verified by the following tests.

The test to verify the contact force of fuse-bases is performed on three unused fuse-bases as supplied. A test-link made of hardened steel with polished and chrome-plated surfaces is inserted three times in the fuse-base. The dimensions of the blade contacts of the fuse-link are identical with the dimensions given in Figure 201.

When pulling steadily by means of suitable test equipment, the withdrawal force F measured (see Figure 108) shall be found to lie within the limits specified in Table 118 of fuse system A.

In order to verify that the fuse-base contacts are firmly seated, steel screws (class 8.8) are fastened at the terminals. They are fastened three times by applying a torque of 1,2 times the value specified by the manufacturer or where no value is specified 1,2 times the value of Table 111 of fuse system A. For flat connections requiring a nut, appropriate steps shall be taken to prevent the nut from turning round.

After this test, the contact pieces of the fuse-base shall not have moved to such an extent as to affect the further use of the fuse-base. The insulating mounting part of the fuse-base shall neither be broken nor show any cracks.

If the measured values are too low, the dynamic test in accordance with 8.5.5.1 (fuse system C) shall be performed.

8.11.1.8 Impact resistance of gripping-lugs of moulded material or of metal fixed in moulded material

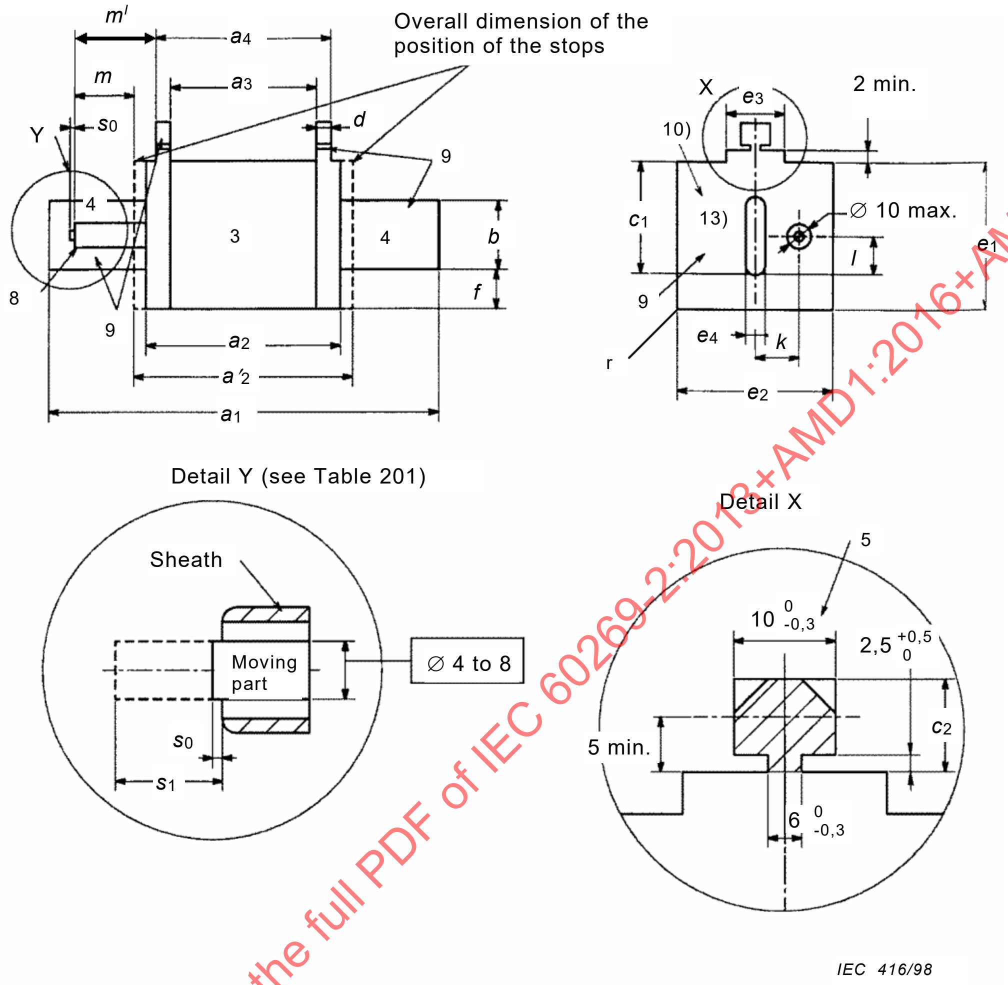
See 8.11.1.8 of fuse system A.

8.11.2.4.1 Test method

See 8.11.2.4.1 of fuse system A.

Dimensions in millimetres

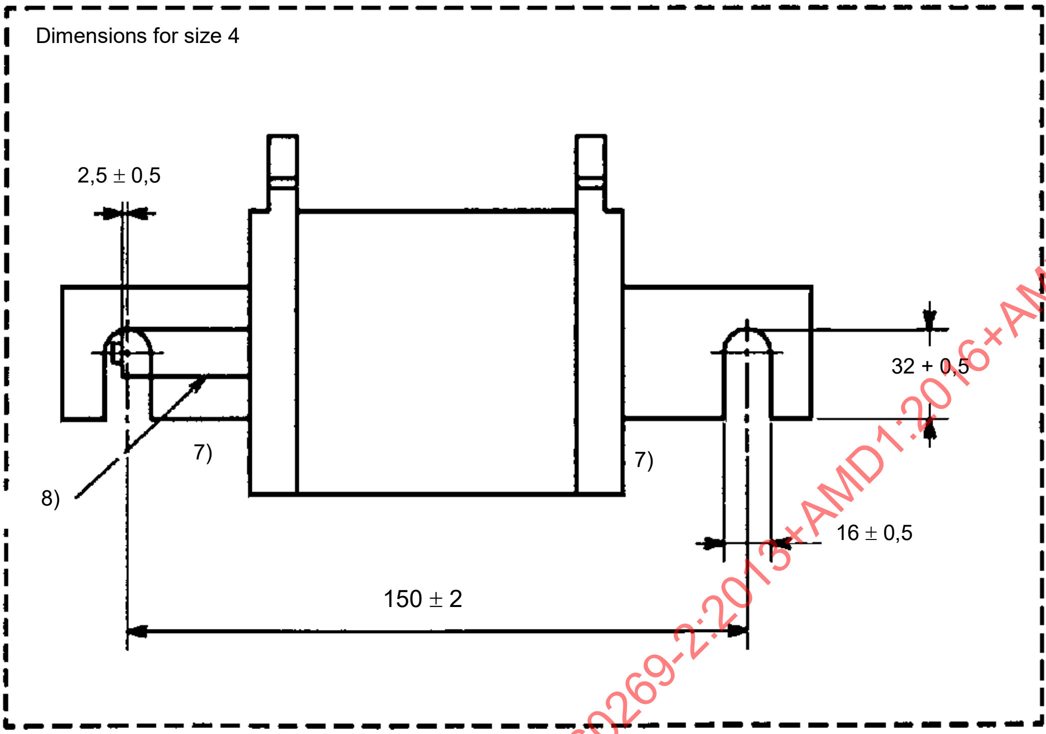
FIGURES



The drawings are not intended to govern the design of fuse-links except as regards the notes and dimensions shown.

Figure 201 – Fuse-links with blade contacts with striker *(1 of 4)*

Dimensions in millimetres



Maximum values of the rated power dissipation P_n

Size	gG				aM			
	500 V a.c.		690 V a.c.		500 V a.c.		690 V a.c.	
	I_n A	P_n W	I_n A	P_n W	I_n A	P_n W	I_n A	P_n W
000	100 125	7,5 9	63	12	100	7	80	6,5
00	160	12	100	12	100/160	7/11	160	11
~~0~~	~~160~~	~~16~~	~~100~~	~~25~~	~~160~~	~~13~~	~~100~~	~~10~~
1	250	23	200	32	250	18	250	22
2	400	34	315	45	400	35	400	40
3	630	48	500	60	630	50	630	53
4	1 000	90	800	90	1 000	80	1 000	80
4a	1 250	110	1 000	110	1 250	110	1 250	110

Figure 201 *(2 of 4)*

Reference A:

Size	a_1 1)	a_2 2)	a'_2	a_3 1)	a_4 1)	b min. 12)	c_1 ±0,8	c_2	d 5)	e_1 max. 6)	e_2 max. 6)	e_3	e_4 ±0,2	f max.	k	l	m	r min.
~~0~~	~~125 ± 2,5~~	~~68-8~~	~~$73^{+0}_{-1,5}$~~	~~$62^{+3}_{-1,5}$~~	~~$68^{+1,5}_{-3}$~~	~~15~~	~~35~~	~~11-2~~	~~$2^{+1,5}_{-0,5}$~~	~~48~~	~~45~~	~~20 ± 5~~	~~6~~	~~15~~	~~14,5~~	~~14~~	~~25 ± 0,5~~	~~2~~
1	135 ± 2,5	75-10	$79^{+0}_{-1,5}$	62 ± 2,5	68 ± 2,5	20	40	11-2	$2,5^{+1,5}_{-0,5}$	53	52	20^{+5}_{-2}	6	15	16	14,5	25,5 ± 0,5	4
2	150 ± 2,5	75-10	$79^{+0}_{-1,5}$	62 ± 2,5	68 ± 2,5	25	48	11-2	$2,5^{+1,5}_{-0,5}$	61	60	20^{+5}_{-2}	6	15	19	14,5	25,5 ± 0,5	5
3	150 ± 2,5	75-10	$79^{+0}_{-1,5}$	62 ± 2,5	68 ± 2,5	32	60	11-2	$2,5^{+1,5}_{-0,5}$	76	75	20^{+5}_{-2}	6	18	24	14,5	25,5 ± 0,5	7
4	200 ± 3	90 max.		62 ± 2,5	68 ± 2,5	49	87	11-2	$2,5^{+1,5}_{-0,5}$	110	105	20^{+5}_{-2}	8	25	27,5	14,5		10

Reference B:

Size	a_1 1)	a_2 2)	a_3 1)	a_4 1)	b min. 12)	c_1 ±0,8	c_2	d 5)	e_1 max. 6)	e_2 max. 6)	e_3	e_4 ±0,2	f max.	k	l	m'	r min.
000	78,5 ± 1,5	54-6	45 ± 1,5	49 ± 1,5	15	35	10-1	$2^{+1,5}_{-0,5}$	48	21	20 ± 5	6	8	0	21,5	16,6 ± 0,5	1
00	78,5 ± 1,5	54-6	45 ± 1,5	49 ± 1,5	15	35	10-1	$2^{+1,5}_{-0,5}$	48	30	20 ± 5	6	15	0	21,5	16,6 ± 0,5	2
1	135 ± 2,5	75-10	62 ± 2,5	68 ± 2,5	20	40	11-2	$2,5^{+1,5}_{-0,5}$	53	52	20^{+5}_{-2}	6	15	13,7	20,5	23,5 ± 0,5	4
2	150 ± 2,5	75-10	62 ± 2,5	68 ± 2,5	25	48	11-2	$2,5^{+1,5}_{-0,5}$	61	60	20^{+5}_{-2}	6	15	16,2	27,3	23,5 ± 05	5
3	150 ± 2,5	75-10	62 ± 2,5	68 ± 2,5	32	60	11-2	$2,5^{+1,5}_{-0,5}$	76	75	20^{+5}_{-2}	6	18	17,0	35,6	23,5 ± 0,5	7
4a11)	200 ± 3	100 max.	84 ± 3	90 ± 3	49	85 ± 2	11-2	$2,5^{+1,5}_{-0,5}$	110	102	30 ± 10	6	30	24,0	49,0	23,5 ± 0,5	10

Dimensions in millimetres

Figure 201 *(3 of 4)*

1) The centres of the dimensions a_1, a_3 and a_4 shall not deviate from the centre of a_2 by more than 1,5 mm.

2) The dimension a_2 shall be observed within the total area $b_{min}/2$ measured from the lower edge of the blade over a width of at least 4 mm on both sides of the blade. Outside this area, the dimension may be less than the values indicated for a_2.

3) Insulating material.

4) The contact surfaces may be plane or provided with ribs.

5) Attachment for replacement handle (detail X).

6) Maximum dimensions of the enclosure of the fuse-link with the radiuses r. Within these limits, the fuse-links may be of any form, for example, square, rectangular, circular, oval polygonal, etc.

7) The slots are mandatory for size 4 fuse-links.

8) Striker.

9) Live parts, gripping-lugs can be insulated.

10) With the exception of the attachment for the replacement handle (detail X), the endplates shall not protrude radially from the insulation body.

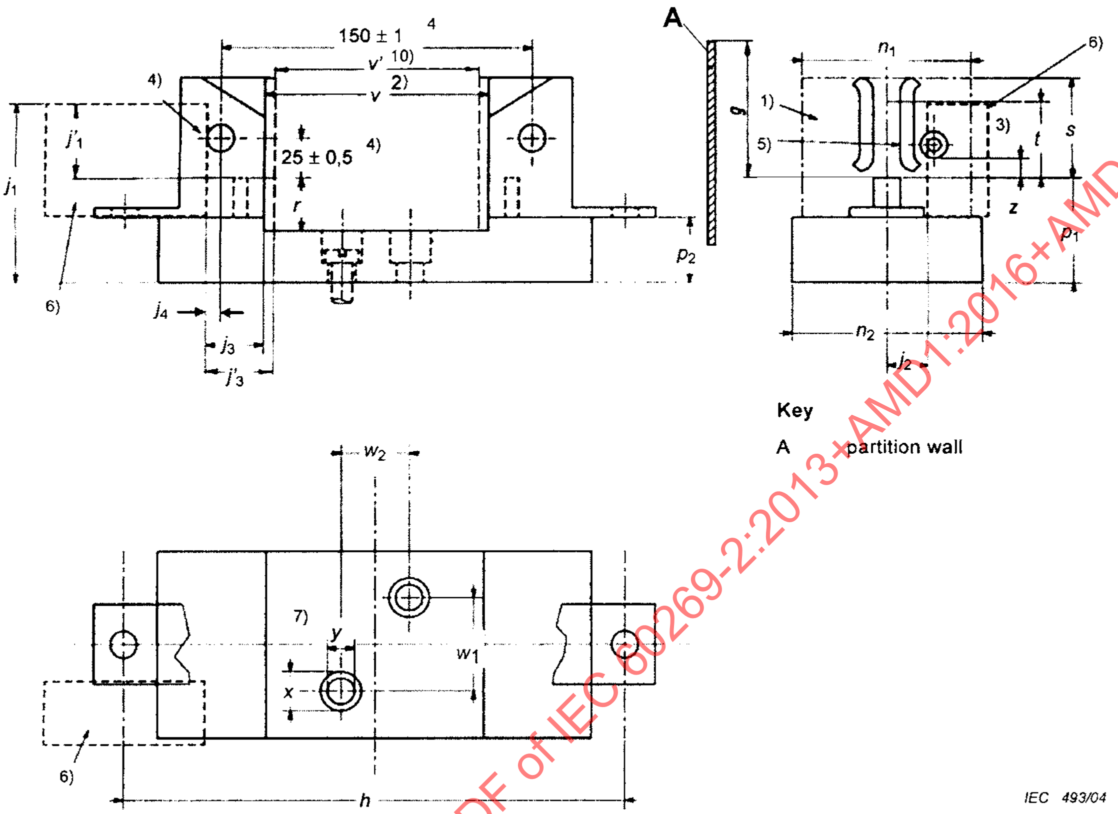
11) Only to be used with a swivel unit that has an interlocking device.

12) As far as overlapping of rated currents exists within the sizes 0, 1, 2 and 3 the dimension of the smaller size is permitted.

13) The edge of blade contacts can be round or of any appropriate shape.

Figure 201 *(4 of 4)*

Dimensions in millimetres



The drawings are not intended to govern the design of fuse-bases except as regards the notes and dimensions shown.

Figure 202 – Fuse-bases for fuse-links with blade contacts with striker *(1 of 3)*

Reference A:

Size	h ±1,5 7)	n_1 max.	n_2 max.	p_1 max.	p_2 ±1,5	r min.	s max.	t min.	v	w_1 7)	w_2 7)	x min. 7)	y ±0,5 7)	z max.
~~0~~	~~150~~	~~44~~	~~52~~	~~48~~	~~-~~	~~17~~	~~25~~	~~15~~	~~74+3~~	~~0±0,7~~	~~25±0,7~~	~~14~~	~~7,5~~	~~3~~
1	175	52	60	55	35	17	38	21	80+3	30±0,7	25±0,7	20	10,5	5
2	200	60	68	60	35	17	46	27	80+3	30±0,7	25±0,7	20	10,5	5
3	210	75	83	68	35	20	58	33	80+3	30±0,7	25±0,7	20	10,5	5
4	-	-	-	-	-	27	84	50	97 min.	-	-	-	-	5

Dimensions in millimetres

Reference B:

Size	g ±1 8)	h ±1,5 7)	n_1 max.	n_2 max.	p_1 max.	p_2 ±1,5	r min.	s max.	t min.	v	v'	w_1 w_2 7)	w_1 w_2 7)	x min. 7)	y ±0,5 7)	z max.
00 11)	47	100	30	38	40	-	17	21	15	56,5+1,5	55-1	0±0,7	25±0,7	14	7,5	3
1	53	175	52	60	55	35	17	38	21	80+3	76-1	30±0,7	25±0,7	20	10,5	5
2	61	200	60	68	60	35	17	46	27	80+3	76-1	30±0,7	25±0,7	20	10,5	5
3	73	210	75	83	68	35	20	58	33	80+3	76-1	30±0,7	25±0,7	20	10,5	5
4a 9)	100	270	102	115	-	40	32	84	50	110±15	-	45±0,7	30±0,7	36	14	6

Dimensions in millimetres

Size	Rated current A	Rated acceptable power dissipation W
00 11)	160	12
~~0~~	~~160~~	~~25~~
1	250	32
2	400	45
3	630	60
4	1 000	90
4a	1 250	110

Figure 202 *(2 of 3)*

Reference A:

Size	j_1	j_2	j_3		j_4	
	min.	max.	min.	max.	min.	max.
~~0~~	~~66~~	~~10,5~~	~~27~~	~~30~~		
1	75,5	12	27	30		
2	79,5	15	27	30		
3	87,5	20	27	30		
4		23,5			6,5	9

Reference B:

Size	j_1'	j_2	j_3'	
	min.	max.	min.	max.
00 [11)]	21,5	0	17,5	19,5
1	20,5	13,7	24,5	26,5
2	27,3	16,2	24,5	26,5
3	35,3	17,0	24,5	26,5
4a	49	24,0	24,5	26,5

1) This area is considered to be live.

2) The maximum value of dimension v is intended to define a point of contact. It shall be observed at least at one point of contact within the range of $b_{min}/2$ measured from the lower edge of the blade contact of the fuse-link. At the upper edge of the blade contact, the value v need not be observed.

3) Height of contact surface. It shall also be possible to insert fuse-links with blade contacts according to Figure 201, even if the contact surface is not smooth but grooved or divided.

4) Dimensions for size 4. Fixing bolts are mandatory for size 4; M12 when threaded.

5) Resilient contact surface, except for size 4. Contact force by auxiliary means.

6) Space for the device acted by the striker. The fuse-base provided with the device intended to receive the striker may have a dimension higher than n_2.

7) These values are only mandatory if interchangeability of fuse-bases is required.

8) When constructing multipole or assemblies of single-pole fuse-bases, it is necessary, for reasons of safety, to fit insulating barriers (for example, partition walls) compatible with the maximum dimension prescribed for n_1.

9) Only to be used with a swivel unit that has an interlocking device.

10) v' is the dimension measured between the longitudinal stops.

11) Fuse-bases of size 00 shall be used for fuse-links of size 000 and size 00.

Figure 202 *(3 of 3)*

Fuse system C –
Fuse-rails
(NH fuse system)

1 General

IEC 60269-1 applies with the following supplementary requirements.

1.1 Scope

The following additional requirements apply to fuse-bases, sizes 00 to 3 in rail design for mounting on 100 mm and 185 mm busbar systems insofar as they are not adequately covered by fuse system A.

2 Terms and definitions

IEC 60269-1 applies with the following supplementary definition.

2.1.301
fuse-rails
fuse-rails combine three single-pole fuse-bases longitudinally arranged in one unit

Note 1 to entry: One terminal of each pole (generally called "busbar terminal") is connected with or without special clamps direct to one phase of a three-phase busbar system. The other terminals ("cable terminals") are prepared to receive outgoing or incoming conductors.

3 Conditions for operation in service

IEC 60269-1 applies.

4 Classification

IEC 60269-1 applies.

5 Characteristics of fuses

IEC 60269-1 applies with the following supplementary requirements.

5.2 Rated voltage

Subclause 5.2 of fuse system A applies.

5.3.2 Rated current

The rated current of the different sizes of the fuse-rails is given in Figure 301.

5.5.1 Rated acceptable power dissipation

The rated acceptable power dissipation of a fuse-rail is given in Figure 301.

6 Markings

IEC 60269-1 applies with the following supplementary requirements.

Clause 6 of fuse system A applies.

7 Standard conditions for construction

IEC 60269-1 applies with the following supplementary requirements.

7.1 Mechanical design

The dimensions of fuse-rails are given in Figure 301.

7.1.2 Connections, including terminals

Subclause 7.1.2 of fuse system A applies.

Fuse-rails with direct terminal clamps shall be capable of accepting conductors within the range of Table 301.

Table 301 – Minimum cross-sectional ranges of unprepared conductors for fuse-rails

Size	Rated current of the fuse-rail A	Cross-sectional area ranges mm^2	
		Cu	**Al**
00	160	6 to 70	25 to 95
1	250	25 to 120	35 to 150
2	400	50 to ~~240~~ 2 × 120	70 to ~~300~~ 2 × 150
3	630	~~No values available~~ 50 to 2 × 185	--------------

7.2 Insulating properties

The creepage distances and clearances of fuse-rails shall meet the requirements of IEC 60664-1 for overvoltage category III and pollution degree 3. The minimum clearances are also applicable to metal parts which are not permanently under voltage but may be touched. They shall not be impaired during replacement of the fuse-link.

8 Tests

IEC 60269-1 applies with the following supplementary requirements.

8.1.6 Testing of fuse-holders

Fuse-rails shall be subjected to the tests according to Table 302. This table replaces Table 109 in fuse system A and Table 14 in IEC 60269-1.

Table 302 – Survey of complete tests on fuse-rails and number of fuse-rails to be tested [1]

Test according to subclause		Number of fuse-rails			
		1	**1**	**1**	**2**
8.1.4	Arrangement of the fuse and dimensions	X			
8.2	Verification of the insulating properties and of the suitability for isolation	X			
8.11.2.2	Verification of resistance to abnormal heat and fire	X			
8.11.1.2	Mechanical strength of the fuse-base		X		
8.3	Verification of temperature-rise and power dissipation			X	
8.11.1.1	Mechanical strength of fuse-holders			X	
8.3	Verification of temperature rise and power dissipation			X	
8.10.1.1	Contacts		X		
8.11.1.2	Mechanical strength of the fuse-base		X		
8.5.5.1	Verification of peak withstand current of a fuse-base [a]		X		
8.9	Verification of resistance to heat [b]			X	
8.11.2.4	Non-deterioration of insulating parts of fuse-link and fuse-base			X	
8.11.1.2	Mechanical strength of the fuse-base			X	
8.10.1.2	Direct terminal clamps (if applicable)	X			X
8.11.2.3	Verification of resistance to rusting		X		

[a] Not necessary if the withdrawal forces according to 8.11.1.2 are met.
[b] The dummy in phase L1 (top phase) is secured.

8.3 Verification of temperature rise and power dissipation

Subclause 8.3 of fuse system A applies with the following addition.

8.3.1 Arrangement of the fuse

Subclause 8.3.1 of fuse system A applies with the following addition:

The test arrangement for fuse-rails is given in Figure 302.

8.5.5.1 Verification of peak withstand current of a fuse-base

On fuse-rails, the verification of peak withstand current is covered by the verification of non-deterioration of contacts according to 8.10. Subclause 8.10.3.1 of fuse system A applies for the acceptability of test results.

If, after the verification of non-deterioration of contacts and direct terminal clamps, the measured values of withdrawal forces according to 8.10.2.1 are below the values shown in Table 118, the verification of peak withstand current according to 8.5.5.1.1 of fuse system C has to be performed.

[1] The tests are listed in the order of useful test sequences.

8.5.5.1.1 Arrangement of the fuse

Fuse-rails are tested in a three-phase arrangement (single-phase testing with the three phases connected in series is possible with the consent of the manufacturer of a fuse-rail).

For fuse-rails, the test current is 50 kA and limited by gG fuse-links of the highest rating for the particular size. The cut-off currents may be below the values given in Table 112 of fuse system A.

The test set-up for fuse-rails is given in Figure 302.

The cross-sections of the busbars are taken from Figure 302 or corresponding to the manufacturer's instructions.

8.5.5.1.2 Test method

Subclause 8.5.5.1.2 of fuse system A applies with the following clarification: the test is performed on the three phases of one fuse-rail.

8.9 Verification of resistance to heat

See 8.9 of fuse system A.

8.9.1 Fuse-base

See 8.9.1 of fuse system A.

8.9.1.1 Test arrangement

See 8.9.1.1 of fuse system A.

8.9.1.2 Test method

See 8.9.1.2 of fuse system A.

8.9.1.3 Acceptability of test results

After this test, the contact pieces of the fuse-rail shall not have moved to such an extent as to affect the further use of the fuse-rail. After extracting the dummy, the dimensions of Figure 301 shall be considered. The insulating mounting part of the fuse-rail shall neither be broken nor shall it show any signs of cracks.

8.10 Verification of non-deterioration of contacts

Subclause 8.10 of fuse system A applies unless otherwise stated below.

8.10.1 Arrangement of the fuse

Subclause 8.10.1 of fuse system A applies with the following additions:

The three phases of one fuse-base rail according to Figure 301 are connected in series for the test. The test arrangement is given in Figure 302.

8.10.1.2 Direct terminal clamps

Subclause 8.10.1.2 of fuse system A applies with the following addition:

The test is performed on nine terminal clamps of three fuse-rails.

8.11.1.2 Mechanical strength of the fuse-base

Subclause 8.11.1.2 of fuse system A applies with the following addition:

The contact force is tested on all three phases of a new fuse-rail.

If the measured values are too low, the dynamic test in accordance with 8.5.5.1 (fuse system C) shall be performed.

8.11.2.4.1 Test method

Subclause 8.11.2.4.1 of fuse system A applies with the following clarification:

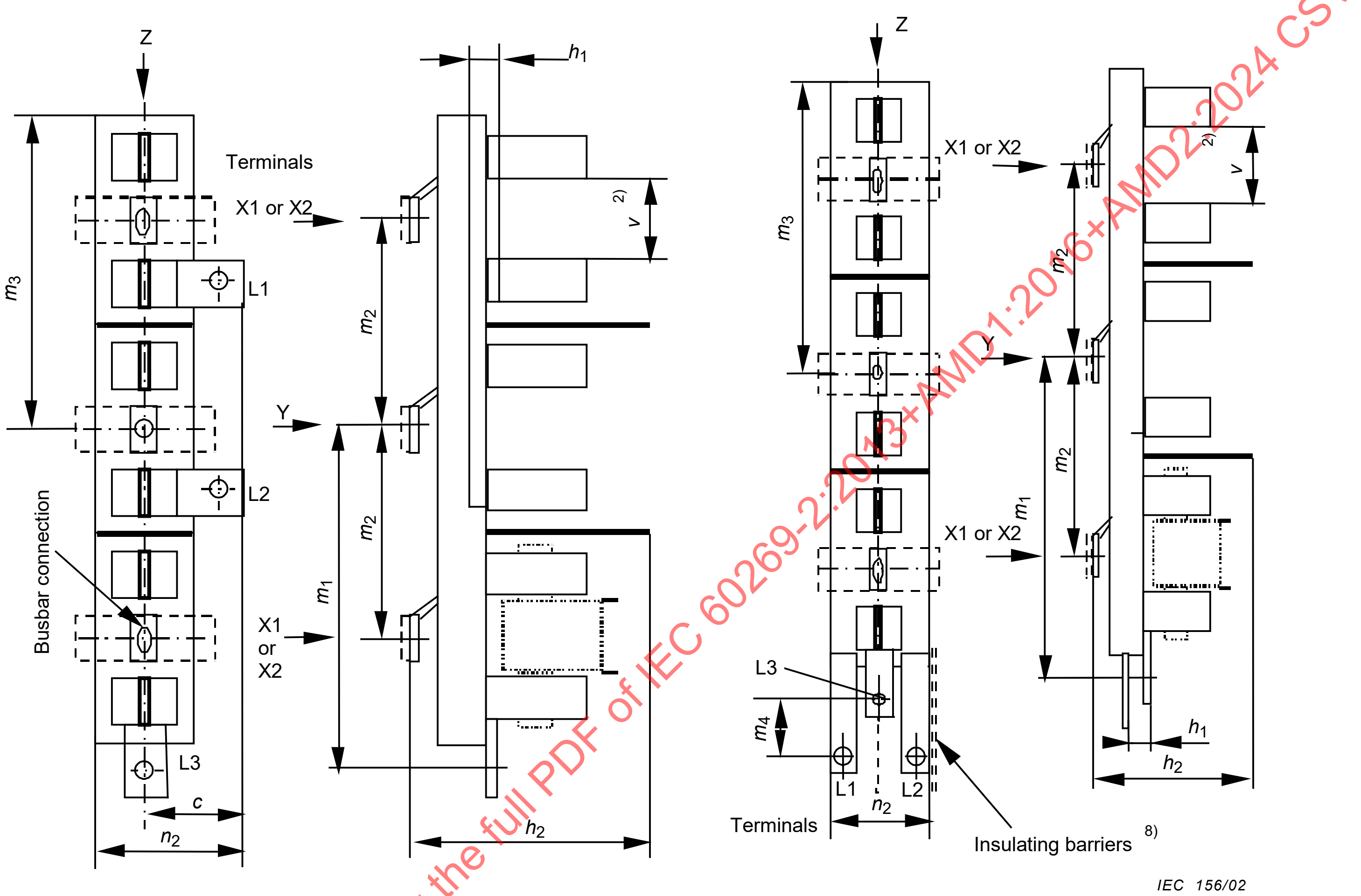
One fuse-rail is tested.

FIGURES

Dimensions in millimetres

Reference A fuse-rail
Terminals on the right

Reference B fuse-rail
Terminals at the bottom



Reference C fuse-rail, terminals only, remaining parts as reference B

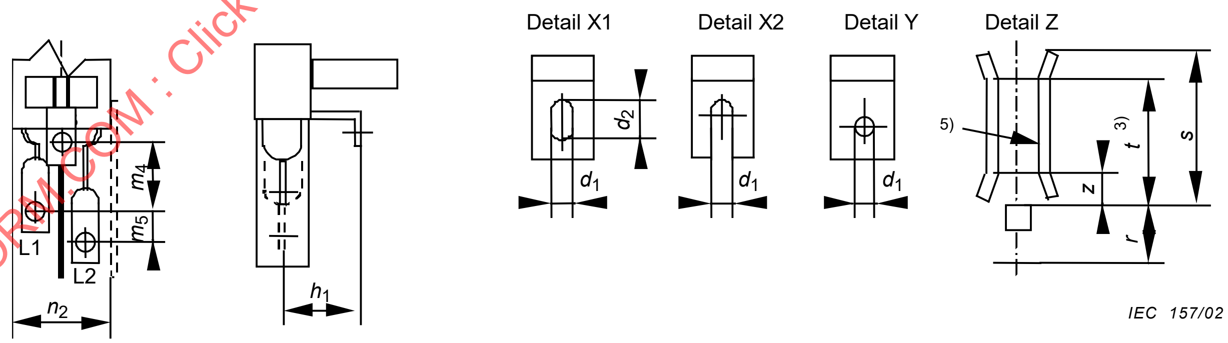
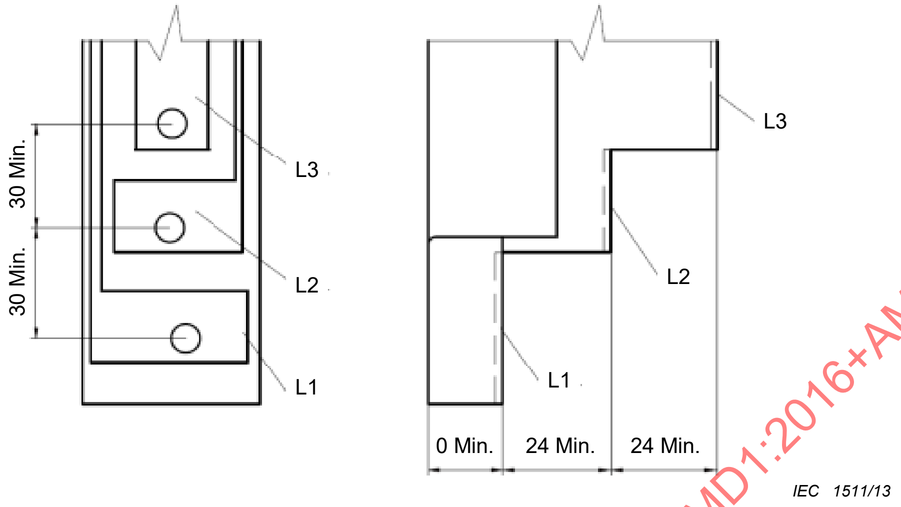


Figure 301 – Fuse-rails for fuse-links with blade contacts *(1 of 3)*

Reference D fuse-rail, size 00, terminals only, remaining parts as reference B



The drawings are not intended to govern the design of fuse-rails except as regards the notes and dimensions shown.

Figure 301 *(2 of 3)*

Dimensions in millimetres

Design	**Size**	**Busbar system** Centre distance	c max.	d_1 ±0,5	d_2 min.	h_1 min.	h_2[b] max.	m_1[a] +20 −5	m_2 ±2,5	m_3 max.	m_4 ±10	m_5 +15	n_2 max.	r min.	s max.	t min.	v	z max.
Reference A	00 [c]	100	40	9	16		90	155	100	165			70	17	21	15	56,5	3
	00 [c]	185					175	285	185	280							±1,5	
	1		60										100	17	38	21	80	
	2	185		14	22	35	175	285	185	280					46	27	±3	5
	3		65										110	20	58	33		
Reference B	00 [c]	100		9	16	10	90	155	100	165	30		60	17	21	15	56,5	3
	00 [c]	185					175	285	185	280							±1,5	
	1													17	38	21	80	
	2	185		14	22	40	175	285	185	280	50		100		46	27	±3	5
	3													20	58	33		
Reference C	00 [c]	100		9	16	25	90	155	100	165	30	25	60	17	21	15	56,5	3
	00 [c]	185					175	285	185	280							±1,5	
	1													17	38	21	80	
	2	185		14	22	40	175	285	185	280	40	55	80		46	27	±3	5
	3													20	58	33		

[a] Other dimensions are permitted and shall be mentioned in the type test report and in the manufacturer's literature.

[b] Maximum overall dimensions.

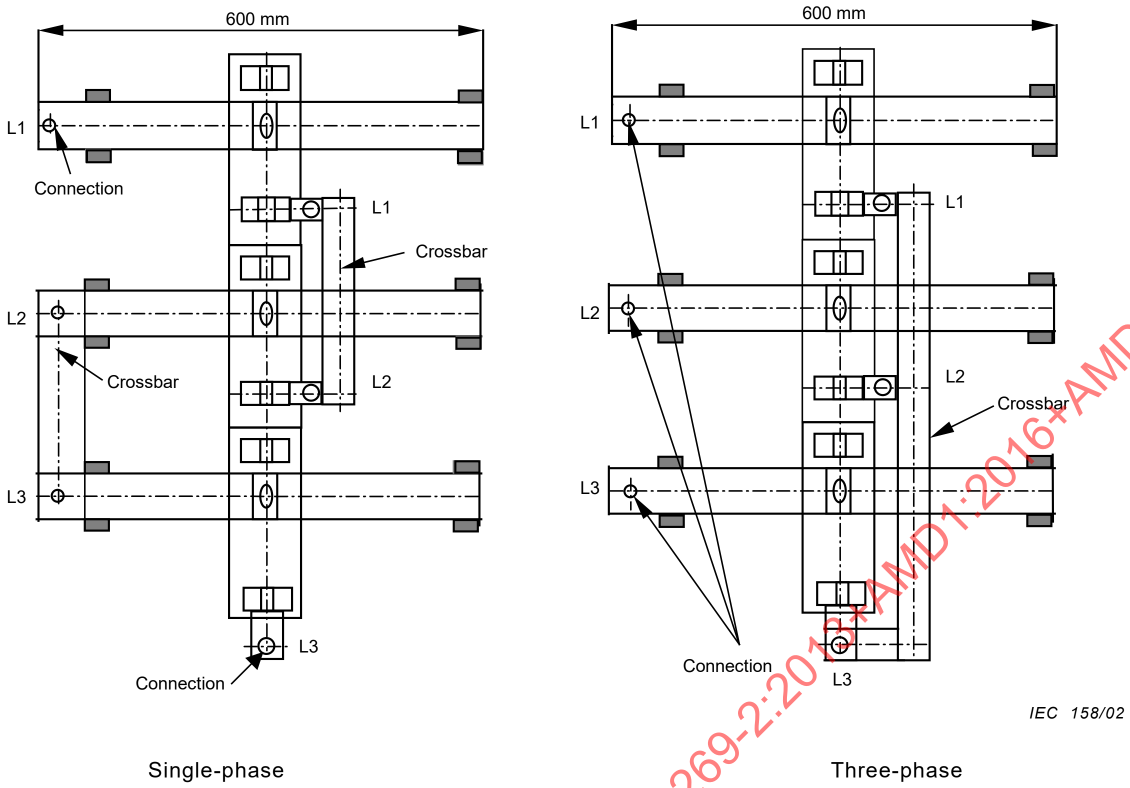
[c] Fuse-bases of size 00 are applicable for fuse-links of size 000 and size 00.

Size	**Rated current per phase** A	**Rated acceptable power dissipation** W
00	160	12
1	250	32
2	400	45
3	630	60

NOTE Footnotes 2), 3), 5) and 8) of Figure 102 apply.

Addition to footnote b – Dimension v may also be met between insulating contact covers.

Figure 301 *(3 of 3)*

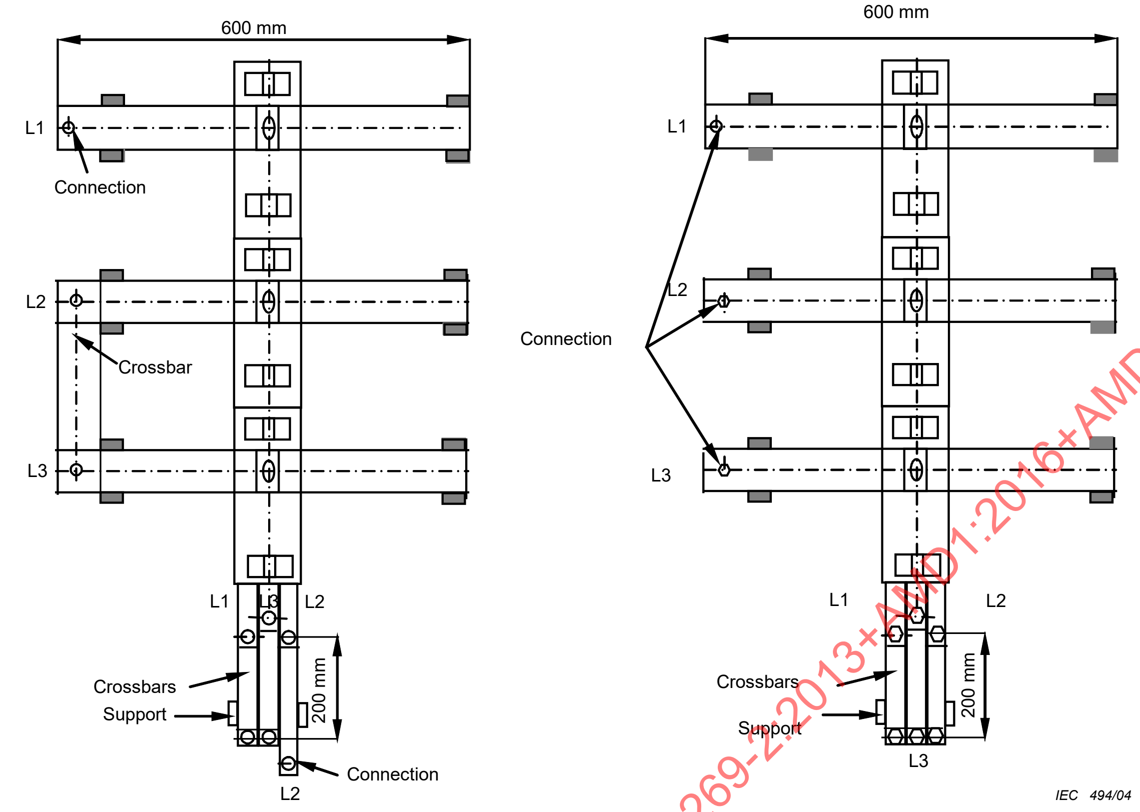


Design reference A

Cross-section of copper busbars:	30 mm or 32 mm × 5 mm for sizes 00 and 1 30 mm or 32 mm × 10 mm for size 2 40 mm × 10 mm for size 3
For tests according to 8.3.4.1 and 8.10:	connections according to 8.3.1 of IEC 60269-1
For test according to 8.5.5.1:	suitable crossbars and connections

The drawings are not intended to govern the design of fuse-rails except as regards the notes and dimensions shown.

Figure 302 – Test arrangement for fuse-rails *(1 of 2)*



Single-phase Three-phase

Design reference B and C

Cross-section of copper busbars:	30 mm or 32 mm × 5 mm for sizes 00 and 1 30 mm or 32 mm × 10 mm for size 2 40 mm × 10 mm for size 3
For tests according to 8.3.4.1 and 8.10:	cross-bars are replaced by connections according to 8.3.1 of IEC 60269-1
For test according to 8.5.5.1:	suitable crossbars and connections

Figure 302 *(2 of 2)*

Fuse system D –
Fuse-bases for busbar mounting (40 mm system)
(NH fuse system)

1 General

IEC 60269-1 applies with the following supplementary requirements.

1.1 Scope

The following additional requirements apply to combined single pole fuse-bases sizes 00 for busbar systems having a centre distance of 40 mm, insofar as they are not adequately covered by fuse system A. Single pole fuse-bases sizes 00 up to 4a for mounting on other busbar systems are treated like fuse-bases according to Figure 102.

The following characteristics of the fuses are specified in addition to IEC 60269-1:

- standard conditions of construction;
- acceptable power dissipation.

2 Terms and definitions

IEC 60269-1 applies with the following supplementary definition.

2.1.401
fuse-base for 40 mm busbar systems
combined single pole fuse-bases (Figure 401) that are fixed on a 40 mm busbar system by the use of special clamping means

Note 1 to entry: Such fuse-bases may be fitted together for a three-pole version (Figure 402) or a three-pole version with two outlets per pole, the latter named "tandem fuse-base" (Figure 403).

3 Conditions for operation in service

IEC 60269-1 applies.

4 Classification

IEC 60269-1 applies.

5 Characteristics of fuses

IEC 60269-1 applies with the following supplementary requirements.

5.2 Rated voltage

Subclause 5.2 of fuse system A applies.

5.3.2 Rated current

The rated current of tandem fuse-bases size 00 is 63 A for each outlet.

63 A is the preferred value for tandem fuse-bases as used in the incoming cable compartment of meter panels. Higher current ratings up to 2 × 160 A are permissible for other applications. They have to be marked accordingly and should be tested according to this standard.

5.5.2 Rated acceptable power dissipation of tandem fuse-bases

The rated acceptable power dissipation of tandem fuse-bases having a rated current of 63 A per outlet is 7,5 W per outlet.

6 Markings

IEC 60269-1 applies with the following supplementary requirements.

Clause 6 of fuse system A applies.

7 Standard conditions for construction

IEC 60269-1 applies with the following supplementary requirements.

7.1 Mechanical design

Dimensions of fuse-bases for the 40 mm busbar system are given in Figures 401, 402 and 403.

7.1.2 Connections, including terminals

Subclause 7.1.2 of fuse system A applies.

Terminals of 63 A tandem fuse-bases size 00 shall be capable of accepting conductors within the range of Table 401.

The manufacturer shall state in his documentation the dimensions and centre distances of the busbars for which the tandem fuse-bases can be used.

When the busbar contact is effected by clamping means, for example, by hook-shaped fasteners with a screw, it shall be assured by constructional means that the function of the contact-making element is not impaired.

NOTE Impairing of the function can be avoided when, for example, slotted socket-head cap screws according to ISO 1207 are used.

Table 401 – Minimum cross-sectional ranges of unprepared conductors for fuse-bases for busbar mounting

Size	Rated current of the fuse-bases A	Cross-sectional area range mm^2	
		Cu	Al
00	63	2,5 to 25	–

7.1.5 Construction of a fuse-base for busbar mounting

Busbar mounted fuse-bases according to Figures 401, 402 and 403 shall have partition walls between adjacent live parts. Fuse-bases should be designed in such a way that partition walls can subsequently be fixed. Measures shall be taken to fix outer walls if necessary.

It shall be possible to insert fuse-links into the fuse-bases and to pull them out by means of a replacement handle according to Figure 103.

It shall be possible to fix fuse-bases for busbar mounting by means of special clamps on 40 mm busbars systems with busbar dimensions 12 mm × 5 mm and/or 12 mm × 10 mm.

Constructional means shall be provided to ensure that the fuse-bases are retained on the busbars without the fastening and contacting screws being tightened.

The clamping screws of the clamping means as well as the terminal screws shall be accessible from the front.

The contact pieces shall be capable of accepting the blade contacts of fuse-links according to Figure 101. The contact pressure has to be guaranteed by spring loaded contact pieces or other adequate means.

Dimensions not given in Figures 401, 402 and 403 can be found in Figure 102.

7.2 Insulating properties and suitability for insulation

See 7.2 of fuse system A.

8 Tests

IEC 60269-1 applies with the following supplementary requirements.

8.3 Verification of temperature rise and power dissipation

Subclause 8.3 of fuse system A applies with the following additions.

8.3.1 Arrangement of the fuse

Subclause 8.3.1 of fuse system A applies with the following additions:

The test arrangements including the conductors are given in Figure 404 and 405. The cross-section of the busbar fitting with the contact system of the sample shall not be smaller than 12 mm × 5 mm. If the contact-making fastening of the fuse-base is achieved by screws, the torques given in Table 402 shall be applied.

Table 402 – Torques to be applied to contact making screws

I_n A	Size	Torque Nm
2 × 63	00	6

8.3.4.1 Temperature rise of the fuse-holder

Subclause 8.3.4.1 of fuse system A applies except that the dummy fuse-link size 00 63 A is described in Figure 407.

8.5.5.1.1 Arrangement of the fuse

The test arrangement in Figure 406 applies for fuse-bases for 40 mm busbar systems. These fuse-bases are always tested in a single-pole arrangement.

The cross-sections of the busbars are taken from Figure 406 or corresponding to the manufacturer's instructions.

For tandem fuse-bases the ranges of cut-off currents given in Table 403 apply.

Table 403 – Test currents

Size	Cut-off current kA
00	4 ... 5 [a]

[a] Preferred values for tandem performances 2 × 63 A in the lower connecting field of meter boards. For other performances with rated current 2 × 100 A a cut-off current between 9 kA and 11 kA is recommended.

8.9.1 Fuse-base

Subclause 8.9.1 of fuse system A applies as far as not otherwise stated below.

8.9.1.1 Test arrangement

The test arrangement for tandem fuse-bases is given in Figure 405. The dummy fuse-link is described in Figure 407. When tandem fuse-bases are tested, the measuring equipment is suspended in the middle upper current path. The tests are generally performed on busbars. The support insulators of the busbars are aligned with the width of the samples in such a way that bending of the busbars is avoided. The cross-section of the busbar shall correspond to the fastening means of the test sample, and the cross-section shall not be smaller than 12 mm × 5 mm. If the contact-making fastening is achieved by a screw, Table 402 applies.

8.9.1.3 Acceptability of test results

Subclause 8.9.1.3 of fuse system A applies with references to Figures 401 and 403.

8.10 Verification of non-deterioration of contacts

Subclause 8.10 of fuse system A applies as far as not otherwise stated below.

8.10.1 Arrangement of the fuse

Subclause 8.10.1 of fuse system A applies with the following additions:

The dummy fuse-link for size 00 63 A is described in Figure 407.

The torque of the contact-making fastening for fuse-bases on 40 mm busbar systems is taken from Table 402.

8.10.2 Test method

Subclause 8.10.2 of fuse system A applies with the following addition:

As far as single contact pieces of fuse-bases for 40 mm busbar systems are concerned, the tap points for resistance measurement shall lie as close as possible to the contact area.

8.11 Mechanical and miscellaneous tests

Subclause 8.11 of fuse system A applies.

8.11.1.2 Mechanical strength of the fuse-base

Subclause 8.11.1.2 of fuse system A applies with the following additions:

The contact force is tested on all outlets of one unused fuse-base. The withdrawal force shall be between the limits as given in Table 404.

Table 404 – Force to withdraw the fuse-link from the fuse-base contacts

Size	Rated current A	Withdrawal force F_{min} N	 F_{max} N
00	63	80	200 [a]

[a] Preferred values for tandem fuse-bases 2 × 63 A in the lower connecting field of meter boards. For other versions with rated current 2 × 100 A, F_{max} = 250 N per pole is recommended.

8.11.2.4.1 Test method

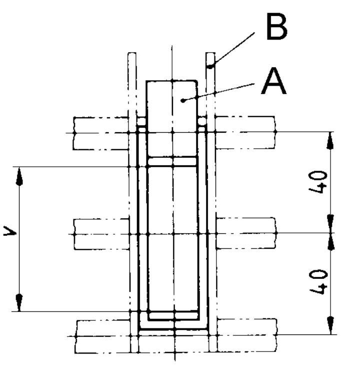
8.11.2.4.1 of fuse system A applies with the following clarification:

Three fuse-bases or one tandem fuse-base shall be tested.

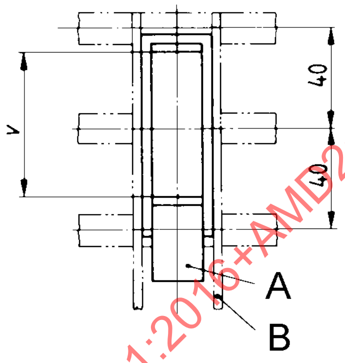
FIGURES

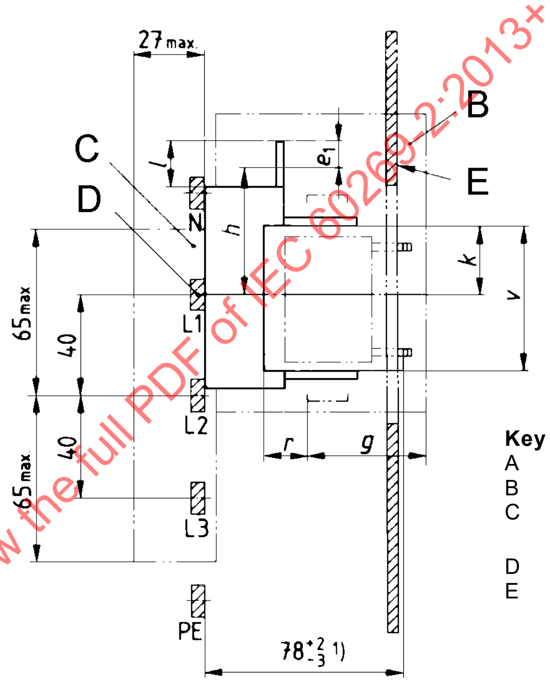
Dimensions in millimetres

Version O for top connection



Version U for bottom connection





Key

A connection strip

B partition wall

C area of live metal parts and other components

D contact area, see footnote 2)

E protection shield

IEC 1816/06

Size	a ±1	v	r min.	g ±1	h 3) +2 −4	k ±2,5	e_1 4)	l 4)
00 5)	33	56,5 ± 1,5	17	47	50	26,5	10	18

1) Dimension 78^{+2}_{-3} between the top edge of the busbar and bearing shoulder of the inserted fuse-link (see dimensions c_1 and e_3 according to Figure 101).

2) The busbar mounting base may rest on the busbars.

3) Preferred dimension for use in meter boards.

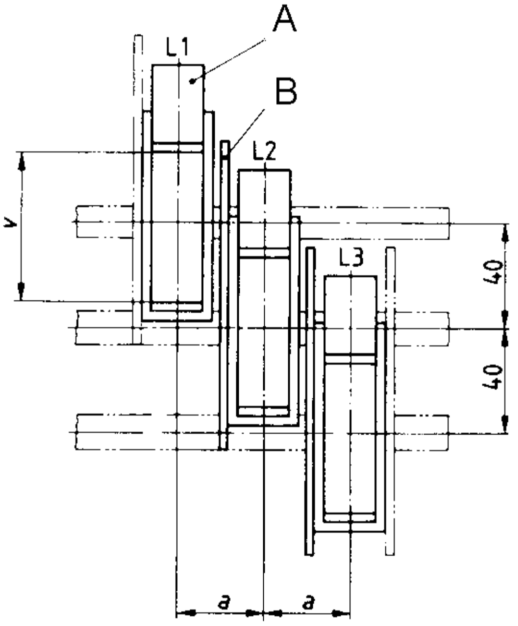
4) Only for flat connections.

5) Fuse-bases of size 00 are applicable for fuse-links of size 000 and size 00.

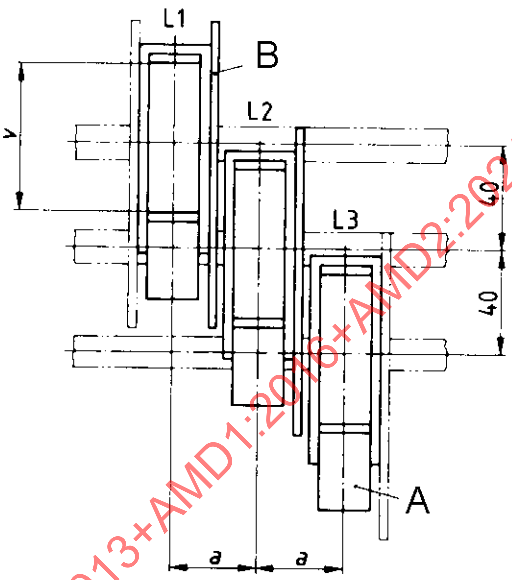
Figure 401 – Busbar mounting bases, 1 pole

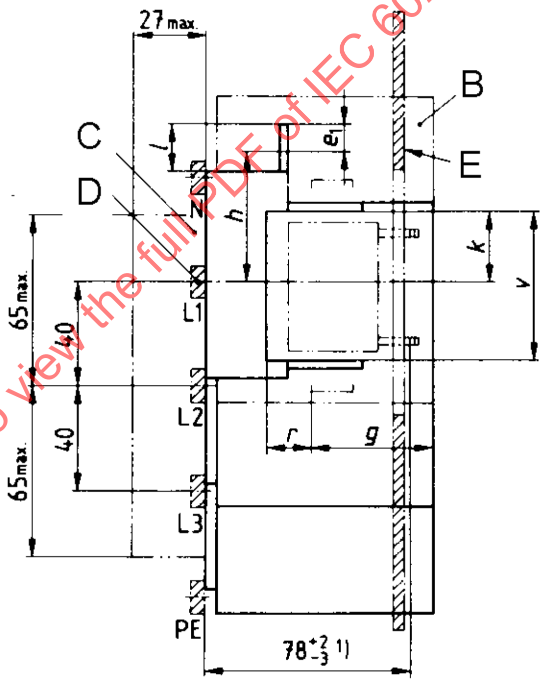
Dimensions in millimetres

Version O for top connection



Version U for bottom connection





Key

A connection strip
B partition wall
C area of live metal parts and other components
D contact area, see footnote 2)
E protection shield

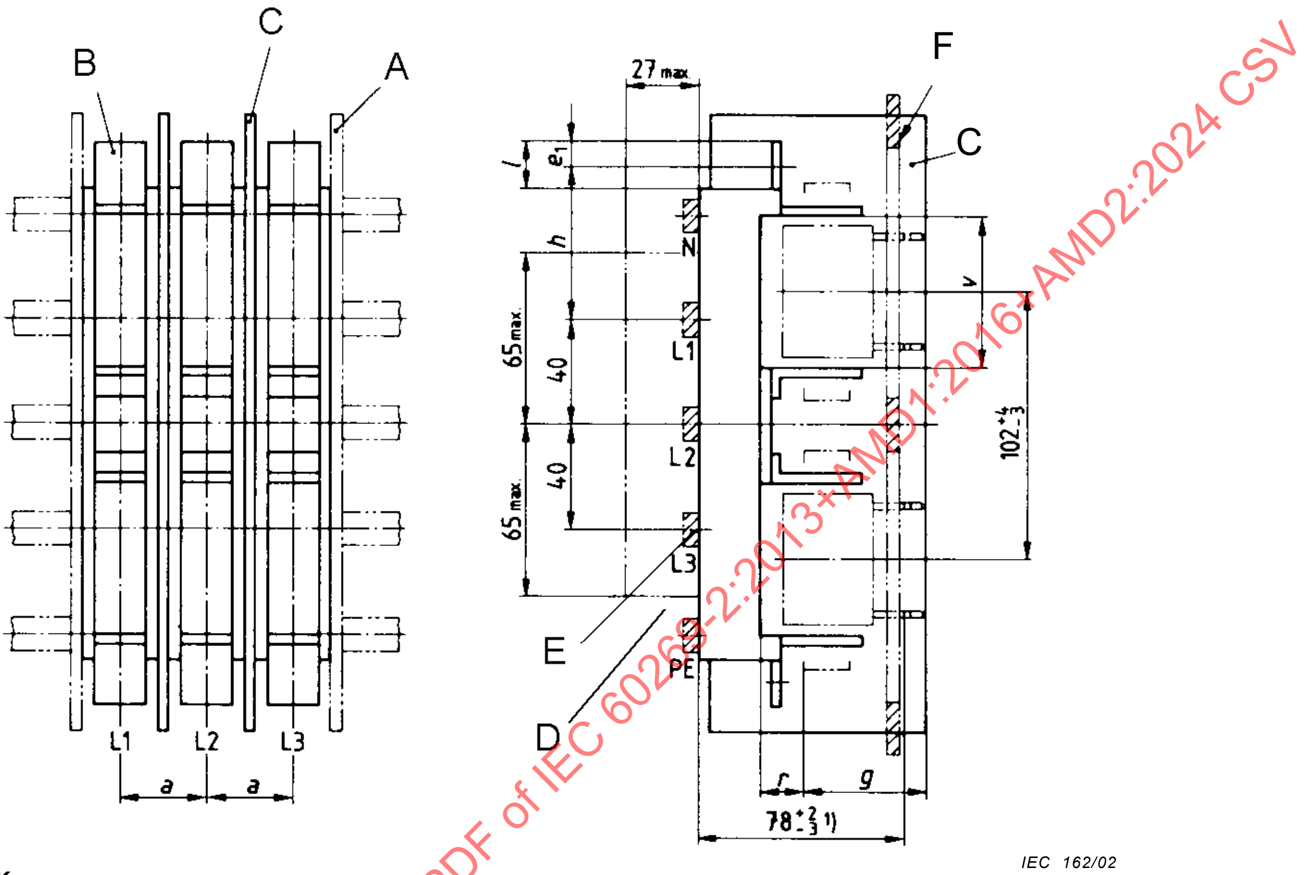
IEC 1817/06

Size	a ±1	v	r min.	g ±1	h 3) +2 −4	k ±2,5	e_1 4)	l 4)
00 5)	33	56,5 ± 1,5	17	47	50	26,5	10	18
NOTE For footnotes 1) to 5) see Figure 401.								

Figure 402 – Busbar mounting bases, 3 pole

Dimensions in millimetres

Versions O and U for top and bottom connection



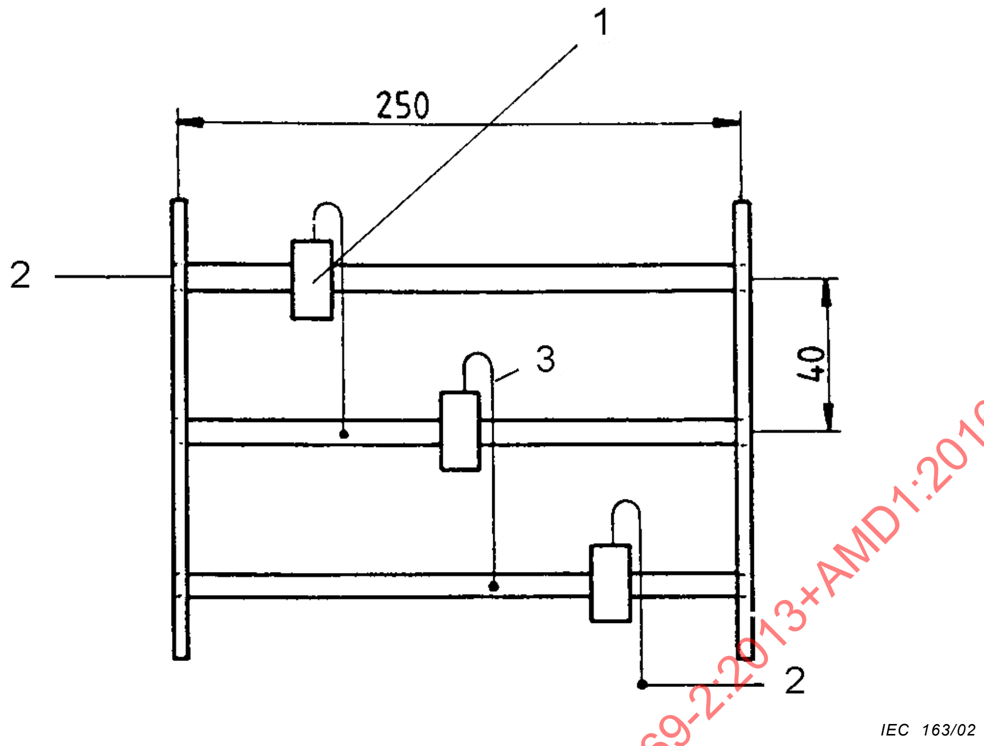
Key

A outer partition wall
B connection strip
C partition wall
D area of live metal parts and other components
E contact area, see footnote 2)
F protection cover

Size	*a* ±1	*v* ±1,5	*r* min.	*g* ±1	*h* 3) +2 −4	e_1 4)	*l* 4)
00 5)	33	56,5 ± 1,5	17	47	50	10	18
NOTE For footnotes 1) to 5), see Figure 401.							

Figure 403 – Busbar mounting base, size 00, 2 × 3 pole (tandem fuse-base)

Dimensions in millimetres



Key

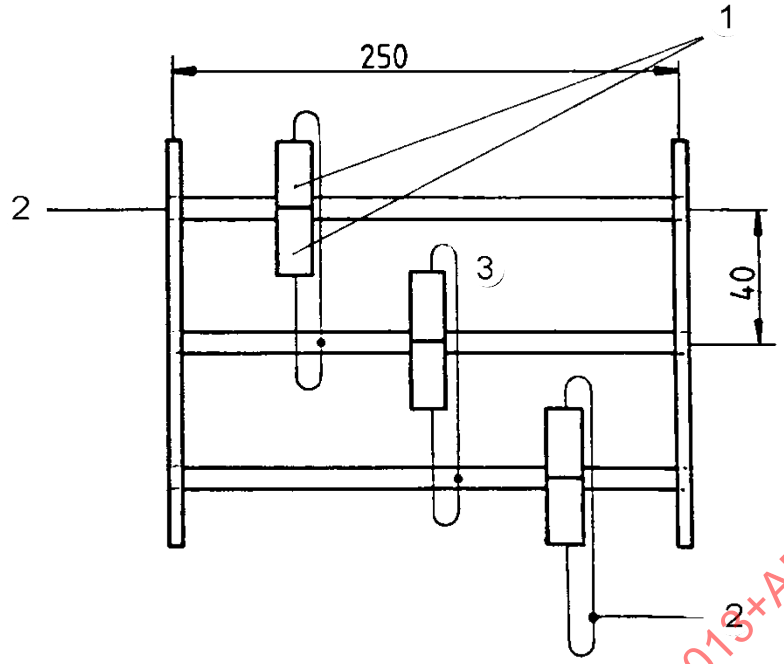
1 single pole (the three poles may be a unit)

2 connection

3 cable, length of each cable 1 m

Figure 404 – Test arrangement for single-pole and triple-pole fuse-bases for busbar-mounting according to 8.3.1

Dimensions in millimetres



Key

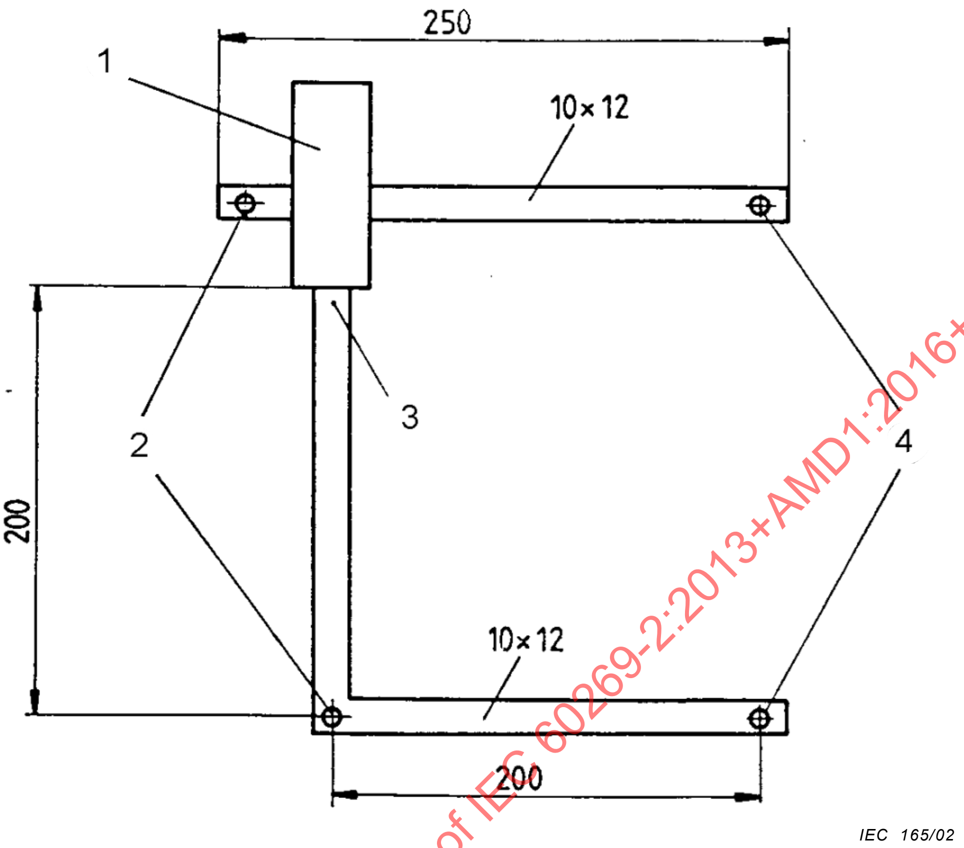
1 two single pole fuse-bases in tandem arrangement
(6 single-poles = 2 × 3 poles may be a unit)

2 connection

3 cable, length of each cable 1 m

Figure 405 – Test arrangement for two single-pole and six single-pole fuse-bases in tandem arrangement for busbar-mounting according to 8.3.1

Dimensions in millimetres



Key

1 single pole sample (or one pole of a multi-pole sample)

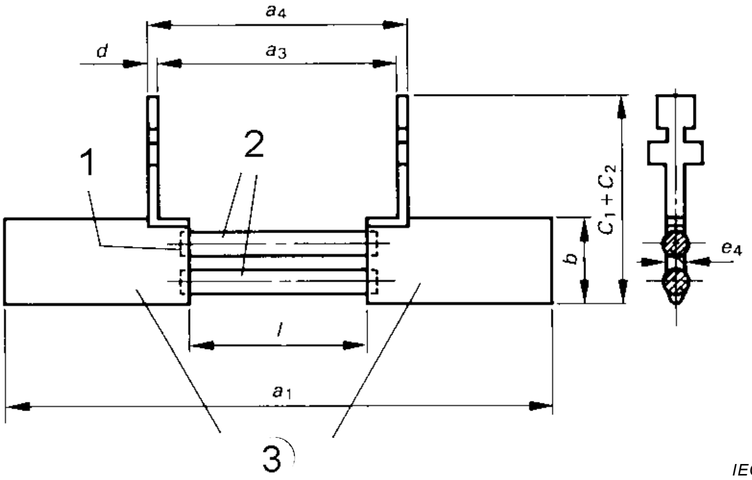
2 support

3 for clamp terminal an adaptor is demanded

4 source

Figure 406 – Test arrangement for the verification of the peak withstand current

Dimensions in millimetres



Key

1 soldered

2 CuMn12Ni

3 copper alloy, silver plated

For the dimensions of the gripping-lugs and other dimensions see Figure 101, in fuse system A.

Size	I_n A	l mm	P [a)] W	R [b)] mΩ	Bars	
					Number	Diameter mm
00	63	$30{,}5\ ^{+0}_{-3}$	7,5	1,88	1	3,5

a) At I_n shown in the second column.
b) Measured at the gripping-lugs; equalized with a tolerance of ±2 %.

Figure 407 – Dummy fuse-link

Fuse system E –
Fuses with fuse-links for bolted connections
(BS bolted fuse system)

1 General

IEC 60269-1 applies with the following supplementary requirements.

1.1 Scope

The following additional requirements apply to fuses with fuse-links having bolted connections. Such fuses have rated currents up to and including 1 250 A and rated voltages up to and including 690 V a.c. and up to and including 500 V d.c.

The following characteristics of the fuses are specified in addition to IEC 60269-1:

- minimum rated breaking capacities;
- time-current characteristics;
- I^2t characteristics;
- standard conditions of construction;
- power dissipation and acceptable power dissipation.

2 Terms and definitions

IEC 60269-1 applies.

3 Conditions for operation in service

IEC 60269-1 applies.

4 Classification

IEC 60269-1 applies.

5 Characteristics of fuses

IEC 60269-1 applies with the following supplementary requirements.

5.3.1 Rated current of the fuse-link

The maximum preferred rated currents are given in Figure 501.

5.3.2 Rated current of the fuse-holder

The maximum preferred rated currents for the fuse-holder are given in Figure 502.

5.5 Rated power dissipation of a fuse-link and rated acceptable power dissipation of a fuse-holder

The maximum values of power dissipation of fuse-links are given in Figure 501.

The values of rated acceptable power dissipation of fuse-holders at rated current when tested in accordance with 8.3.1 are given in Figure 502.

5.6 Limits of time-current characteristics

5.6.1 Time-current characteristics, time-current zones and overload curves

In addition to the limits of pre-arcing time given by the gates and the conventional times and currents, the time-current zones, excluding manufacturing tolerances, are given in Figures 503 and 504. The tolerance on time-current characteristics shall not deviate by more than ±10 % in terms of current.

5.6.2 Conventional times and currents

The conventional times and currents, in addition to the values of IEC 60269-1, are given in Table 501.

Table 501 – Conventional time and current for "gG" fuse-links

Rated current I_n A	Conventional time h	Conventional current	
		I_{nf}	I_f
$I_n < 16$	1	1,25 I_n	1,6 I_n

5.6.3 Gates

For "gG" fuse-links the gates given in Table 502 and in IEC 60269-1 apply.

Table 502 – Gates for specified pre-arcing times of "gG" fuse-links

I_n A	I_{min} (10 s) A	I_{max} (5 s) A	I_{min} (0,1 s) A	I_{max} (0,1 s) A
2	3,4	5,0	4,6	7,5
4	6,5	10,5	10,0	18,5
6	10,0	18,0	17,0	35,0
10	18,0	36,0	35,0	60,0

5.7.2 Rated breaking capacity

The rated breaking capacity shall be a minimum of 80 kA a.c. and 40 kA d.c.

6 Markings

IEC 60269-1 applies with the following supplementary requirements.

6.1 Markings of fuse-holders

In addition to IEC 60269-1, the following marking applies:

– size.

The marking of the rated current and the rated voltage shall be discernible from the front when a fuse-link has not been fitted.

6.2 Markings of fuse-links

In addition to IEC 60269-1, the following marking applies:

– size or reference;
– rated breaking capacity.

7 Standard conditions for construction

IEC 60269-1 applies with the following supplementary requirements.

7.1 Mechanical design

The dimensions of fuse-links and fuse-bases are given in Figures 501 and 502.

7.1.2 Connections including terminals

Under consideration.

7.2 Insulating properties and suitability for insulation

The creepage distances and clearances of fuse parts shall meet the requirements of IEC 60664-1 for overvoltage category III and degree of pollution 3.

7.9 Protection against electric shock

Where standardized fuse-holders according to Figure 502 are used, the degree of protection against electric shock shall be at least IP2X for all three stages.

8 Tests

IEC 60269-1 applies with the following supplementary requirements.

8.3 Verification of temperature rise and power dissipation

8.3.1 Arrangement of the fuse

The test arrangement for fuse-links is given in Figure 505. The test arrangement shall be mounted vertically.

8.3.3 Measurement of the power dissipation of the fuse-link

The points of measurement of power dissipation are given in Figure 505.

8.4 Verification of operation

8.4.1 Arrangement of the fuse

The test arrangement of the fuse-link is given in Figure 505. The test arrangement shall be mounted vertically.

8.5 Verification of breaking capacity

8.5.1 Arrangement of the fuse

The test arrangement of the fuse-link is given in Figure 506.

8.5.8 Acceptability of test results

The requirements of IEC 60269-1 apply and in addition fuse-links shall operate without the melting of the fine fuse wire and without mechanical damage to the rig.

8.9 Verification of resistance to heat

Fuse-holders fitted with fuse-links having the maximum power dissipation corresponding to the acceptable power dissipation of the fuse-holder shall be cyclically loaded as pre-treatment. The pre-treatment is specified in 8.4.3.2 of IEC 60269-1. After cooling to normal temperature, the breaking capacity shall be tested at I_1 in accordance with 8.5.

Fuse-links containing organic material in the body or filler shall be subjected to the same test as described above. These fuse-links shall interrupt the test currents I_1 and I_5.

8.10 Verification of non-deterioration of contacts

Subclause 8.10 of IEC 60269-1 applies.

8.10.1 Arrangement of the fuse

Subclause 8.10.1 of IEC 60269-1 applies with the following addition.

The dummy fuse-links shall have dimensions that comply with Figure 501 for those references that are accommodated in the standardized fuse-holders in Figure 502.

The power dissipation of the dummy fuse-links shall be the rated acceptable power dissipation of the fuse-holders given in Figure 502 when tested in the standardized power dissipation test rig given in Figure 505.

The dummy fuse-links shall be so constructed that they do not operate during the passage of the overload current I_{nf}.

8.10.2 Test method

Subclause 8.10.2 of IEC 60269-1 applies with the following addition:

The following wording is added after the first paragraph of 8.10.2 in IEC 60269-1.

The following test values have to be applied:

Test current: conventional non-fusing current I_{nf}

Load period: 25 % of the conventional time

No-load period: 10 % of the conventional time

A test voltage lower than the rated voltage may be used.

8.10.3 Acceptability of the results

After 250 cycles, the measured temperature-rise values shall not exceed the temperature rise measured at the beginning of the tests by more than 15 K.

After 750 cycles, if necessary, the temperature shall not exceed the values measured before the beginning of the tests by more than 20 K.

8.11 Mechanical and miscellaneous tests

8.11.1.1 Mechanical strength of fuse-holders

The fuse-holder, fitted with a fuse-link of the largest rated current and power dissipation that can be accommodated by the fuse-holder, shall be subjected to a temperature rise test at rated current.

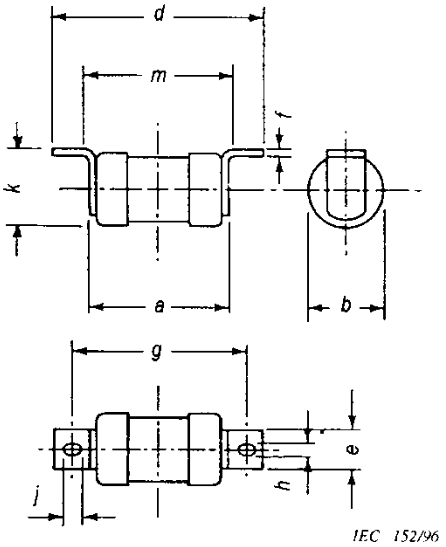
At the conclusion of the temperature rise test, the fuse-link or the fuse-carrier as appropriate, shall be withdrawn and inserted into the fuse-base 100 times.

At the conclusion of these tests, all parts shall be intact and shall function normally.

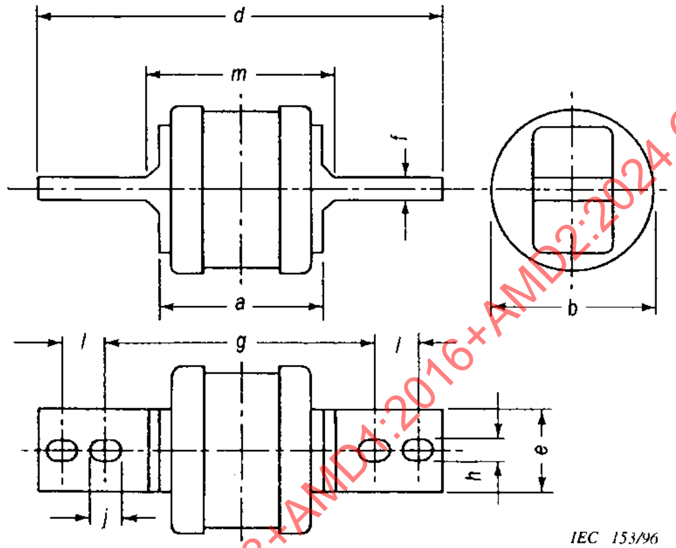
Compliance shall be verified by a further temperature rise test at rated current at the conclusion of which the values obtained shall be not more than 5 K or 15 % (whichever is greater) above the values obtained from the temperature-rise test prior to the commencement of the mechanical test.

Dimensions in millimetres

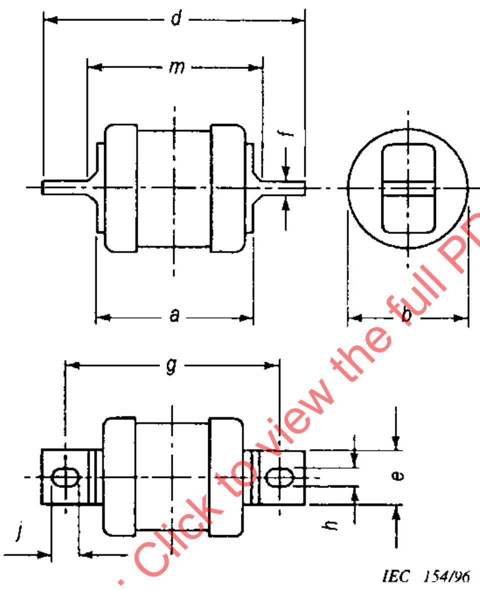
FIGURES



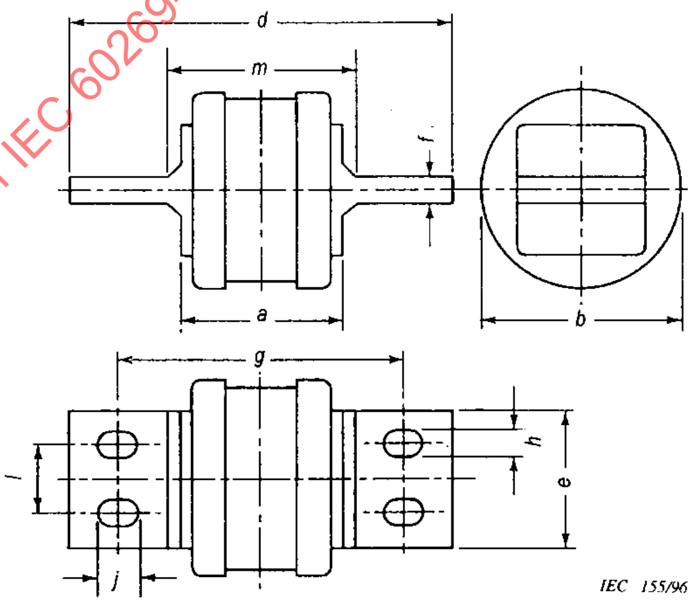
Size A fuse-link



Size C fuse-link



Size B fuse-link



Size D fuse-link

The drawings are not intended to govern the design of fuse-links except as regards the notes and dimensions shown.

Figure 501 – Fuse-links for bolted connection – Sizes A, B, C and D *(1 of 2)*

Size	Maximum rated current A	Maximum power dissipation W	*a* (max.) a,b	*b* (max.)	*d* (max.)	*e* (max.) c	*f* (max.) c		*g* (nom.)	*h* (nom.)	*j* (min.) b,d	*k* (max.)	*l* (nom.) a	*m* (max.)
A1	20	2,7	36,5	14,5	56	11,2	0,8	1,5	44,5	4,2	5,5	14,5	–	36,5
A2	32	4,4	57	24	86	9,2	0,8	1,5	73	5,5	7	25,5	–	60
A3	63	6,9	58	27	91	13	1,2	1,6	73	5,5	7	28	–	61
A4	100	9,1	70	37	111	20	2,4	3,2	94	8,7	9,5	38,5	–	74
B1	100	9,1	70	37	138	20	3,2	4	111	8,7	11	–	–	82
B2	200	17	77	42	138	20	3,2	4	111	8,7	11	–	–	82
B3	315	32	77	61	138	26	3,2	4,8	111	8,7	11	–	–	82
B4	400	40	83	66	138	26	4,8	6,6	111	8,7	11	–	–	89
C1	400	40	83	66	212	26	4,8	6,6	133	10,3	11	–	25,4	95
C2	630	55	85	77	212	26	6,3	7,8	133	10,3	11	–	25,4	95
C3	800	70	89	84	212	39	9,5	11,1	133	10,3	12,5	–	25,4	101
D1	1 250	100	89	102	200	64	9,5	12,7	149	14,3	16,5	–	31,8	95

[a] In all sizes, dimension *a* includes any projections such as rivet heads, but the design of the tags between dimensions *a* and *m* is limited by a line drawn at 45° to the contact surface.

[b] All fixing holes are elongated as indicated by *j*, to allow for manufacturing tolerances on dimension *a*.

[c] Dimensions *e* and *f*, are nominal material sizes and subject to manufacturing tolerances as specified in the relevant standards for the raw materials.

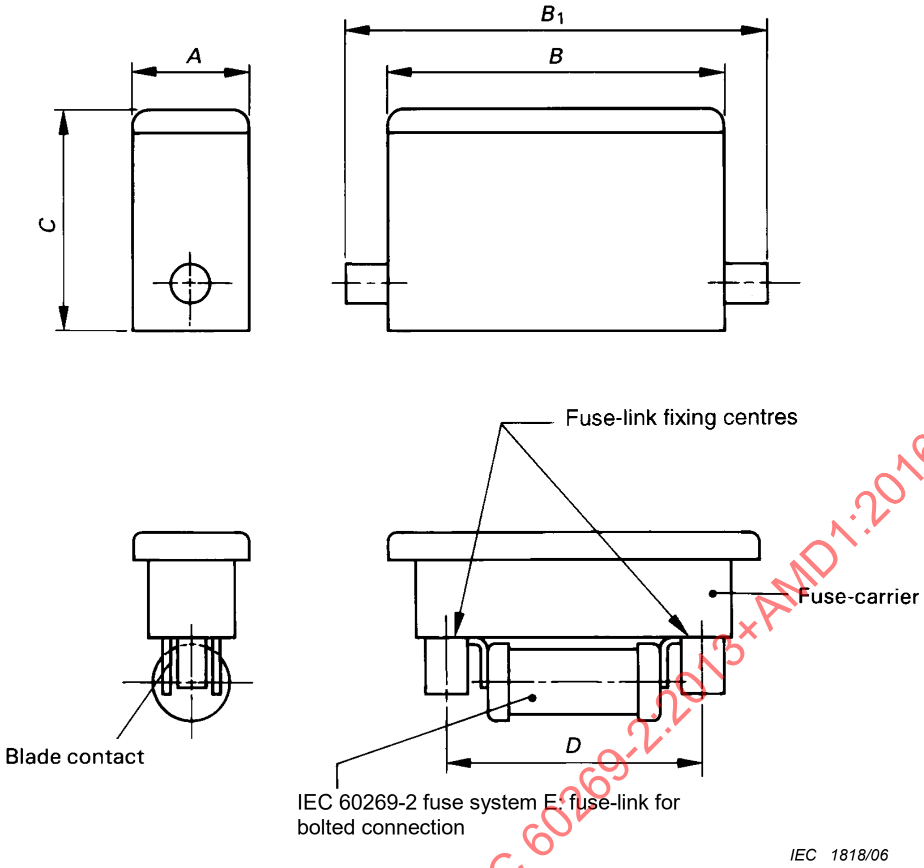
[d] For A1 to A4 size fuse-links, the fixing slots may be extended either axially or laterally to form open-ended slots.

Standardized "gM" fuse-links

Size	Standardized ratings	Current rating A	Characteristic rating A
A1	20M25	20	25
A1	20M32	20	32
A2	32M40	32	40
A2	32M50	32	50
A2	32M63	32	63
A3	63M80	63	80
A3	63M100	63	100
A4 and B1	100M125	100	125
A4 and B1	100M160	100	160
A4 and B1	100M200	100	200
B2	200M250	200	250
B2	200M315	200	315

NOTE The power dissipation of "gM" fuse-links is lower than the values given for "gG" fuse-links in the same dimensional references.

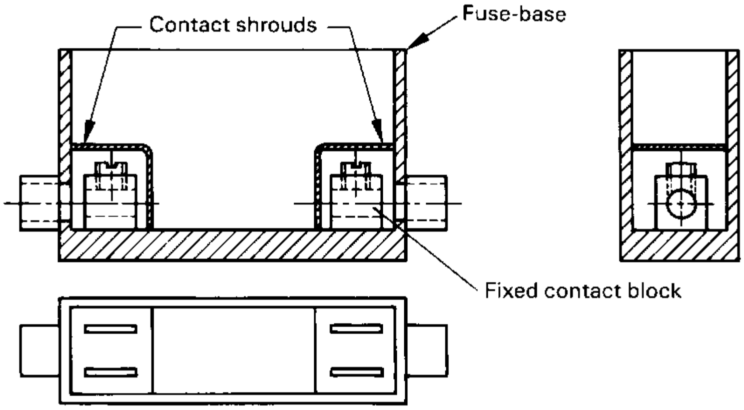
Figure 501 *(2 of 2)*



Dimensions in millimetres

NOTE The fuse-carrier can accommodate centre tag or offset tag fuse-links.

Figure 502 – Typical fuse-holder *(1 of 2)*



Dimensions in millimetres

NOTE Apertures in shrouds to give a degree of protection of IP2X (IEC 60529).

Maximum rated current A	**Rated acceptable power dissipation** W	*A* max.	*B* max.	B_1 max.	*C* max.	*D*	**Fuse-link accommodated, size**
20	2,7	30	91	110	62	44,5	A1
32	4,4	35	114	134	75	73	A2
63	6,9	47	140	140	91	73	A3
100	9,1	61	175	175	121	94	A4
200	17,0	86	233	310	159	111	B1 + B2

This drawing is included by way of illustration only and does not prejudice the use of other shapes or forms provided they fall within the dimensions listed above.

Figure 502 *(2 of 2)*

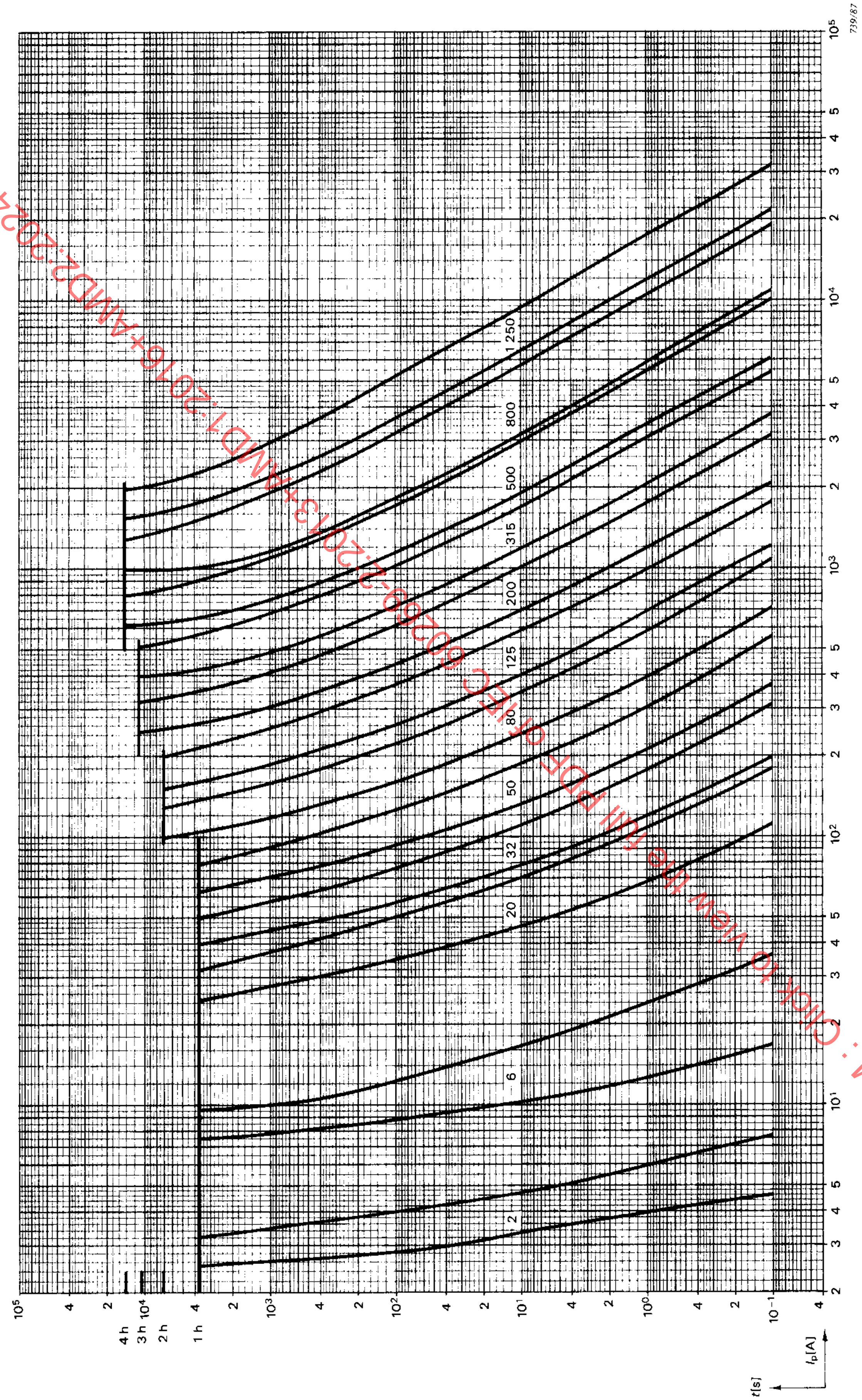


Figure 503 – Time-current zones for "gG" fuse-link

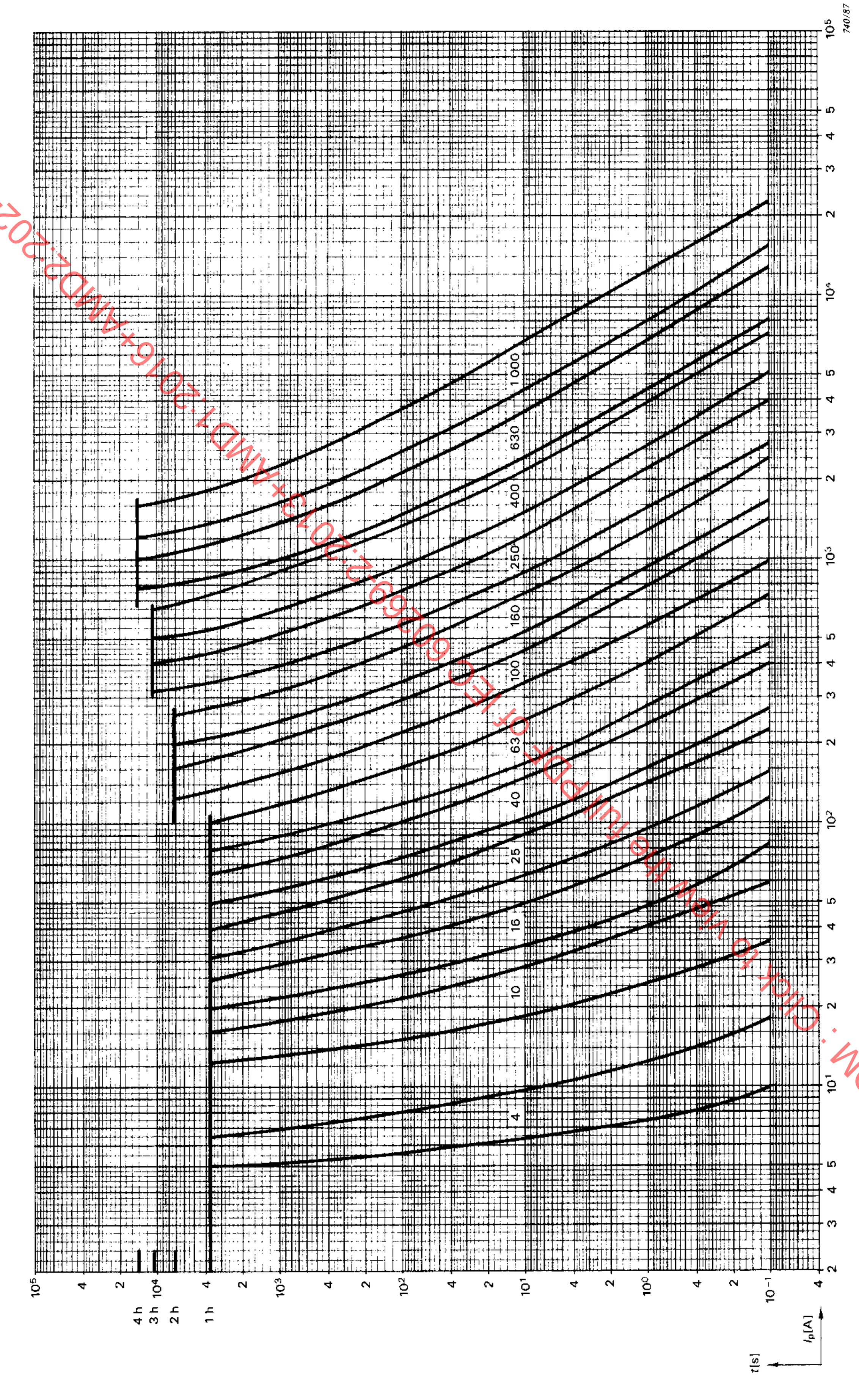
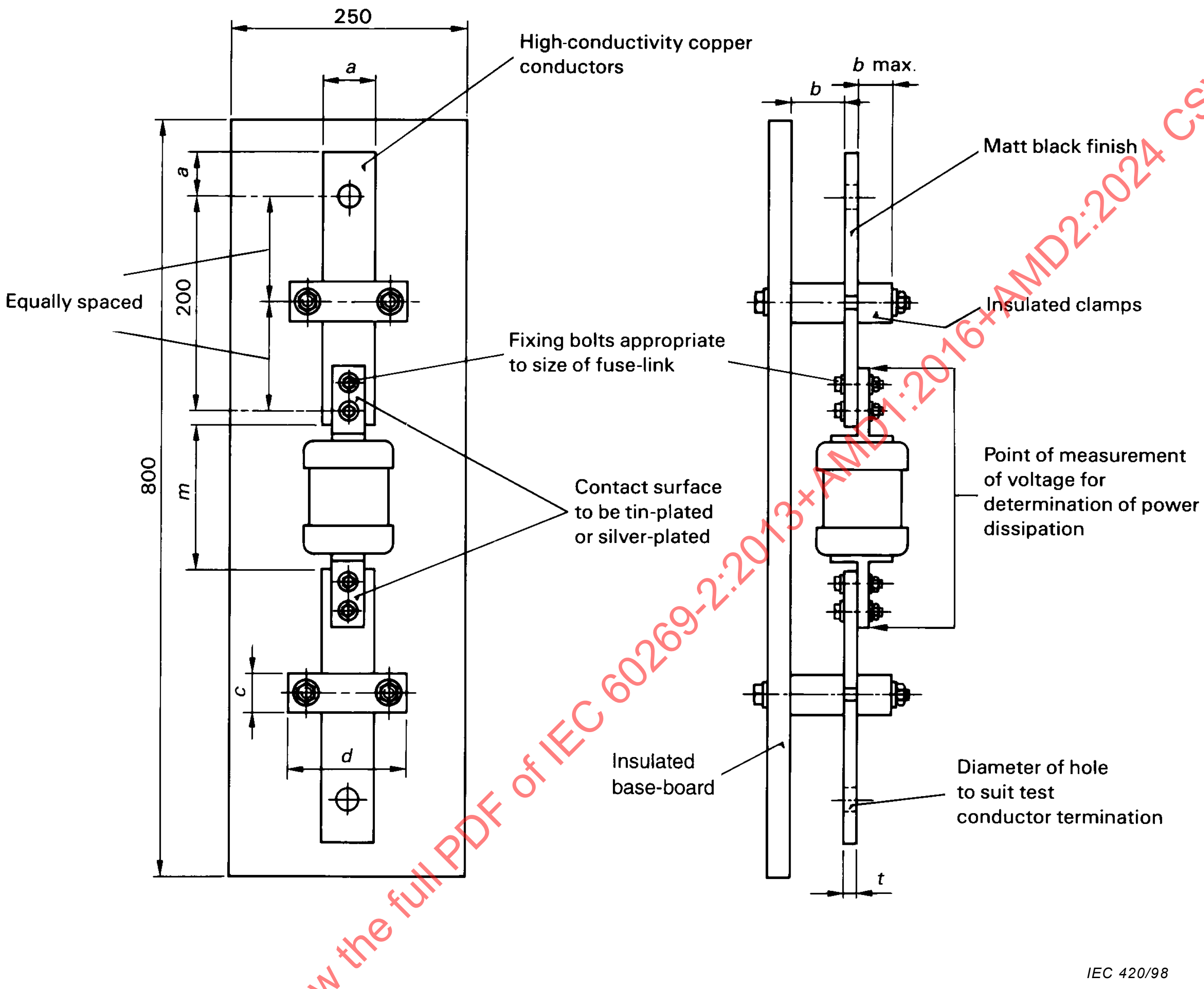


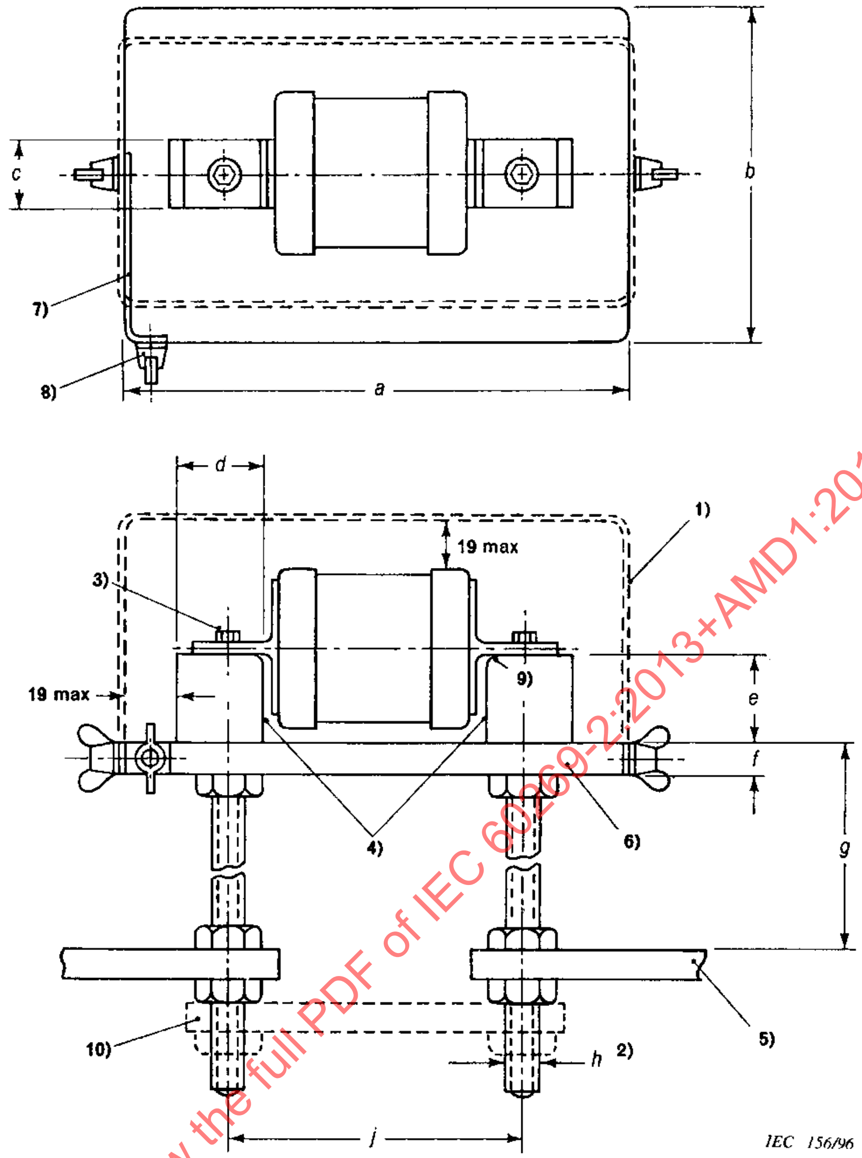
Figure 504 – Time-current zones for "gG" fuse-link

Dimensions in millimetres



Fuse-link Size	Dimensions						Current rating in A up to
	a	*b*	*c*	*d*	*m*	*t*	
A1	10	12,5	16	50	38	0,5	20
A2	10	12,5	16	50	61	0,5	32
A3	16	12,5	16	50	62	1,0	63
A4	20	25	25	70	75	1,6	100
B1	20	25	25	70	83	1,6	100
B2	20	25	25	70	83	5	200
B3	25	38	25	80	83	8	315
B4	25	38	25	80	90	10	400
C1	25	38	25	80	96	10	400
C2	32	38	25	80	96	12	630
C3	40	45	32	100	101	12	800
D1	80	60	45	160	96	10	1 250
NOTE Approximate dimensions are acceptable.							

Figure 505 – Power dissipation test rig



Dimensions in millimetres

Fuse-link, size	Current rating up to A	Dimensions								
		a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*j*
A1 to A4 B1 to B4	400	187	127	25	36,5	38	12	114	M12	111
C1 to C3	800	248	140	38	51	50	20	114	M20	159
D1	1 250	305	152	63	83	57	20	114	M24	159

Figure 506 – Breaking capacity test rig for fuse-links for bolted connection *(1 of 2)*

1) Detachable cover fabricated from woven wire cloth, mild steel sheet or perforated mild steel sheet of such thickness as to ensure reasonable rigidity. Individual apertures in the wire cloth or perforated steel sheet shall not exceed 8,5 mm^2 in area. The cover may differ in section from that shown on the drawings provided that the clearance of 19 mm between the cover and live metal parts is not exceeded.

2) Connecting studs of high conductivity copper.

3) Fixing centres; for A1 to A3 fuse-links, suitable adapters of minimum section 25 mm × 6,3 mm shall be used.

4) A visible gap at this position is essential to ensure that the end caps are not supported by the contact blocks.

5) The arrangement of the test connections beyond the test rig is not specified (the second paragraph of 8.5.1 of IEC 60269-1 does not apply).

The size of the copper conductors shall be selected according to the rated breaking capacity.

6) The base shall be made from phenolic resin bonded laminated sheet having a cross-breaking strength of not less than 85 MPa.

7) Copper strip.

8) Terminal for fine fuse-wire. Fine copper fuse wire of approximately 0,1 mm diameter, with a free length not less than 50 mm long connected between this terminal and one pole of the test supply.

9) Chamfer.

10) Short-circuiting link required for prospective current test. This may be slotted for easy disconnection.

The size of the copper link shall be selected according to the rated breaking capacity.

Figure 506 *(2 of 2)*

Fuse system F – Fuses with fuse-links having cylindrical contact caps (NF cylindrical fuse system)

1 General

IEC 60269-1 applies with the following supplementary requirements.

1.1 Scope

The following additional requirements apply to ~~fuses with~~ fuse-links having cylindrical caps with or without striker, complying with the dimensions specified in Figures 601 and 603. Such fuses ~~for~~ have rated currents not exceeding 125 A and ~~for~~ rated voltages up to and including ~~690~~ 1 000 V a.c. or ~~440~~ 1 500 V d.c.

The following characteristics of the fuses are specified in addition to IEC 60269-1:

- minimum rated breaking capacities;
- time-current characteristics;
- I^2t characteristics;
- standard conditions of construction;
- power dissipation and acceptable power dissipation.

2 Terms and definitions

IEC 60269-1 applies.

3 Conditions for operation in service

IEC 60269-1 applies.

4 Classification

IEC 60269-1 applies.

5 Characteristics of fuses

IEC 60269-1 applies with the following supplementary requirements.

5.2 Rated voltage

For a.c. the standard values of rated voltage are 400 V, 500 V and 690 V. For d.c. the rated voltages are 250 V, 440 V and 500 V. The standard values of d.c. rated voltage are not related to the standard values of a.c. rated voltage. For example the following standard combinations are possible: 500 V a.c. and 440 V d.c., 690 V a.c. and 440 V d.c., etc.

5.3.1 Rated current of the fuse-link

The maximum rated currents of the fuse-link are given in Table 601. These values depend upon utilization categories and rated voltages.

Table 601 – Maximum rated current of fuse-links with cylindrical caps

Size	400 V a.c		500 V a.c		690 V a.c.	
	gG	aM	gG	aM	gG	aM
	I_n A	I_n A	I_n A	I_n A	I_n A	I_n A
8 × 32	25	12				
10 × 38	32	32	25	20	16	12
14 × 51			50	50	50	40
22 × 58			100	100	80	80
NOTE Fuse-links with higher rated currents can exist.						

5.3.2 Rated current of the fuse-holder

The maximum rated currents of the fuse-holder are given in Table 602.

Table 602 – Maximum rated current of fuse-holders

Size	I_n A
8 × 32	25
10 × 38	32
14 × 51	50
22 × 58	100
The use of fuse-links having higher rated currents should be as agreed by the manufacturer and the user.	

5.5 Rated power dissipation of a fuse-link and rated acceptable power dissipation of a fuse-holder

The maximum values of the rated power dissipation of fuse-links are specified in Table 603.

Table 603 – Maximum values of the rated power dissipation of a fuse-link

	gG		gG		gG		aM		aM		aM	
Size	400 V a.c.		500 V a.c.		690 V a.c.		400 V a.c.		500 V a.c.		690 V a.c.	
	I_n A	P_n W	I_n A	P_n W	I_n A	P_n W	I_n A	P_n W	I_n A	P_n W	I_n A	P_n W
8 × 32	20 25	2,3 2,5					10 12	0,6 0,8				
10 × 38	32	3,0	20 25	2,8 3,0	16	2,2	25 32	1,3 2,0	16 20	1 1,2	12	0,9
14 × 51			50	5,0	40 50	4,6 5,0			40 50	2,9 3,2	32 40	2,3 2,9
22 × 58			100	9,5	63 80	7,3 8,5			100	7,0	63 80	5,3 6,8

NOTE The power dissipation represents the maximum power dissipation of the fuse-link and at the same time the minimum power acceptance to be tolerated by the fuse-base or fuse-holder.

The rated acceptable power dissipation of fuse-bases is given in Table 604.

Table 604 – Rated acceptable power dissipation of a fuse-holder

Size	8 × 32	10 × 38	14 × 51	22 × 58
Rated acceptable power dissipation	2,5 W	3 W	5 W	9,5 W

5.6 Limits of time-current characteristics

5.6.1 Time-current characteristics, time-current zones and overload curves

When applicable, the time-current zones given in Figure 104 of fuse system A of this standard, including manufacturing tolerances shall be met by all pre-arcing and operating times measured during the tests.

5.6.2 Conventional times and currents

The conventional times and currents, in addition to the values of IEC 60269-1, are given in Table 605.

Table 605 – Conventional time and current for "gG" fuse-links with rated current lower than 16 A

Rated current I_n A	Conventional time h	Conventional current I_{nf}	Conventional current I_f
$I_n \leq 4$ A	1	1,5 I_n	2,1 I_n
$4 < I_n < 16$	1	1,5 I_n	1,9 I_n

5.6.3 Gates

For "gG" fuse-links the gates given in Table 606 apply, in addition to the gates of IEC 60269-1.

Table 606 – Gates for specified pre-arcing and operating times of "gG" fuse-links with rated current lower than 16 A

I_n A	I_{min} (10 s) A	I_{max} (5 s) A	I_{min} (0,1 s) A	I_{max} (0,1 s) A
2	3,7	9,2	6,0	23,0
4	7,8	18,5	14,0	47,0
6	11,0	28,0	26,0	72,0
8	16,0	35,2	41,6	92,0
10	22,0	46,5	58,0	110,0
12	24,0	55,2	69,6	140,4

5.7.2 Rated breaking capacity

The minimum rated breaking capacities are specified in Table 607.

Table 607 – Minimum rated breaking capacities

Rated voltage	Minimum rated breaking capacities
≤ 500 V a.c	100 kA
500 < U_n ≤ 690 V a.c.	50 kA
≤ 750 V d.c.	25 kA

6 Markings

IEC 60269-1 applies with the following supplementary requirements.

Fuse-links and fuse-holders which meet the requirements and tests of this fuse system may be marked with IEC 60269-2.

6.1 Markings of fuse-holders

In addition to IEC 60269-1, the following marking applies:

– size.

6.2 Markings of fuse-links

In addition to IEC 60269-1, the following marking applies:

– size or reference;
– rated breaking capacity.

The fuse-links shall be marked as described in Table 608.

Table 608 – Marking of fuse-links

Characteristic	gG		aM	
Colour of marking	Black		Green	
Kind of print	Strip with inverse print	Normal print	Strip with inverse print	Normal print
Voltage V				
400	x		x	
500		x		x
690	x		x	

7 Standard conditions for construction

IEC 60269-1 applies with the following supplementary requirements.

7.1 Mechanical design

The dimensions of fuse-links and fuse-bases are given in Figures 601 and 603.

The fuse-links with strikers shall also comply with the dimensions given in Figure 602.

7.1.2 Connections including terminals

The terminals shall be capable of accepting the following cross-sections in Table 609.

Table 609 – Minimum range of cross-sections for rigid copper conductors

Size	8 × 32	10 × 38	14 × 51	22 × 58
Cross-section mm^2	1,5 to 4	1,5 to 6	2,5 to 16	4 to 50

Examples of terminals are given in IEC 60999-1 and IEC 60999-2.

7.2 Insulating properties and suitability for insulation

The creepage distances and clearances of fuse parts shall meet the requirements of IEC 60664-1 for overvoltage category III and degree of pollution 3.

7.7 I^2t characteristics

For the fuse-links covered by this fuse system the maximum pre-arcing I^2t values given in Table 7 of IEC 60269-1 apply for the maximum operating I^2t values. Values of rated currents lower than 16 A are given in Table 610.

Table 610 – Pre-arcing and operating I^2t values at 0,01 s for “gG” fuse-links

I_n A	Pre-arcing I^2t_{min} A^2s	Operating I^2t_{max} A^2s
2	1	23
4	6	90
6	24	225
8	49	420
10	100	576
12	160	750

The maximum operating I^2t values for “aM” fuse-links are specified in Table 611 on the test-voltage of 1,1 × U_n and test no. 2 of the largest rated current of each homogeneous series (Table 20 of IEC 60269-1).

Table 611 – Maximum operating I^2t values for “aM” fuse-links

Rated voltage U_n V	I^2t_{max} A^2s
$U_n \leq 400$	18 I_n^2
$400 < U_n \leq 500$	24 I_n^2
$500 < U_n \leq 690$	35 I_n^2
NOTE For a voltage of 230 V a.c. the maximum I^2t value is 12 I_n^2.	

These values apply for the prospective currents corresponding to pre-arcing times less than 0,01 s.

7.8 Overcurrent discrimination of "gG" fuse-links

Fuse-links in series with rated current ratio of 1:1,6 and rated current 16 A and above have to discriminate up to the values specified in 8.7.4.

7.9 Protection against electric shock

Protection against electric shock can be increased by means of partition walls and covers of the fuse-contacts.

8 Tests

IEC 60269-1 applies with the following supplementary requirements.

8.1.6 Testing of fuse-holders

In addition to the test given in IEC 60269-1, the fuse-holders shall be subjected to the tests according to Table 612.

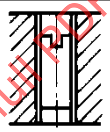
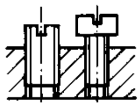
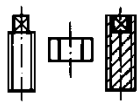
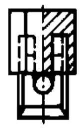
Table 612 – Survey of tests on fuse-holders and number of fuse-holders to be tested

Test according to subclause		Number of fuse-holders				
		3	1	1	1	5
8.5.5.1	Verification of the peak withstand current of a fuse-base		X	X		
8.9	Verification of resistance to heat				X	
8.10	Verification of non-deterioration of contacts					X
8.11.1.1	Mechanical strength of fuse-holders	X				

8.3.1 Arrangement of the fuse

The screws of the terminals are to be fastened by applying a torque which is given in Table 613.

Table 613 – Torque to be applied to the terminal screws

Nominal diameter of thread mm	Torque Nm I	 II	 III	 IV	 V
					
Up to and including 2,8	0,2	–	0,4	0,4	–
Over 2,8 up to and including 3,0	0,25	–	0,5	0,5	–
Over 3,0 up to and including 3,2	0,3	–	0,6	0,6	–
Over 3,2 up to and including 3,6	0,4	–	0,8	0,8	–
Over 3,6 up to and including 4,1	0,7	1,2	1,2	1,2	1,2
Over 4,1 up to and including 4,7	0,8	1,2	1,8	1,8	1,8
Over 4,7 up to and including 5,3	0,8	1,4	2,0	2,0	2,0
Over 5,3 up to and including 6,0	1,2	1,8	2,5	3,0	3,0
Over 6,0 up to and including 8,0	2,5	2,5	3,5	6,0	4,0
Over 8,0 up to and including 10,0	–	3,5	4,0	10,0	6,0
Over 10,0 up to and including 12,0	–	4,0	–	–	8,0
Over 12,0 up to and including 15,0	–	5,0	–	–	10,0

The conductor is moved each time the screw or nut is loosened.

Column I applies to screws without heads if the screw, when tightened, does not protrude from the hole, and to other screws which cannot be tightened by means of a screwdriver with a blade wider than the diameter of the screw.

Column II applies to nuts of mantle terminals which are tightened by means of a screwdriver.

Column III applies to other screws which are tightened by means of a screwdriver.

Column IV applies to screws and nuts other than nuts of mantle terminals, which are tightened by means other than a screwdriver.

Column V applies to nuts of mantle terminals which are tightened by means other than a screwdriver.

8.3.4.1 Temperature-rise of the fuse-holder

The dummy fuse shall have the dimensions indicated in Figure 601 and the rated power dissipation indicated in Table 604.

8.3.4.2 Power dissipation of a fuse-link

The points between which the power dissipation of a fuse-link is preferably measured are marked with S in Figure 601.

8.4.3.6 Operation of indicating devices and strikers, if any

Subclause 8.4.3.6 of IEC 60269-1 applies with the following addition:

The projection of the striker before operation (S_0) shall not exceed 1 mm; after operation, it shall be between 7 mm and 10 mm (S_1). See Figure 602.

The force of the striker on all points between its final limits shall be at least 2,5 N and shall not exceed 20 N at the end of the travel.

After operation, the striker shall remain captive.

The fuse-links with striker may have no indicating device other than a striker.

8.5.5.1 Verification of the peak withstand current of a fuse-base

Verification of the peak withstand current of a fuse-base need not be carried out, if this has already been verified during the breaking capacity test of the fuse-links with the highest rating of the size, providing the cut-off current is within the values given in Table 614.

8.5.5.1.1 Arrangement of the fuse

The test shall be of the single-phase type. The test set-up for the fuse-base shall be in line with 8.5.1 of IEC 60269-1.

8.5.5.1.2 Test method

The current shall be limited by a fuse-link of the highest rating for the particular size. The peak values of the test currents attained must lie in the ranges shown in Table 614.

Table 614 – Test currents

Size	Cut-off current kA
8 × 32	3 … 4
10 × 38	5 … 6
14 × 51	13 … 16
22 × 58	17 … 21

The maximum values may be exceeded as long as the requirements stated under 8.5.5.1.3 are met.

If the cut-off current range cannot be attained with the highest rating for the size, a correspondingly higher series-connected fuse shall be used. In this case, the test specimen shall be equipped with a dummy fuse-link. Its external dimensions correspond to the dimension given in Figure 601.

8.5.5.1.3 Acceptability of test results

The fuse-links shall not be ejected. There shall be no signs of arcing or welding or other damage likely to prevent further use of the fuse-bases. Pitting marks on the contacts are permissible.

8.7.4 Verification of overcurrent discrimination

The overcurrent discrimination for fuses with rated current up to 12 A and the overcurrent discrimination ratio of 1:1,6 for fuses with rated current higher than 12 A is verified by the I^2t values evaluated from the recorded test results.

The samples are arranged as for the breaking capacity test according to 8.5 and Table 20 of IEC 60269-1 regarding the test circuit and tolerance of current.

Four samples are tested, two samples are tested at the r.m.s. prospective test current I, corresponding to the minimum pre-arcing I^2t values, the other samples at the r.m.s. prospective test current I, corresponding to the operating I^2t values.

~~The test voltage for 690 V a.c. fuses is 1,05 × U_n / $\sqrt{3}$.~~

~~The test voltage for all other fuses is 1,1 × U_n / $\sqrt{3}$.~~

The test voltage for all fuses is $\frac{1{,}1 \cdot U_n}{\sqrt{3}}$ with tolerances of –3 % / +2 %.

Table 615 – Test currents and I^2t limits for discrimination test

I_n A	Minimum pre-arcing I^2t		Maximum operating I^2t		Discrimination ratio
	Prospective I r.m.s. kA	I^2t A^2s	Prospective I r.m.s. kA	I^2t A^2s	
2	0,013	0,67	0,064	16	Can be calculated
4	0,035	4	0,130	67	
6	0,064	16	0,220	193	
8	0,100	40	0,310	390	
10	0,130	67	0,400	640	
12	0,180	130	0,450	820	
16	0,270	291	0,550	1 210	1: 1,6
20	0,400	640	0,790	2 500	
25	0,550	1 210	1,000	4 000	
32	0,790	2 500	1,200	5 750	
40	1,000	4 000	1,500	9 000	
50	1,200	5 750	1,850	13 700	
63	1,500	9 000	2,300	21 200	
80	1,850	13 700	3,000	36 000	
100	2,300	21 200	4,000	64 000	
125	3,000	36 000	5,100	104 000	

The evaluated I^2t values shall lie within the corresponding I^2t limits specified in Table 615.

8.9 Verification of resistance to heat

These tests apply to fuse-links and fuse-bases. Fuse-holders fitted with fuse-links having the maximum power dissipation corresponding to the power acceptance of the fuse-holder shall be cyclically loaded as pre-treatment. The pre-treatment is specified in 8.4.3.2 of IEC 60269-1. After cooling to normal temperature the breaking capacity shall be tested at I_1 in accordance with 8.5.

Fuse-links containing organic material in the body or filler shall be subjected to the same test as describe above. These fuse-links shall interrupt the test currents I_1 and I_5.

8.10 Verification of non-deterioration of contacts

Subclause 8.10 of IEC 60269-1 applies.

8.10.1 Arrangement of the fuse

Subclause 8.10.1 of IEC 60269-1 applies with the following addition:

The dummy fuse shall have the dimensions indicated in Figure 601 and have the rated power dissipation equal to the values given for the relevant dimensions in Table 604.

8.10.2 Test method

Subclause 8.10.2 of IEC 60269-1 applies with the following additions:

The following test values shall be applied:

Test current:	conventional non-fusing current I_{nf}
Load period:	25 % of the conventional time
No-load period:	10 % of the conventional time

A test voltage lower than the rated voltage may be used.

8.10.3 Acceptability of test results

After 250 cycles, the measured temperature-rise values shall not exceed the temperature-rise measured before the beginning of the tests by more than 15 K.

After 750 cycles, if necessary, the temperature-rise values shall not exceed the temperature-rise measured before the beginning of the tests by more than 20 K.

8.11.1.1 Mechanical strength of fuse-holders

The fuse-holder, fitted with a fuse-link of the largest rated current and power dissipation that can be accommodated by the fuse-holder, shall be subjected to a temperature-rise test at rated current.

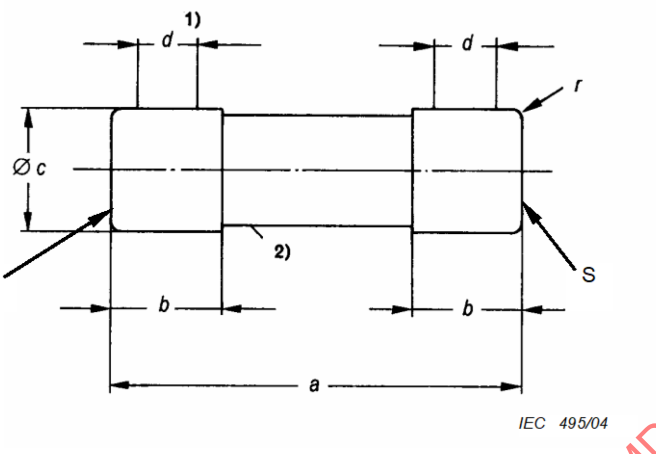
At the conclusion of the temperature-rise test, the fuse-link or the fuse-carrier, as appropriate, shall be withdrawn and inserted into the fuse-base 100 times.

At the conclusion of these tests, all parts shall be intact and shall function normally.

Compliance shall be verified by a further temperature rise test at rated current at the conclusion of which the values obtained shall be not more than 5 K or 15 % (whichever is greater) above the values obtained from the temperature rise test prior to the commencement of the mechanical test.

Dimensions in millimetres

FIGURES



Measuring points S according to 8.3.4.2

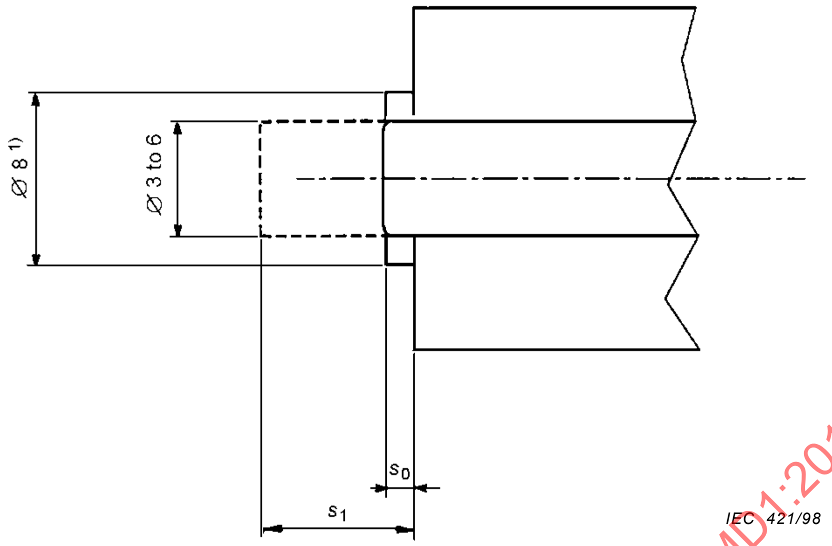
The drawings are not intended to govern the design of fuse-links except as regards the notes and dimensions shown.

1) Cylindrical part within which the specified tolerances shall not be exceeded.

2) The diameter of the fuse-link between the end caps shall not exceed diameter *c*.

Size	*a*	*b* max.	*c*	*d* min.	*r*
8 × 32	31,5 ± 0,5	6,7	8,5 ± 0,1	4	1 ± 0,5
10 × 38	~~38 ± 0,6~~ +0,9 /−0,6	10,5	10,3 ± 0,1	6	1,5 ± 0,5
14 × 51	$51^{+0,6}_{-1}$	13,8	14,3 ± 0,1	7,5	2 ± 1
22 × 58	$58^{+0,1}_{-2}$	16,2	22,2 ± 0,1	11	2 ± 1

Figure 601 – Fuse-links with cylindrical caps



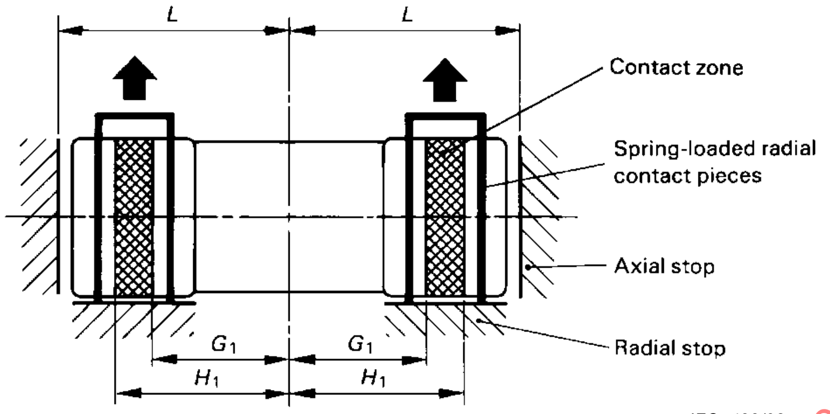
Dimensions in millimetres

NOTE The drawings are not intended to govern the design of fuse-links except as regards the notes and dimensions shown.

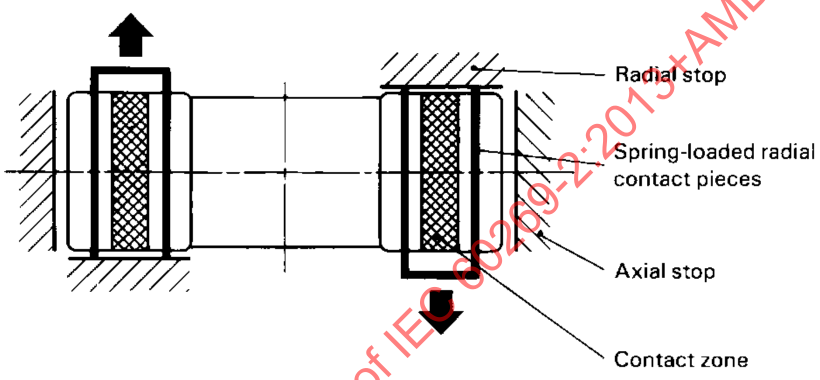
1) Diameter of cylinder in which the striker shall stay.

Figure 602 – Fuse-links with cylindrical contact caps with striker – Additional dimensions for sizes 14 × 51 and 22 × 58 only

Base **A** *Contact on two cylindrical caps*



Base **B** *Contact on two cylindrical caps*

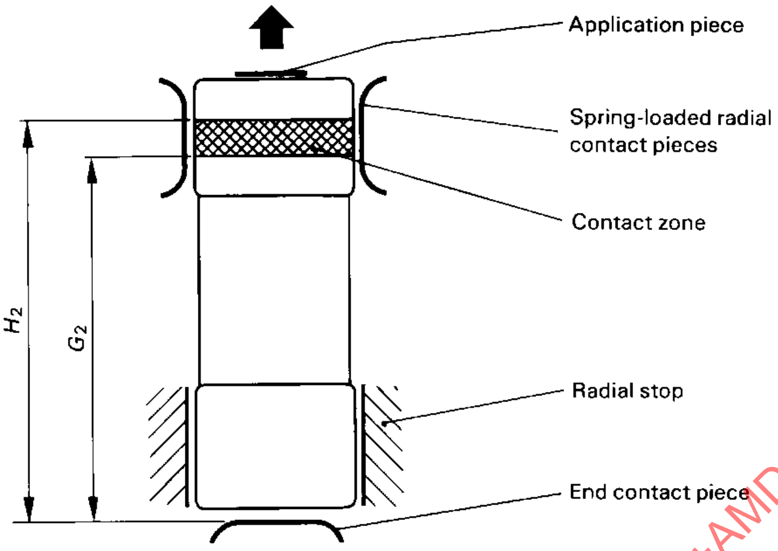


Dimensions in millimetres

Size	I_n A	G_1 max.	H_1 min.	$L\ ^{+0,8}_{0}$
8 × 32	~~16~~ 25	11,5	14	16
10 × 38	~~25~~ 32	13	15,5	19,3
14 × 51	50	18	20,5	25,8
22 × 58	100	18	25	29

Figure 603 – Base for fuse-links with cylindrical caps *(1 of 2)*

Base C *One contact on a cylindrical surface, the other contact on an end surface*



Dimensions in millimetres

Size	I_n A	G_2 max.	H_2 min.
8 × 32	16	26,5	29,5
10 × 38	25	31,5	34,5
14 × 51	50	43	47
22 × 58	100	46	52

The drawings are not intended to govern the design of fuse-links except as regards the notes and dimensions shown.

1) The contacts shall be made within the contact zones shown on the fuse-links. For sizes 14 × 51 and 22 × 58, the contact forces shall be provided by an external spring (for sizes 8 × 32 and 10 × 38, the elasticity of the contact pieces themselves is sufficient). The elastic properties and coating of the contact pieces shall remain stable when subjected to the thermal and mechanical stresses reasonably to be expected in practice.

2) Axial stops, application pieces and contact pieces shall be so constructed as not to interfere with the operation of any indicating devices or strikers which may be incorporated in the fuse-link.

3) At least one of the contact pieces, or in the case of base C, the application piece, shall be sufficiently elastic (with external springs for sizes 14 × 51 and 22 × 58) in the direction of the arrow, taking into account the axial tolerances of the dimensions of the fuse-links.

4) Contact shall be ensured in the zones provided by means of radial stops situated in the vicinity of the contact pieces of the fuse-link.

➡ Indicates the direction in which the fuse-link is withdrawn.

Figure 603 *(2 of 2)*

Fuse system G – Fuses with fuse-links with offset blade contacts (BS clip-in fuse system)

1 General

IEC 60269-1 applies with the following supplementary requirements.

1.1 Scope

The following requirements apply to fuses with fuse-links having offset blade contacts. Such fuses have rated currents up to and including 125 A and rated voltages up to and including 400 V a.c.

NOTE These fuses are intended for use on systems employing the future standardised voltage of 230/400 V a.c. that will evolve from the existing nominal 220/380 V and 240/415 V systems. However many countries are still using the higher voltage of 240/415 V a.c. and therefore these fuses will continue to be supplied and tested as 240 V a.c. or 415 V a.c. rating until such time as all supplies have evolved to the recommended values of 230 V and 400 V.

The following characteristics of the fuses are specified in addition to IEC 60269-1:

- minimum rated breaking capacities;
- time-current characteristics;
- I^2t characteristics;
- standard conditions of construction;
- power dissipation and acceptable power dissipation.

2 Terms and definitions

IEC 60269-1 applies.

3 Conditions for operation in service

IEC 60269-1 applies.

4 Classification

IEC 60269-1 applies.

5 Characteristics of fuses

IEC 60269-1 applies with the following supplementary requirements.

5.2 Rated voltage

The values of standardized rated voltages given in Table 1 of IEC 60269-1 applicable to this standard are:

Fuse-link size E1 230 V a.c.

Fuse-link sizes F1, F2, F3 400 V a.c.

(Refer also to the note in 1.1).

5.3.1 Rated current of the fuse-link

For each size, the maximum rated currents are given in Figure 701. Ratings of 8 A and 12 A are not included in this fuse system.

5.3.2 Rated current of the fuse-holder

Maximum rated currents for the fuse-holder are given in Figure 702.

5.5 Rated power dissipation of a fuse-link and rated acceptable power dissipation of a fuse-holder

The maximum values of power dissipation permitted for fuse-links when tested in accordance with 8.3.1 are specified in Figure 701 when measured on the standard rig shown in Figure 705.

The values of rated acceptable power dissipation of fuse-holders at rated current when tested in accordance with 8.3.1 are given in Figure 702.

NOTE The point of measurement of voltage for the determination of the acceptable power dissipation of a fuse-holder is shown in Figure 702.

5.6.1 Time-current characteristics, time-current zones

In addition to the limits of pre-arcing time given by the gates and the conventional times and currents, the time-current zones, excluding manufacturing tolerances, are given in Figures 703 and 704. The tolerance on time-current characteristics shall not deviate by more than 10 % in terms of current.

5.6.2 Conventional times and currents

The conventional times and currents in addition to the values of IEC 60269-1 are given in Table 701.

Table 701 – Conventional time and current for "gG" fuse-links

Rated current I_n A	Conventional time h	Conventional current	
		I_{nf}	I_f
$4 < I_n < 16$	1	1,25 I_n	1,6 I_n
$I_n \leq 4$	1	1,25 I_n	2,1 I_n

5.6.3 Gates

For "gG" fuse-links the gates given in Table 702 and in IEC 60269-1 apply.

Table 702 – Gates for specified pre-arcing times of "gG" fuse-links

I_n A	I_{min} (10 s) A	I_{max} (5 s) A	I_{min} (0,1 s) A	I_{max} (0,1 s) A
2	3	6	4	8
4	6	12	9	20
6	9	20	16	36
10	16	36	33	70

5.7.2 Rated breaking capacity

The rated breaking capacities shall be

a) 50 kA for size E1 fuse-links;

b) 80 kA for sizes F1, F2 and F3 fuse-links.

6 Markings

IEC 60269-1 applies with the following supplementary requirements.

6.1 Markings of fuse-holders

In addition to IEC 60269-1, the following marking applies:

– size.

6.2 Markings of fuse-links

In addition to IEC 60269-1, the following marking applies:

– size or reference;

– rated breaking capacity.

7 Standard conditions for construction

IEC 60269-1 applies with the following supplementary requirements.

7.1 Mechanical design

Dimensions of fuse-links and fuse-holders are given in Figures 701 and 702.

7.1.2 Connections including terminals

Terminals of fuse-holders shall accept stranded or solid copper conductors with cross-sectional areas as given in Table 703.

Table 703 – Sizes of copper conductors

Rated current of fuse-holder A	Cross-sectional area of conductor mm^2	Size
20	4	E1
32	10	F1
63	25	F2
125	70	F3

7.2 Insulating properties and suitability for insulation

The creepage distances and clearances of fuse-accessories shall meet the requirements of IEC 60664-1 for overvoltage category III and degree of pollution 3.

7.7 I^2t characteristics

In addition to the values given in Table 7 of IEC 60269-1, the values for rated currents lower than 16 A are given in Table 704.

Table 704 – Pre-arcing I^2t values at 0,01 s for "gG" fuse-links

I_n A	I^2t_{min} A^2s	I^2t_{max} A^2s
2	0,30	2,5
4	2,0	15
6	5	45
10	25	200

7.9 Protection against electric shock

Where standardized fuse-holders according to Figure 702 are used, the degree of protection against electric shock shall be at least IP2X for all three states.

8 Tests

IEC 60269-1 applies with the following supplementary requirements.

8.3.3 Measurement of the power dissipation of the fuse-link

The fuse-link shall be mounted on the test rig shown in Figure 705. The points of measurement of power loss are given in Figure 705.

8.3.4.1 Temperature rise of the fuse-holder

The dummy fuse-links shall have dimensions that comply with Figure 701 for testing in the corresponding fuse-holder of Figure 702. The power dissipation of the dummy fuse-links shall be the rated acceptable power dissipation of the fuse-holder as given in Figure 702 when tested in the standardized power dissipation test rig given in Figure 705.

8.4.1 Arrangement of the fuse

The test arrangement of the fuse-link is given in Figure 705.

8.5.1 Arrangement of the fuse

Fuse-links shall be tested for breaking capacity in fuse-holders which comply with this standard. The fuse-holder shall be rigidly supported. Any conductor for the connection of the fuse-holder to the main-circuit test connections shall have a cross-section appropriate to the fuse-holder terminal given in Table 703. These conductors may be up to 0,2 m on either side of the complete fuse in the plane of the connecting device and in the direction of the connecting line between the terminals of the fuse.

The disposition of the test connections beyond the test rig, i.e. the fuse-holder and any conductors connecting it to the test connections, is not specified.

8.7.4 Verification of overcurrent discrimination

For current ratings of 16 A and above, 8.7.4 of IEC 60269-1 applies.

For current ratings less than 16 A, discrimination is determined from the manufacturer's data as verified in accordance with 8.7.1 of IEC 60269-1.

8.9 Verification of resistance to heat

Fuse-holders fitted with fuse-links having the maximum power dissipation corresponding to the power acceptance of the fuse-holder shall be cyclically loaded as pre-treatment. The pre-treatment is specified in 8.4.3.2 of IEC 60269-1. After cooling to normal temperature the breaking capacity shall be tested at I_1 in accordance with 8.5.

Fuse-links containing organic material in the body or filler shall be subjected to the same test as described above. These fuse-links shall interrupt the test currents I_1 and I_5.

8.10 Verification of non-deterioration of contacts

Subclause 8.10 of IEC 60269-1 applies.

8.10.1 Arrangement of the fuse

Subclause 8.10.1 of IEC 60269-1 applies with the following addition.

The dummy fuse-links shall have dimensions that comply with Figure 701 for testing in the corresponding fuse-holder of Figure 702.

The power dissipation of the dummy fuse-links shall be the maximum rated acceptable power dissipation of the fuse-holder as given in Figure 702 when tested in the standardized power dissipation test rig given in Figure 705.

8.10.2 Test method

Subclause 8.10.2 of IEC 60269-1 applies with the following addition:

The following wording is added after the first paragraph of 8.10.2 in IEC 60269-1.

The following test values shall be applied:

Test current:	non-fusing current I_{nf}
Load period:	25 % of the conventional time
No-load period:	10 % of the conventional time

A test voltage lower than the rated voltage may be used.

8.10.3 Acceptability of test results

After 250 cycles, the measured temperature-rise values shall not exceed the temperature rise measured at the beginning of the tests by more than 15 K.

After 750 cycles, if necessary, the temperature shall not exceed the values measured at the beginning of the tests by more than 20 K.

8.11 Mechanical and miscellaneous tests

8.11.1.1 Mechanical strength of fuse-holders

The fuse-holder, fitted with a fuse-link of the largest rated current and power dissipation that can be accommodated by the fuse-holder, shall be subjected to a temperature-rise test at rated current.

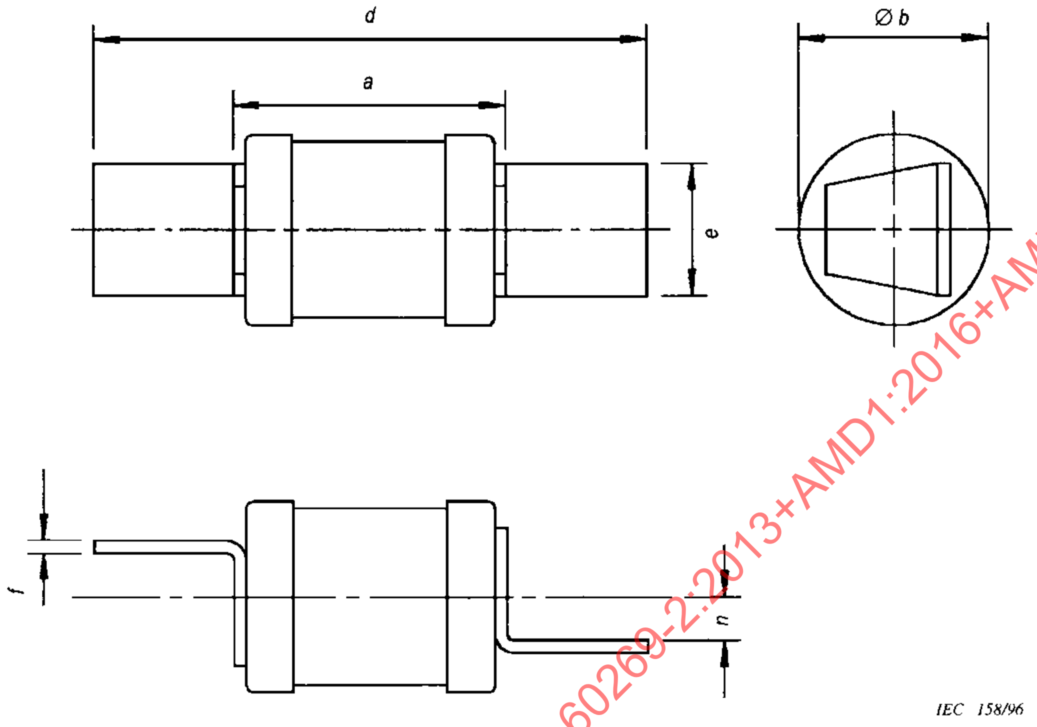
At the conclusion of the temperature-rise test, the fuse-link or the fuse-carrier as appropriate, shall be withdrawn and inserted into the fuse-base 100 times.

At the conclusion of these tests, all parts shall be intact and shall function normally.

Compliance shall be verified by a further temperature rise test at rated current at the conclusion of which the values obtained shall be not more than 5 K or 15 % (whichever is greater) above the values obtained from the temperature rise test prior to the commencement of the mechanical test.

Dimensions in millimetres

FIGURES

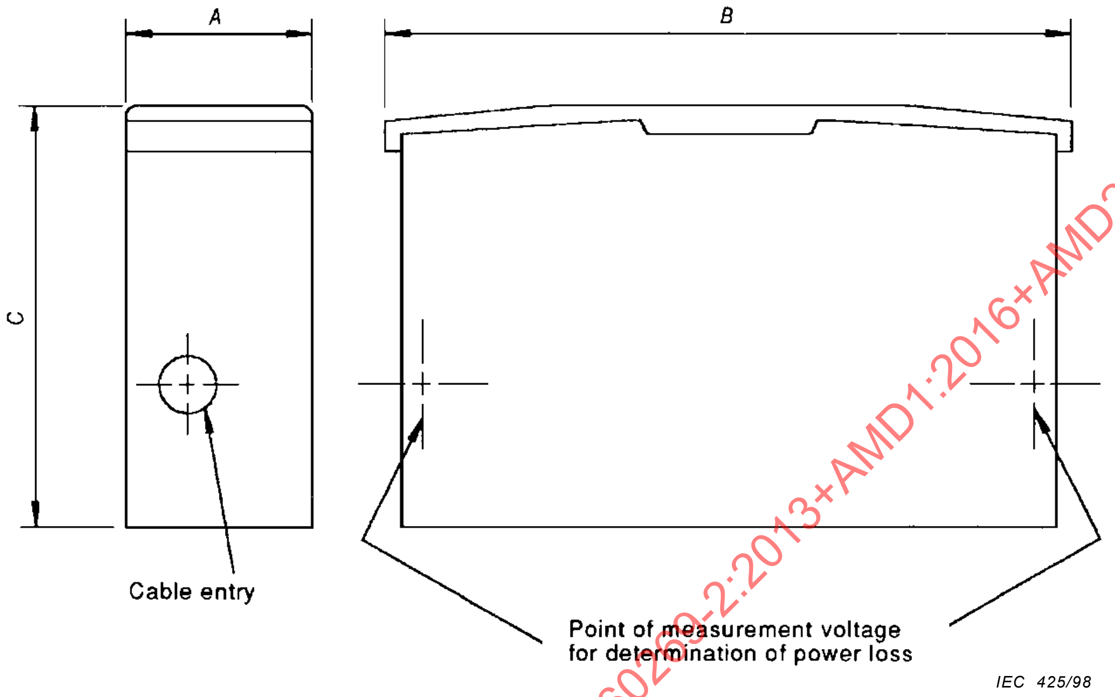


Size	Maximum rated current	Maximum power dissipation	*a*[1)]	*b*	*d*		*e*		*f*		*n*	
	A	W	Max.	Max.	Max.	Min.	Max.	Min.	Max.	Min.	Max	Min.
E1	20	1,8	25	14,5	51	47	13	11	1,5	0,8	3,8	3,2
F1	32	3,2	35,5	14,5	62	58	13	11	1,5	0,8	3,8	3,2
F2	63	4,8	39	17,5	69	65	15,5	14,5	1,6	1,2	3,8	3,2
F3	125	7,5	39	27	80	76	20	19	2,0	1,6	3,8	3,2

[1)] Dimension "*a*" may be up to 0,5 mm more than the stated value to allow for projecting rivet heads at the centre of tag faces.

Figure 701 – Fuse-links having offset blade contacts, sizes E1, F1, F2 and F3

Dimensions in millimetres



Size of fuse-link	Maximum rated current A	Rated acceptable power dissipation W	*A* Max.	*B* Max.	*C* Max.
E1	20	2	26	71	59
F1	32	3,5	26	81	59
F2	63	5	32	96	68
F3	125	7,5	40,5	110	81

NOTE The above illustration does not prejudice the use of other shapes or forms provided they fall within the maximum dimensions listed.

Figure 702 – Typical fuse-holder

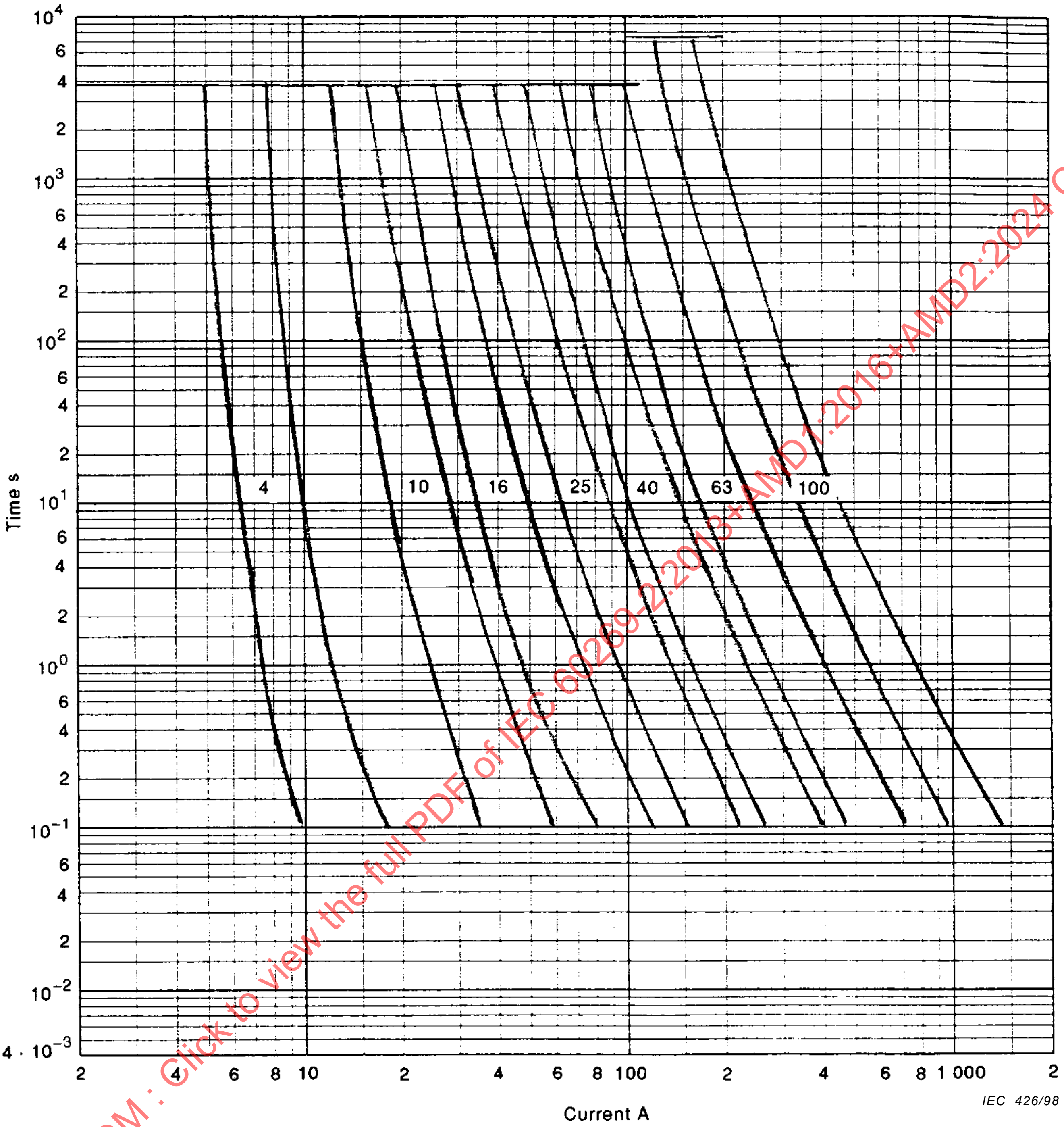
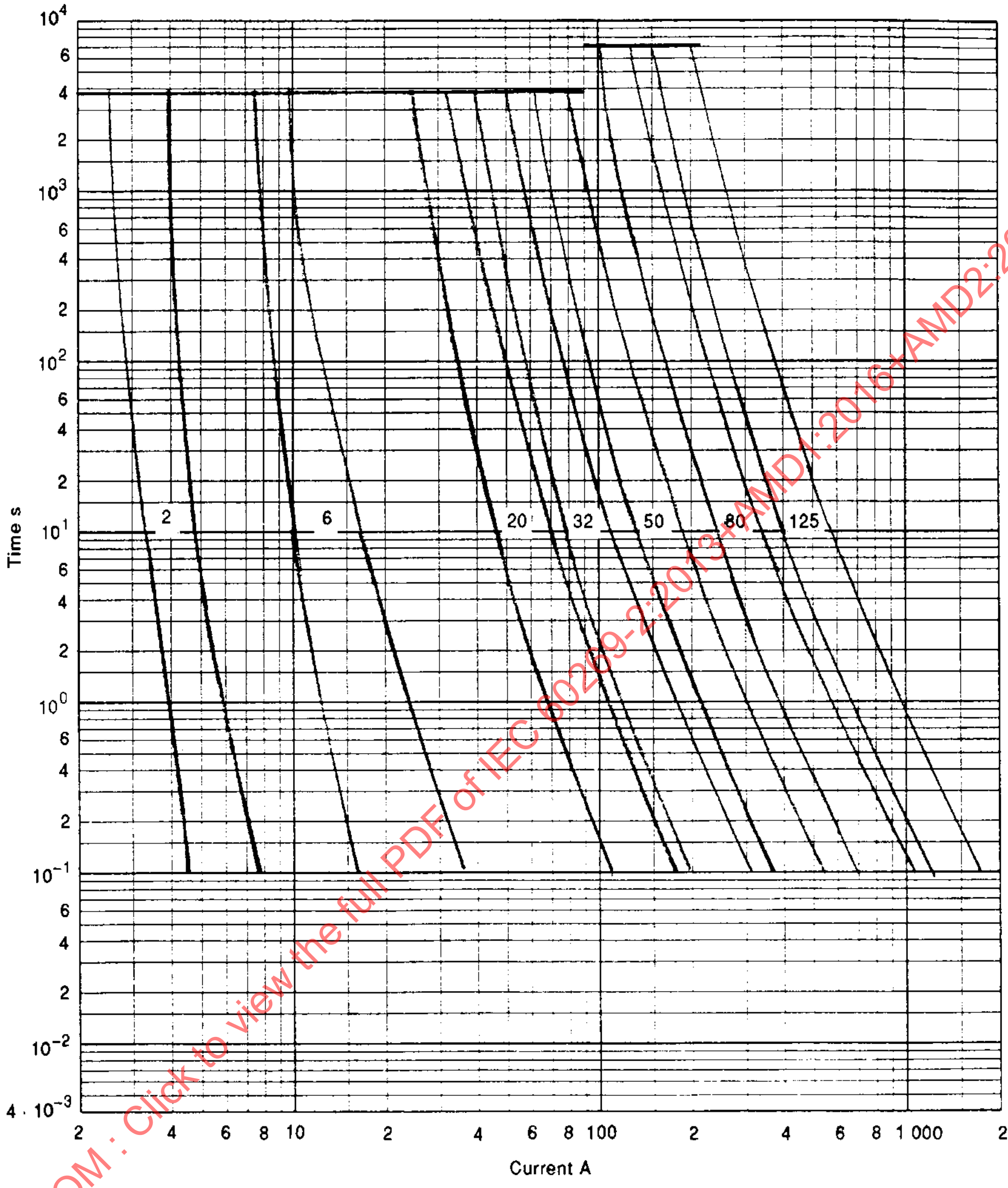
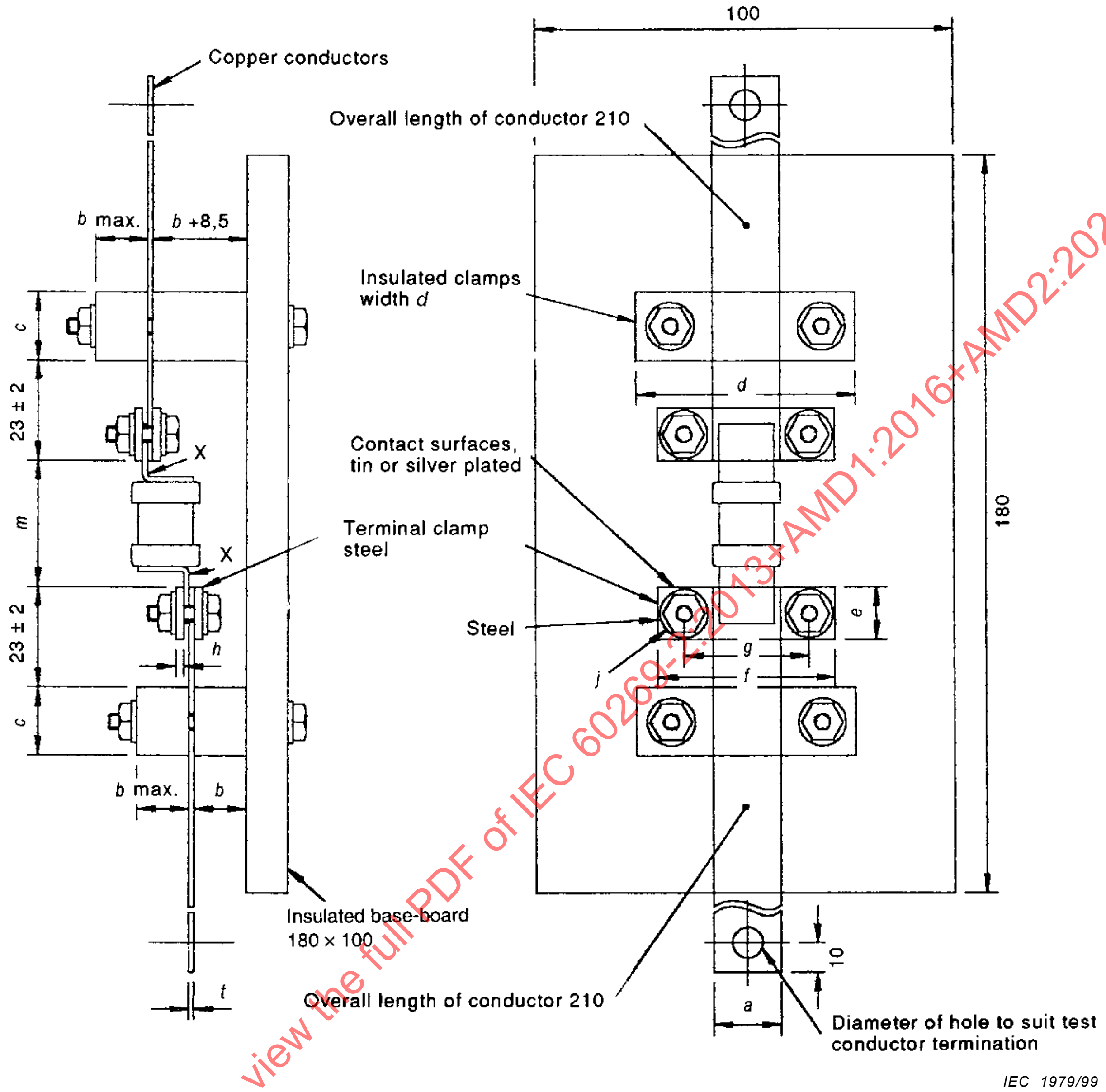


Figure 703 – Time-current zones for "gG" fuse-links



~~Dimensions in millimetres~~

Figure 704 – Time-current zones for "gG" fuse-links



Dimensions in millimetres

Key

X – X indicates point of measurement of voltage for determination of power dissipation.

Size	*a*	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*j*	*m*	*t*	Rated current in A, up to
E1	10	12,5	16	50	12,5	40	28	1,6	M4	30	0,5	20
F1	10	12,5	16	50	12,5	40	28	1,6	M4	30	0,5	32
F2	16	12,5	16	50	15	45	28	1,6	M5	45	1,0	63
F3	20	25	25	50	15	50	35	2	M5	45	1,6	125

Figure 705 – Power dissipation test rig

Fuse system H –
Fuses with fuse-links having "gD" and "gN" characteristics
(class J, class T, and class L time delay and non time delay fuse types)

1 General

IEC 60269-1 applies with the following supplementary requirements.

1.1 Scope

The following additional requirements apply to "gD" and "gN" fuses which comply with the dimensions specified in Figures 801, 802, 803, 804, 805, 806. Such fuses have rated currents up to and including 60 A for cylindrical contacts, 600 A for blade/bolted connections and 6 000 A for bolted connections. Rated voltage is 600 V a.c and the interrupting rating is 200 kA.

Two distinct time-current characteristics, time delay and non-time delay, are inherent in this system. Both time-current characteristics comply with the same conventional fusing and non-fusing current limits and cut-off and maximum operating I^2t limits specified for the system.

The following characteristics of the fuses are specified in addition to IEC 60269-1:

- minimum rated breaking capacities;
- time-current characteristics;
- I^2t characteristics;
- standard conditions of construction;
- power dissipation and acceptable power dissipation.

2 Terms and definitions

IEC 60269-1 applies.

3 Conditions for operation in service

IEC 60269-1 applies.

4 Classification

IEC 60269-1 applies.

5 Characteristics of fuses

IEC 60269-1 applies with the following supplementary requirements.

5.2 Rated voltage

The rated voltage is 600 V a.c.

5.3.1 Rated current of the fuse-link

In addition to the ratings specified in IEC 60269-1, suitable ratings may be selected from the R40 series and, in addition, the following ratings are acceptable: 5 – 17,5 – 35 – 70 – 175 – 350 – 700 – 1 200 – 3 500.

For each size, the maximum rated current is given in Figures 801, 802, and 805.

5.3.2 Rated current of the fuse-holder

The maximum rated currents for the fuse-holders are given in Figures 803, 804, and 806.

5.5 Rated power dissipation of a fuse-link and rated acceptable power dissipation of a fuse-holder

The maximum values of rated power dissipation are given in Figures 801, 802, and 805. The rated acceptable power dissipation of the fuse-base shall be not less than the maximum value of rated power dissipation for the fuse-link of the same rating.

5.6 Limits of the time-current characteristics

5.6.1 Time-current characteristics, time-current zones

In addition to the limits of pre-arcing time given by the gates and the conventional times and currents, the time-current zones, excluding manufacturing tolerances, are given in Figures 808, 809, 810, 811, 812, and 813. The tolerance on time-current characteristics shall not deviate by more than ±10 % in terms of current.

5.6.2 Conventional times and currents

For "gD" and "gN" fuse-links, the conventional times and currents given in Table 801 shall apply.

Table 801 – Conventional time and current for "gD" and "gN" fuse-links

Rated current I_n A	Conventional time h	Conventional current	
		I_{nf}	I_f
$I_n \le 60$	1	1,1 I_n	1,35 I_n
$60 < I_n \le 600$	2	1,1 I_n	1,35 I_n
$600 < I_n \le 6\ 000$	4	1,1 I_n	1,50 I_n

5.6.3 Gates

For "gD" and "gN" fuse-links, the gates given in Table 802 shall apply.

Table 802 – Gates for specified pre-arcing times of "gD" and "gN" fuse-links

Fuse-link	I_n [a]	I_{min} (10 s)	I_{max} (5 s)	I_{min} (0,1 s)	I_{max} (0,1 s)
gD [a]	$15 \le I_n \le 600$	5,0 I_n	8 I_n	8,5 I_n	13 I_n
gN [a]	$15 \le I_n \le 60$	2,0 I_n	3,5 I_n	4,7 I_n	7,5 I_n
gN	$60 < I_n \le 600$	2,5 I_n	4,5 I_n	5,8 I_n	9,0 I_n
gN	$600 < I_n \le 6\,000$	3,5 I_n	6,0 I_n	9,0 I_n	13 I_n

[a] Values for fuse-links with rated current less than 15 A are under consideration.

5.7.2 Rated breaking capacity

The rated a.c. breaking capacity shall be 200 kA.

6 Markings

IEC 60269-1 applies with the following supplementary requirements.

6.1 Markings of fuse-holders

In addition to IEC 60269-1, the following marking applies:

– size or reference.

6.2 Markings of fuse-links

In addition to IEC 60269-1, the following marking applies:

– size or reference;
– rated breaking capacity.

7 Standard conditions for construction

IEC 60269-1 applies with the following supplementary requirements.

7.1 Mechanical design

The dimensions of fuse-links and fuse-bases are given in Figures 801, 802, 803, 804 805, and 806.

7.2 Insulating properties and suitability for insulation

The creepage distances and clearances of fuse parts shall meet the requirements of IEC 60664-1 for overvoltage category III and pollution degree 3.

7.5 Breaking capacity

The maximum arc voltage shown in Table 6 in IEC 60269-1 for “gN" and “gD” 600 V rated fuses is 3 000 V.

7.6 Cut-off current characteristics

The maximum values shall not exceed those given in Table 807.

7.7 I^2t characteristics

The pre-arcing I^2t values at 0,01 s for "gD" and "gN" fuse-links shall lie within the limits indicated in Table 803 below.

The maximum operating I^2t values are given in Table 808.

Table 803 – Pre-arcing I^2t values at 0,01 s for "gD" and "gN" fuse-links

I_n A	I^2t min. $10^3 \times A^2s$	I^2t max. $10^3 \times A^2s$
10	0,08	0,23
15	0,17	0,49
17,5	0,24	0,70
20	0,31	0,93
25	0,50	1,4
30	0,70	2,1
35	1,2	3,5
40	1,6	4,7
50	2,4	7,1
60	3,5	10
70	5,5	17
80	7,5	23
100	11	33
125	17	49
150	24	70
175	33	98
200	49	130
250	70	200
300	98	290
350	130	390
400	200	580
500	300	890
600	410	1 200
700	730	2 000
800	900	2 700
1 000	1 300	3 800
1 200	2 100	6 000
1 400	2 800	8 400
1 600	3 800	11 000
2 000	6 000	17 000
2 500	9 000	26 000
3 000	13 000	38 000
3 500	17 000	50 000
4 000	26 000	74 000
5 000	38 000	110 000
6 000	50 000	150 000

7.8 Overcurrent discrimination

Discrimination between fuse links over 15 A of the same type and utilization category is achieved by maintaining a 2:1 ratio between upstream fuse and downstream fuse current ratings. A ratio of 1,6:1 is possible between "gD" and "gN" fuse-links, provided the "gD" fuse-link has the higher rated current.

7.9 Protection against electric shock

The protection against electric shock can be increased by means of partition walls and covers of the fuse contacts.

8 Tests

IEC 60269-1 applies with the following supplementary requirements.

8.3 Verification of temperature rise and power dissipation

8.3.1 Arrangement of the fuse

The fuse shall be mounted with its major axis in the horizontal position. For fuse-links rated above 600 A, each terminal shall be connected to a copper bus bar which is silver-plated at the point of contact with the fuse-link.

The cross-sectional area of the cable or busbar shall be selected in accordance with the values given in Table 804.

Table 804 – Cross-sectional area of copper conductors for tests corresponding to 8.3 and 8.4

Fuse rating A	Cross-sectional area mm²
$I_n \leq 30$	8,4
$30 < I_n \leq 60$	21,1
$60 < I_n \leq 100$	42,3
$100 < I_n \leq 200$	107
$200 < I_n \leq 400$	253
$400 < I_n \leq 600$	507
$600 < I_n \leq 800$	484
$800 < I_n \leq 1\,200$	645
$1\,200 < I_n \leq 1\,600$	1 290
$1\,600 < I_n \leq 2\,000$	1 940
$2\,000 < I_n \leq 2\,500$	2 580
$2\,500 < I_n \leq 3\,000$	2 900
$3\,000 < I_n \leq 4\,000$	3 870
$4\,000 < I_n \leq 6\,000$	5 810

8.3.4.1 Temperature rise of the fuse-holder

The point at which the temperature rise is measured is marked by the letter A in Figure 807, except dummy fuse links are used. Dummy fuse-links for class J and T fuse links are shown in Tables 805 and 806.

Table 805 – Class J dummy fuse-link dimensions

Rating A	Shape	Dimensions mm				
		Outside diameter	Wall thickness	Length	Thickness	Width
30	Tube	20,62	1,45	57,15	-	-
60	Tube	26,97	1,63	60,32	-	-
100	Blade			117,48	3,18	19,05
200	Blade			146,05	4,75	28,58
400	Blade			180,98	180,98	41,28
600	Blade			203,2	9,52	50,8
NOTE Dummy fuse-links are manufactured of unplated copper.						

Table 806 – Class T dummy fuse-link dimensions

Rating A	Shape	Dimensions mm				
		Outside diameter	Wall thickness	Length	Thickness	Width
30	Tube	14,3	1,45	38,1	-	-
60	Tube	20,62	1,45	39,62	-	-
100	Blade	-	-	75,01	3,18	19,05
200	Blade	-	-	82,55	4,78	22,22
400	Blade	-	-	92,08	6,35	25,4
600	Blade	-	-	101,19	7,92	31,75
800	Blade	-	-	109,93	9,53	44,45
1 200	Blade	-	-	133,66	11,11	50,8
NOTE Dummy fuse-links are manufactured of unplated copper.						

8.3.4.2 Power dissipation of a fuse-link

The measurement points for power dissipation are marked by the letter B in Figure 807.

8.4 Verification of operation

8.4.1 Arrangement of the fuse

The test arrangement shall be as specified in 8.3.1.

8.4.3.3.2 Verification of gates

The following tests may be made at reduced voltage. Additional to the tests specified in 8.4.3.3.1 of IEC 60269-1, the following shall be verified for "gD" and "gN" fuse-links:

a) a fuse-link is subjected to the current of Table 802, column 3 for 10 s. It shall not operate;

b) a fuse-link is subjected to the current of Table 802, column 4. It shall operate within 5 s;

c) a fuse-link is subjected to the current of Table 802, column 5 for 0,1 s. It shall not operate;

d) a fuse-link is subjected to the current of Table 802, column 6. It shall operate within 0,1 s.

8.5.4 Recovery voltage

The value of a.c. power-frequency recovery voltage according to Table 20 in IEC 60269-1 shall be replaced by $(100\ ^{+5}_{0})$% of the rated voltage 600 V for “gN” and “gD” fuse-links. The mean value of d.c. recovery voltage according to Table 21 in IEC 60269-1 shall be replaced by $(100\ ^{+5}_{0})$ % of the rated voltage for “gN” and “gD” fuse links.

8.6 Verification of cut-off current characteristics

The cut-off current shall not exceed the limits shown in Table 807.

The samples are to be arranged as for the breaking capacity test according to 8.5 and Table 20 of IEC 60269-1.

Table 807 – Maximum cut-off current (I_c) for "gD" and "gN" fuse-links at 200 kA prospective current

I_n A	I_c kA	I_n A	I_c kA
10	4,1	300	33
15	5,0	350	36
17,5	5,7	400	38
20	6,2	500	52
25	7,5	600	55
30	9,5	700	73
35	9,5	800	80
40	10	1 000	89
50	11,3	1 200	100
60	12,5	1 400	115
70	14,4	1 600	125
80	15,7	2 000	150
100	17,5	2 500	180
125	19,6	3 000	200
150	21,2	3 500	229
175	23	4 000	250
200	25	5 000	300
250	25	6 000	350

8.7 Verification of I^2t characteristics and overcurrent discrimination

The maximum operating I^2t values shall not exceed the limits shown in Table 808. The samples are to be arranged as for the breaking capacity test according to 8.5 and Table 20 of IEC 60269-1.

Table 808 – Maximum operating I^2t values for "gD" and "gN" fuse-links at 200 kA prospective current

I_n A	I^2t $10^3 \times A^2s$	I_n A	I^2t $10^3 \times A^2s$
10	0,78	300	470
15	1,8	350	840
17,5	2,4	400	1 100
20	3,1	500	1 740
25	4,9	600	2 500
30	7,0	700	7 700
35	10	800	10 000
40	13	1 000	10 400
50	21	1 200	15 000
60	30	1 400	23 000
70	39	1 600	30 000
80	51	2 000	40 000
100	80	2 500	75 000
125	117	3 000	100 000
150	169	3 500	115 000
175	230	4 000	150 000
200	300	5 000	350 000
250	439	6 000	500 000

8.9 Verification of resistance to heat

Fuse-holders fitted with fuse-links having the maximum power dissipation corresponding to the power acceptance of the fuse-holder shall be cyclically loaded as pre-treatment. The pre-treatment is specified in 8.4.3.2 of IEC 60269-1. After cooling to normal temperature, the breaking capacity shall be tested at I_1 in accordance with 8.5.

Fuse-links containing organic material in the body or filler shall be subjected to the same test as described above. These fuse-links shall interrupt the test currents I_1 and I_5.

8.10 Verification of non-deterioration of contacts

Subclause 8.10 of IEC 60269-1 applies.

8.10.1 Arrangement of the fuse

Subclause 8.10.1 of IEC 60269-1 applies with the following addition.

The dummy fuse-links are given in Tables 805 and 806 and shall have the dimensions and the maximum power dissipation, P_n(W), indicated in Figures 801, 802, and 805. The dummy fuse-links shall be constructed of unplated copper with exact dimensions according to the figures so that they do not operate during passage of the overload current I_{nf}.

8.10.2 Test method

The following test values shall be applied:

Test current: non-fusing current I_{nf}

Load period: 25 % of the conventional time

No-load period: 10 % of the conventional time

A test voltage lower than the rated voltage may be used.

8.10.3 Acceptability of test results

After 250 cycles, the measured temperature-rise values shall not exceed the temperature rise measured at the beginning of the tests by more than 15 K.

After 750 cycles, if necessary, the temperature shall not exceed the values measured before the beginning of the tests by more than 20 K.

8.11 Mechanical and miscellaneous tests

8.11.1.1 Mechanical strength of fuse-holders

The fuse-holder, fitted with a dummy fuse-link according to Table 805 and Table 806 or fitted with a fuse-link of the largest rated current and power dissipation that can be accommodated by the fuse-holder, shall be subjected to a temperature-rise test at rated current.

At the conclusion of the temperature-rise test, the fuse-link or the fuse-carrier, as appropriate, shall be withdrawn and inserted into the fuse-base 100 times.

At the conclusion of these tests, all parts shall be intact and shall function normally.

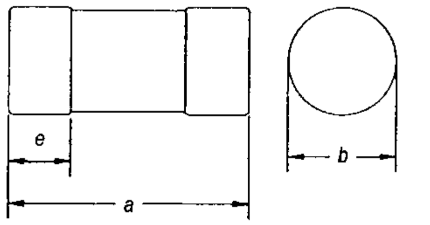
Compliance shall be verified by a further temperature-rise test at rated current at the conclusion of which the values obtained shall be not more than 5 K or 15 % (whichever is greater) above the values obtained from the temperature rise test prior to the commencement of the mechanical test.

8.11.2 Miscellaneous tests

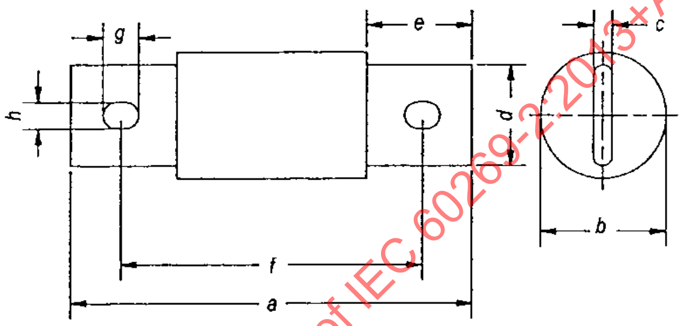
8.11.2.2 Verification of resistance to abnormal heat and fire

Under consideration.

FIGURES



A (1-60 A)



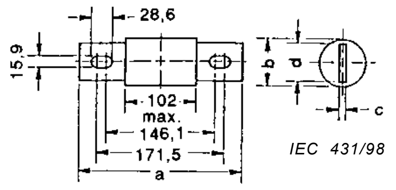
B (70-600 A)

Drawing	600 V a.c.		Dimensions mm							
	I_n A	P_n (W)	*a*[a]	*b*[b]	*c* ±0,08	*d* ±0,9	*e* min.	*f* ±1,6	*g* ±1,5	*h* ±0,13
A	1 to 30	6	57,1	20,6	–	–	12,7	–	–	–
	35 to 60	8	60,3	27,0	–	–	15,9	–	–	–
B	70 to 100	18	118	28,6	3,18	19,1	24,6	92,1	9,52	7,14
	125 to 200	25	146	41,3	4,78	28,6	34,1	111	9,52	7,14
	250 to 400	50	181	54,0	6,35	41,3	46,8	133	13,5	10,3
	500 to 600	70	203	66,7	9,52	50,8	53,2	152	17,5	13,5

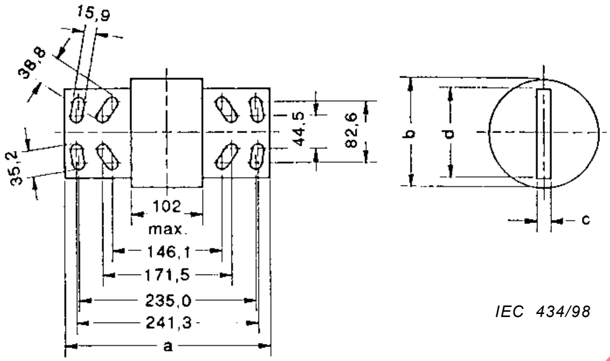
[a] 1 A to 60 A: ±0,8
70 A to 600 A: ±2,4

[b] 1 A to 60 A: ±0,20
70 A to 600 A: max.

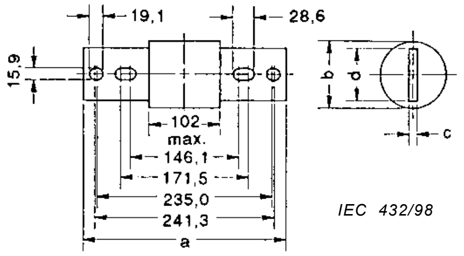
Figure 801 – Class J fuse-links (1 A to 600 A)



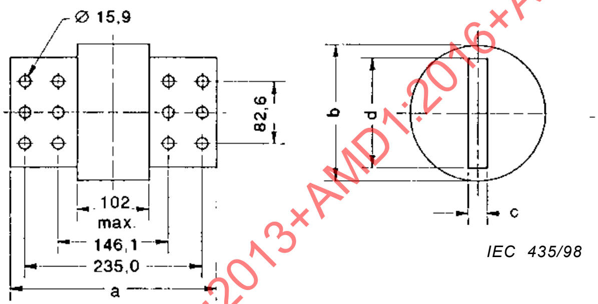
C (700-800 A)



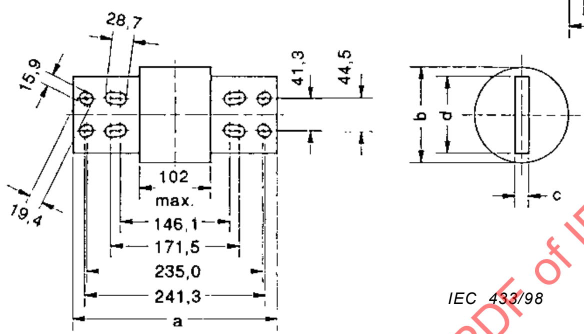
F (3 500-4 000 A)



D (1 000-2 000 A)



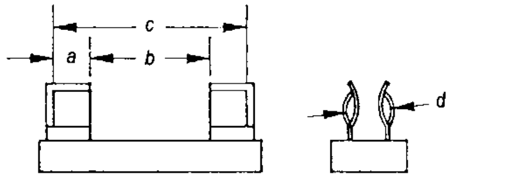
G (5 000-6 000 A)



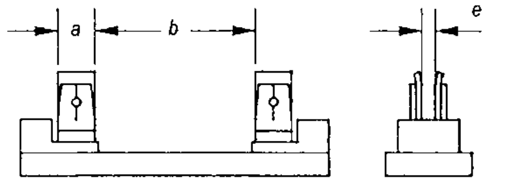
E (2 500-3 000 A)

Drawing	600 V a.c.		Dimensions mm			
	I_n (A)	P_n (W)	*a* ±2,4	*b* max.	*c* ±0,8	*d* ±1,6
C	700	63	219	64,3	9,5	50,8
	800	72	219	64,3	9,5	50,8
D	1 000	90	273	70,6	9,5	50,8
	1 200	108	273	70,6	9,5	50,8
	1 400	126	273	77,0	11,1	60,3
	1 600	144	273	77,0	11,1	60,3
	2 000	180	273	89,7	12,7	69,8
E	2 500	213	273	128	19,0	88,9
	3 000	255	273	~~130~~ 128	19,0	102
F	3 500	300	273	147	19,0	121
	4 000	340	273	147	19,0	121
G	5 000	425	273	182	25,4	133
	6 000	510	273	182	25,4	146

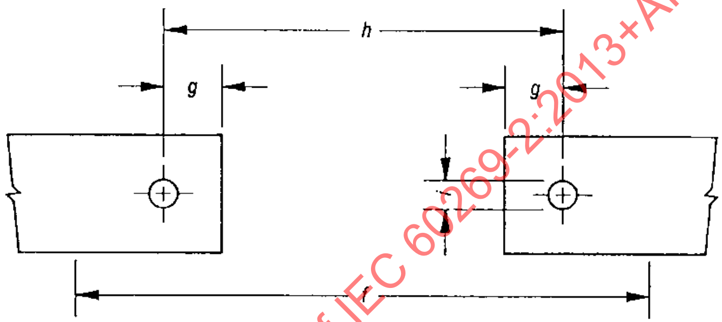
Figure 802 – Class L fuse-links (700 A to 6 000 A)



A - Base for cylindrical contacts IEC 436/98



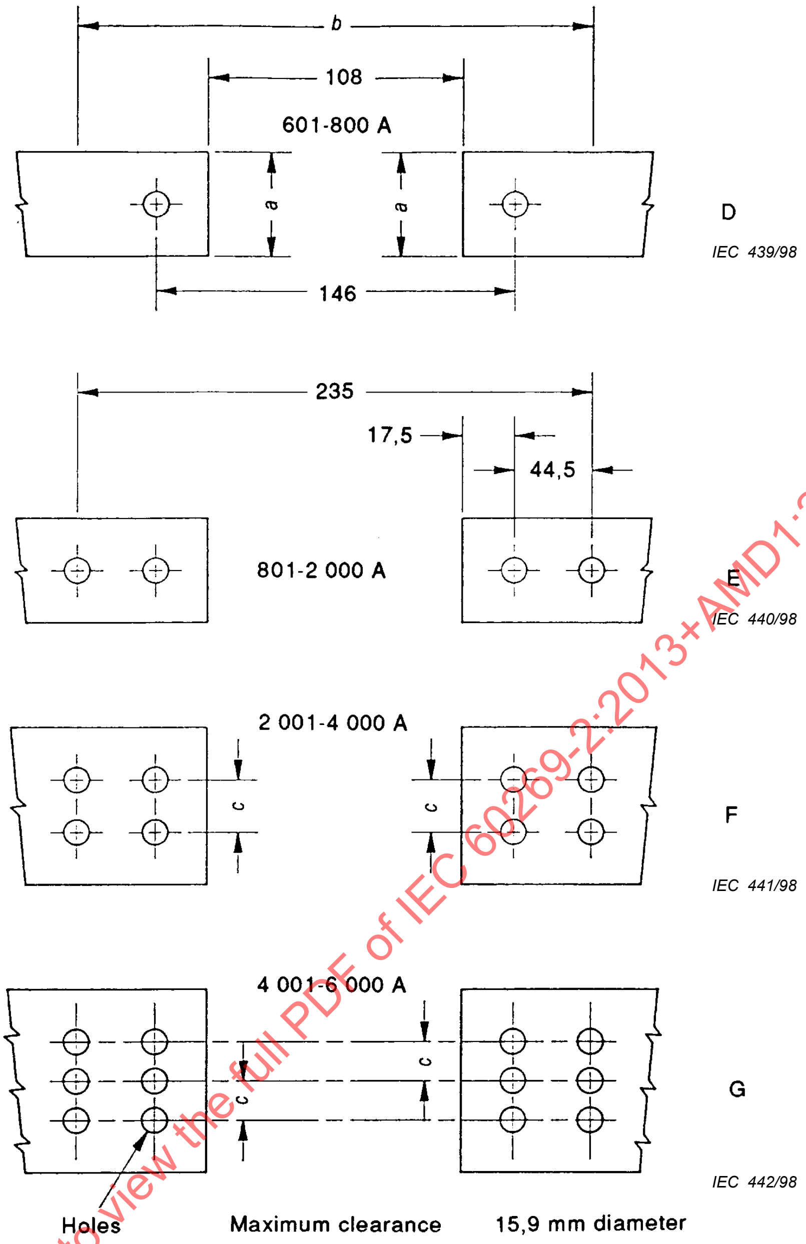
B - Base for blade contacts IEC 437/98



C - Base for contacts for bolted connection IEC 438/98

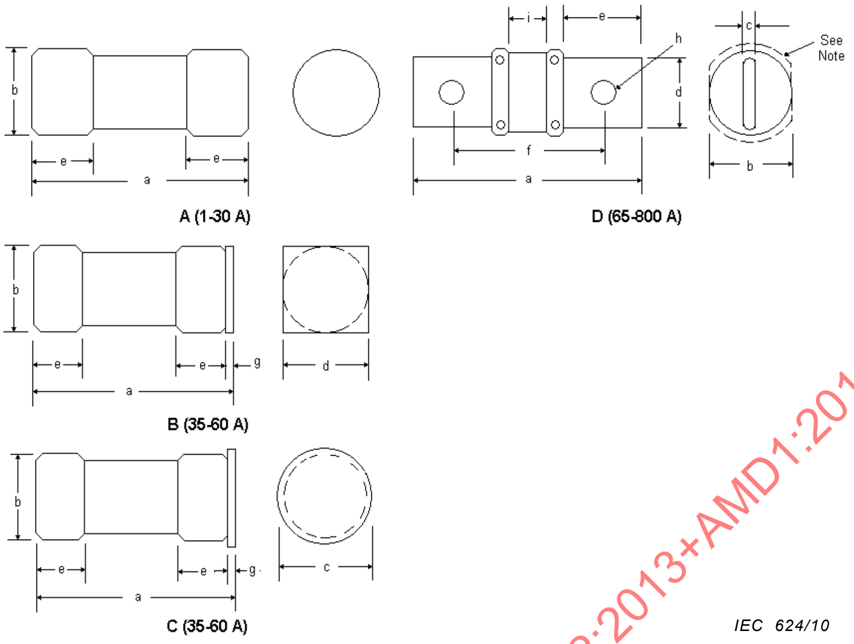
Drawing	I_n max. A	Dimensions mm									
		a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	–
		Minimum width contact clips	Distance between contact clips	Minimum distance between end stops	Nominal diameter fuse-link contact	Nominal thickness fuse-link blade	Minimum clear-ance	Max.	Clearance hole spacing	Diameter clearance hole	Diameter of stud
A	30	12,7	31,8	57,9	20,6	–	–	–	–	–	–
	60	15,9	28,6	61,1	27,0	–	–	–	–	–	–
B and C	100	22,2	69,9	120	–	3,18	120	9,53	92,1	~~7,14~~ 6,75	~~6,35~~ 6,0
	200	31,8	79,4	148	–	4,76	148	14,3	111	~~7,14~~ 6,75	~~6,35~~ 6,0
	400	44,5	88,9	183	–	6,35	183	20,2	133	~~10,3~~ 10,5	~~9,53~~ 10,0
	600	50,8	98,4	206	–	9,53	206	25,0	152	~~13,5~~ 12,5	~~12,7~~ 12,0

Figure 803 – Fuse-base and contacts for class J fuse-links 1 A to 600 A



Drawing	Rated current of fuse-links A	Dimensions mm		
		a	*b*	*c*
		Contact width	**Minimum**	
D	700 to 800	51	220	–
E	1 000 to 1 200	51	280	–
	1 400 to 1 600	60	280	–
	2 000	70	280	–
F	2 500	89	280	41
	3 000	100	280	41
	3 500 to 4 000	120	280	83
G	5 000	130	280	41
	6 000	150	280	41

Figure 804 – Fuse-base and contacts for class L fuse-links 700 A to 6 000 A



Drawing	AC 600V		Dimensions mm								
	I_n A	P_n W	*a* ± 1,02	*b*[a]	*c* ± 0,15	*d*[b]	*e* Min.	*f* ± 1,02	*g* ± 0,15	*h*[c]	*i* Min.
A	1 to 30	8	38,10	14,30	-	-	6,6	-	-	-	-
B	35 to 60	12	39,62	20,62	20,62	-	9,9	-	1,57	-	-
C	35 to 60	12	39,62	20,62	-	25.25	9,9	-	1,57	-	-
D	70 to 100	18	75,01	21,03	3,18	19,05	16,41	59,74	-	7,14	12,7
	125 to 200	34	82,55	27,38	4,78	22,22	19,99	63,67	-	8,74	12,7
	250 to 400	64	92,08	41,28	6,35	25,40	23,52	69,06	-	10,31	12,7
	500 to 600	92	101,19	53,19	7,92	31,75	27,28	75,01	-	12,29	12,7
	650 to 800	120	109,93	63,91	9,53	44,45	30,66	80,57	-	13,89	12,7
	1000 to 1200	180	133,66	66,68	11,00	50,8	37,57	96,55	-	15,47	12,7

NOTE The effective length, *e*, of the blade is measured from the blade end to the fuse body or other acceptable interference means in the blade, such as pins through the blades, a collar, or similar.

[a] 1 A to 60 A: ± 0,51 70 A to 800 A: Maximum dimensions shown.

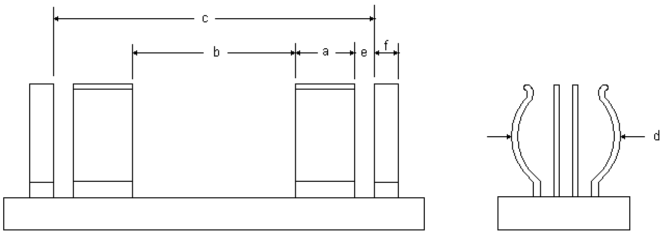
[b] 35 A to 60 A: - 0,15 + 0,41 70 A to 800 A: ± 0,51.

[c] 61 A to 100 A: + 0,013 125 A to 200 A: + 0,15 250 A to 400 A: + 0,18 500 A to 1200 A: + 0,20.

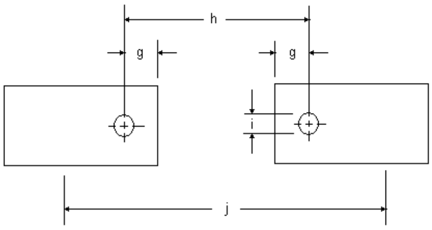
35 A to 60 A: B and C are alternate constructions.

70 A to 1200 A: The dashed line represents the limit of the maximum 1,58 mm projection of the screw, rivet head, or similar.

Figure 805 – Class T fuse-links (1 A to1 200 A)



A - Base for cylindrical contacts



B - Base for contacts for bolted connection

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Drawing	I_n Max A	Dimensions mm										
		a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*	*j*	
		Minimum width contact clips	Distance between contact clips	Minimum distance between end stops	Nominal diameter fuse-link	Minimum width of rejection slot	Minimum width of end stop	Max.	Clearance hole spacing	Diameter clearance hole	Minimum clearance	Diameter of stud
A	30	~~6,6~~ 7,3	~~29,90~~ 23,6	39,12	14,30	-	3,18	-	-	-	-	-
	60	9,9	~~19,82~~ 18,8	40,64	20,62	1,72	3,18	-	-	-	-	-
B	100	-	-	-	-	-	-	~~5,46~~ 8,46	~~59,74~~ 6,35	7,14	76,02	6,47
	200	-	-	-	-	-	-	~~7,25~~ 10,41	63,67	8,94	83,57	7,93
	400	-	-	-	-	-	-	~~9,01~~ 12,19	69,06	10,31	93,10	9,47
	600	-	-	-	-	-	-	~~10,89~~ 14,22	~~75,01~~ 11,11	12,29	102,21	11,45
	800	-	-	-	-	-	-	~~12,58~~ 16,0	~~80,51~~ 12,70	13,89	110,95	13,03
	1200	-	-	-	-	-	-	15,03	~~96,55~~ 14,29	15,47	134,68	14,63

Figure 806 – Fuse-base and contacts for class T fuse-links 1 A to 1 200 A

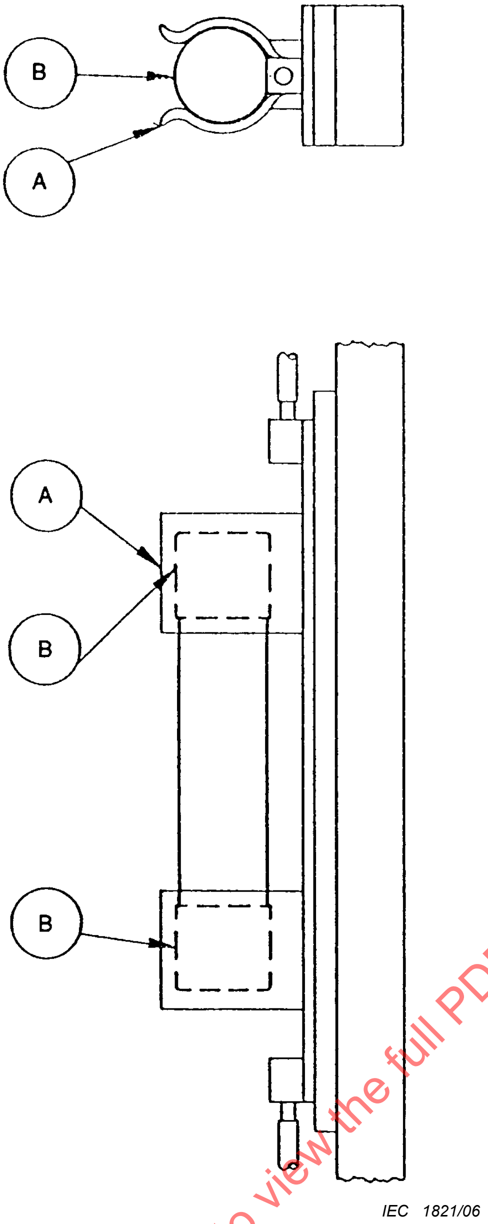

Figure 807a

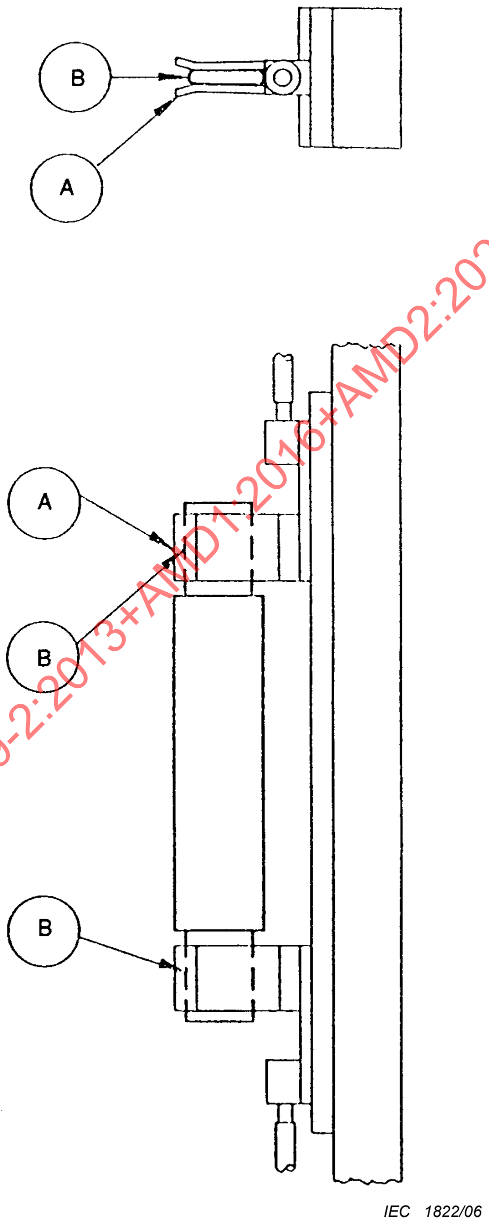

Figure 807b

Key

A – Measurement points for temperature

B – Measurement point for power dissipation

Figure 807 – Temperature test arrangement

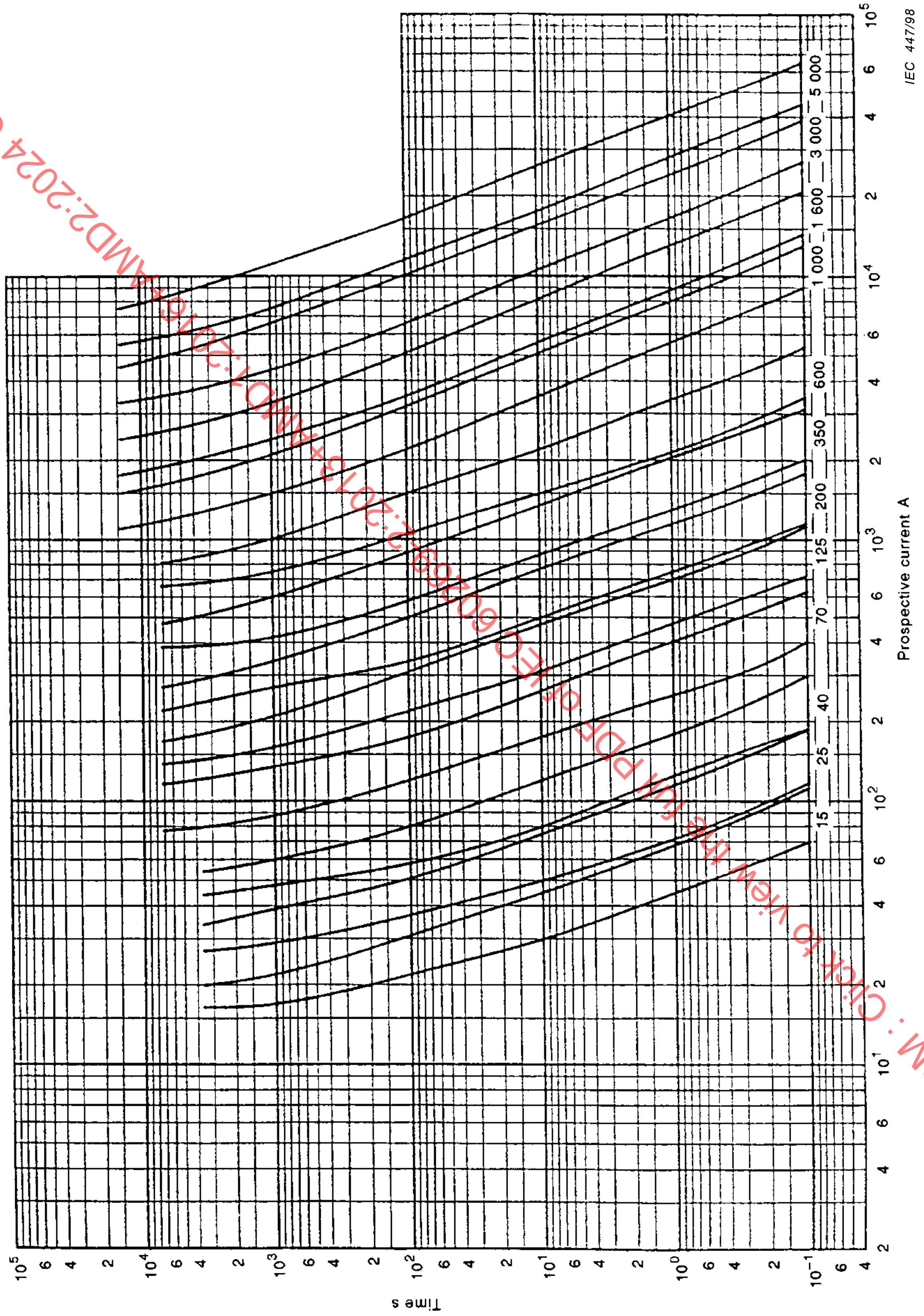

Figure 808 – Time-current zones for "gN" fuse-links

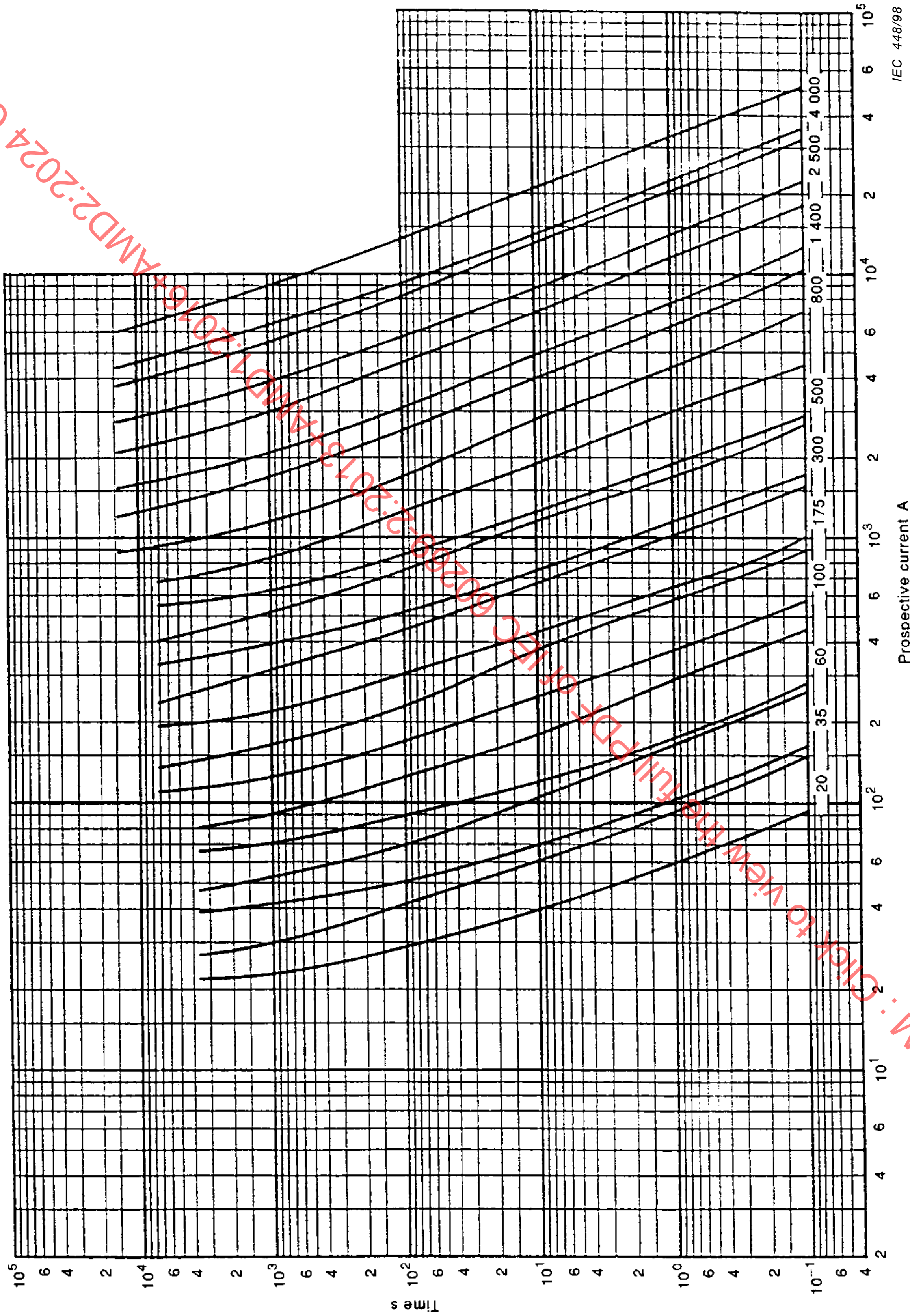

Figure 809 – Time-current zones for "gN" fuse-links

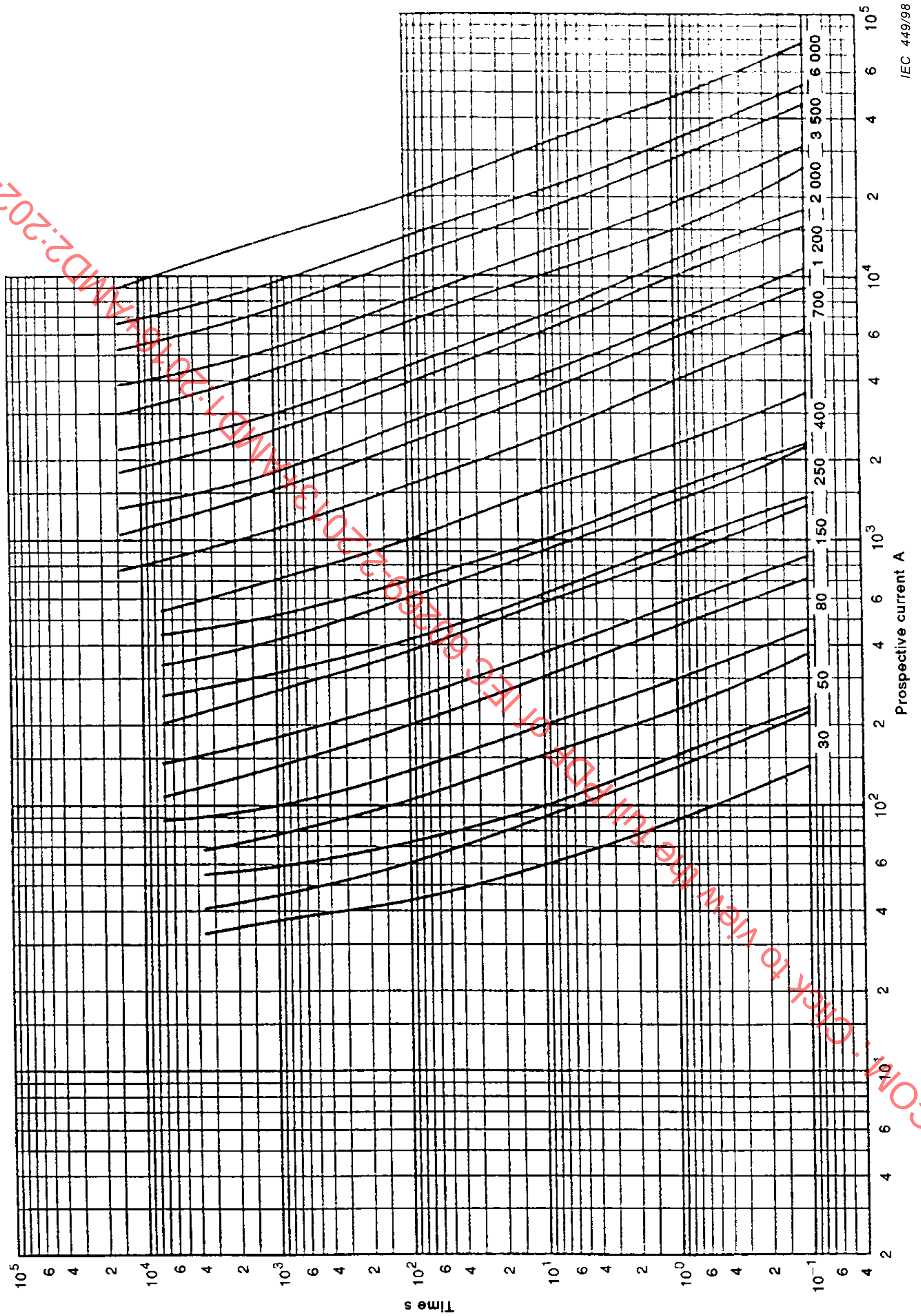

Figure 810 – Time-current zones for "gN" fuse-links

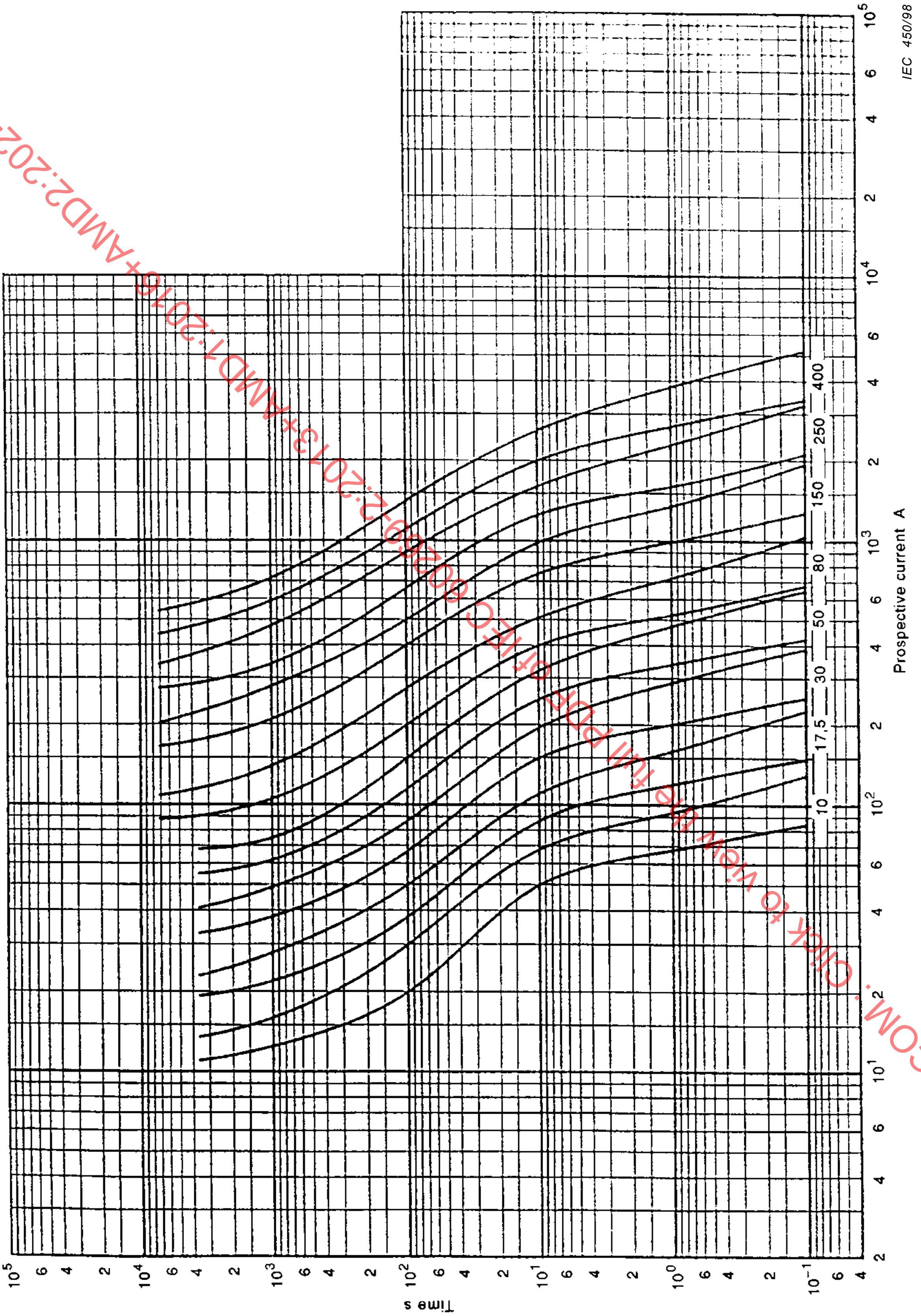

Figure 811 – Time-current zones for "gD" fuse-links

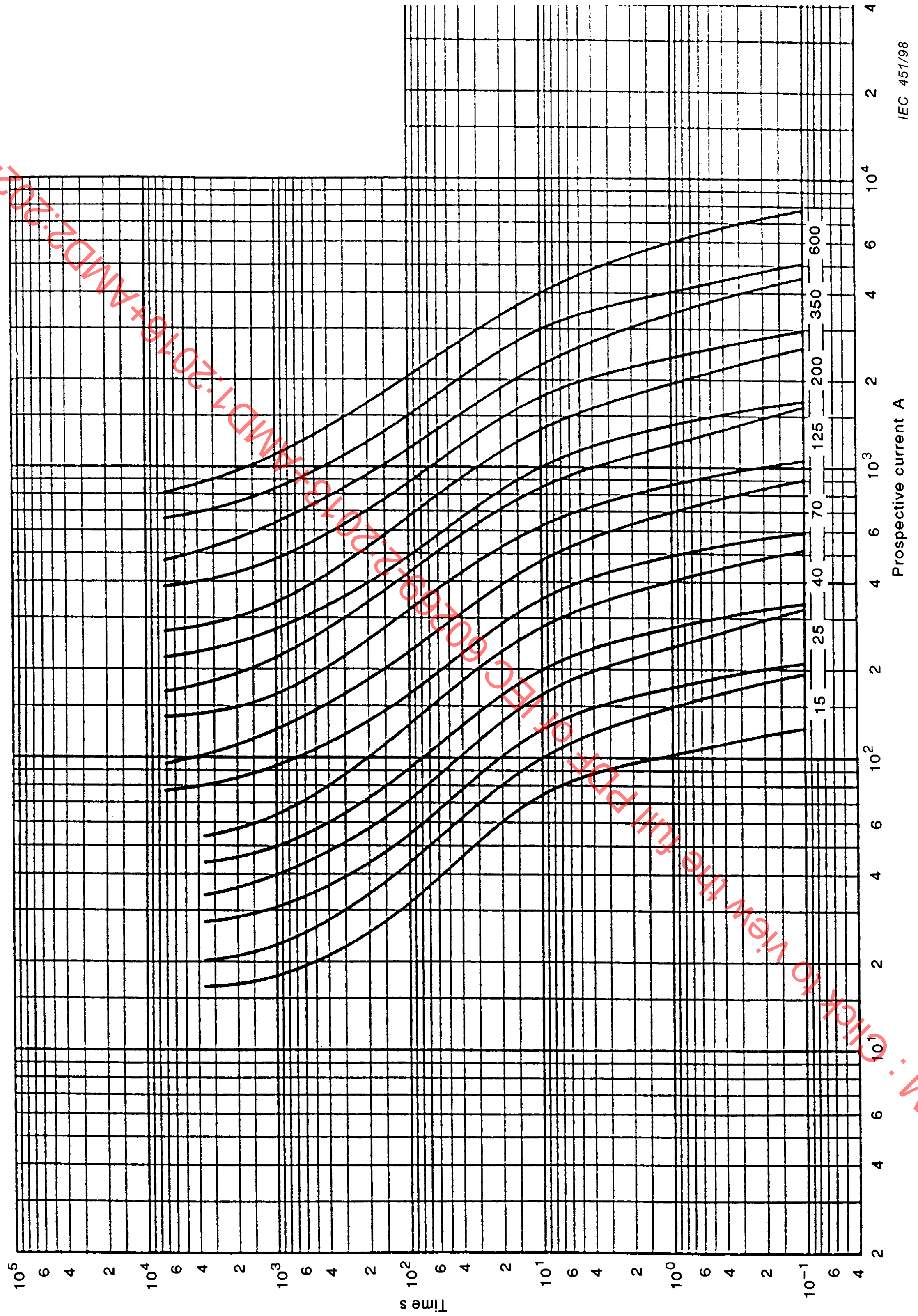

Figure 812 – Time-current zones for "gD" fuse-links

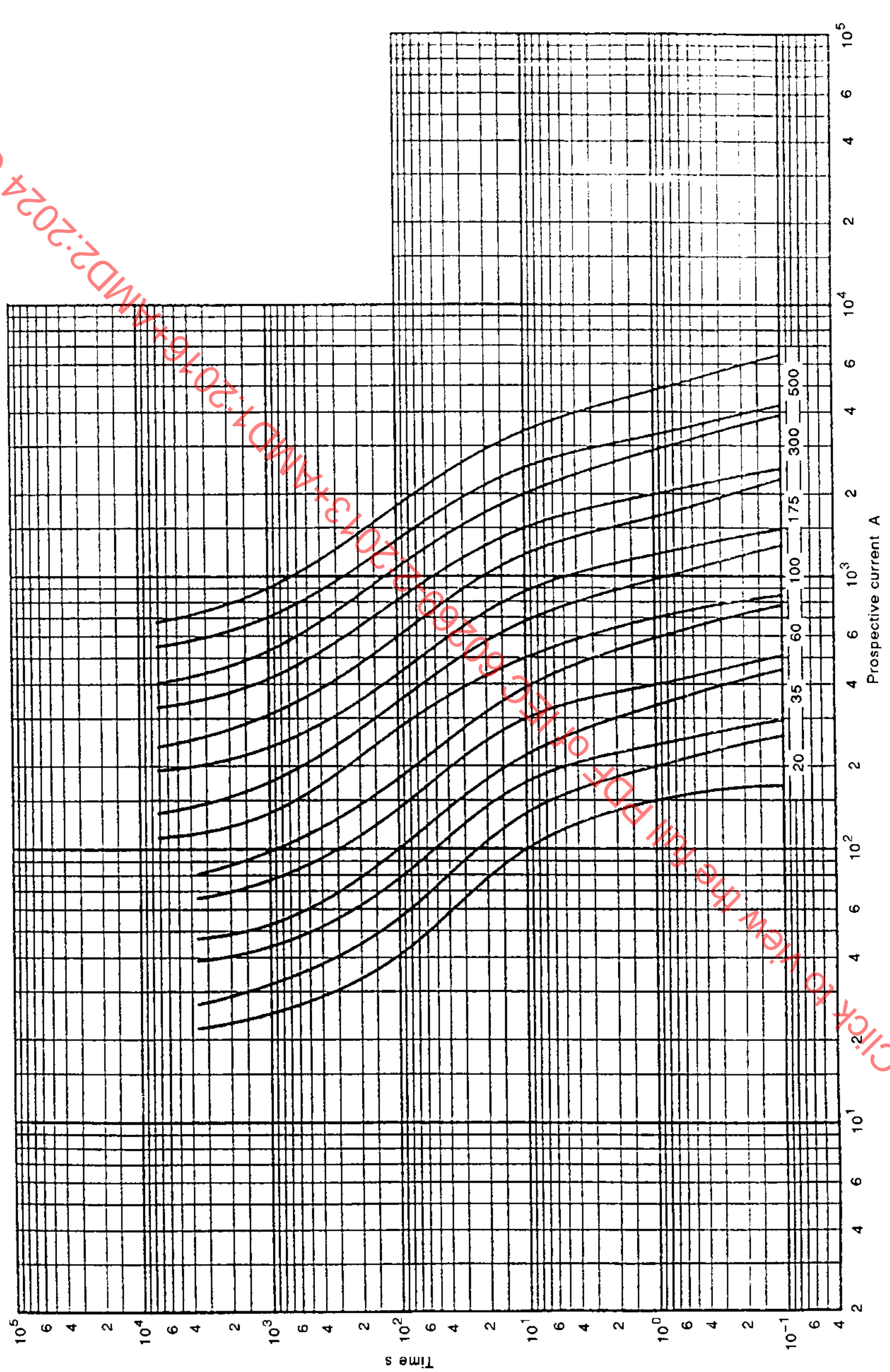

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Figure 813 – Time-current zones for "gD" fuse-links

Fuse system I –
gU fuse-links with wedge tightening contacts

1 General

IEC 60269-1 applies with the following supplementary requirements.

1.1 Scope

The following additional requirements apply to fuse-links having wedge-tightening contacts of standardized dimensions and performance intended for use in a.c. electricity supply networks where they are accessible to, and may be replaced by, suitable authorized persons only. Such fuse-links have rated currents up to and including 630 A and a rated voltage of 400 V a.c. Requirements for fuse-links for use in d.c. networks and for fuse-links incorporating integral indicating devices are not included.

NOTE 1 These fuse-links are intended for use on systems employing the future standardized voltage of 400 V a.c. that will evolve from the existing nominal 380 V and 415 V systems. However many countries are still using associated distribution transformers with a designed open-circuit voltage of 433 V a.c. and a desired on-load voltage of 415 V a.c. Therefore these fuse-links will continue to be supplied and tested as 415 V a.c. rating until such time as all supplies have evolved to the recommended value of 400 V a.c.

NOTE 2 Non-interchangeability and protection against accidental contact with live parts are not necessarily ensured by constructional means.

Whilst these fuse-links are very similar to the standardized "gG" types they require faster performance characteristics, especially at short times, in order to ensure good discrimination with high voltage fuse-links on the primary side of the transformer. It is intended that the performance of these fuse-links should be aligned with the requirements of gG. In the interim period, the breaking range and utilisation category as described in fuse system I should be defined as gU.

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.

If separate fuse-bases or holders are used, they should comply with the appropriate requirements of IEC 60269-1.

The following characteristics of the fuses are specified in addition to the IEC 60269-1:

- minimum rated breaking capacities;
- time-current characteristics;
- I^2t characteristics;
- standard conditions of construction;
- power dissipation and acceptable power dissipation.

2 Terms and definitions

IEC 60269-1 applies.

3 Conditions for operation in service

IEC 60269-1 applies with the following supplementary requirements.

3.9 Discrimination of fuse-links

Subclause 3.9 of IEC 60269-1 does not apply. In the case of these fuse-links, correct discrimination is ensured by adherence to Table 2 of IEC 60269-1 and the standard zones for time/current characteristics as specified in 5.6.1 and given in Figures 901, 902, 903 and 904, together with compliance with the values given in Table 902 of 7.7.

4 Classification

IEC 60269-1 applies.

5 Characteristics of fuses

IEC 60269-1 applies with the following supplementary requirements.

5.2 Rated voltage

The value of standardized rated voltage given in Table 1 of IEC 60269-1 applicable to this standard is 400 V a.c. (refer also to Note 1 of 1.1).

5.3.1 Rated current of the fuse-link

The standardized current ratings of fuse-links with centres at 82 mm are 100 A, 160 A, 200 A, 250 A, 315 A, 355 A and 400 A. The standardized current ratings of fuse-links with centres at 92 mm are 100 A, 160 A, 200 A, 250 A, 315 A, 355 A, 400 A, 500 A and 630 A. Other current ratings, including and exceeding 20 A, may be selected from the values given in 5.3.1 of IEC 60269-1. Performance values for these other ratings are not standardized but shall not exceed those applying to the next highest standardized current rating nor be less than those applying to the next lowest standardized current rating. All ratings shall comply with the standardized dimensions shown in Figure 905.

5.5 Rated power dissipation of a fuse-link

The maximum values of power dissipation permitted for fuse-links when tested in accordance with 8.3.1 are specified in Table 901 when measured on the standard test rig shown in Figure 906.

Table 901 – Maximum power dissipation values

Rated current (A)	100	160	200	250	315	355	400	500	630
Power dissipation (W)	10	14	18	22	29	29	33	38	46
NOTE The point of measurement of voltage for determination of power dissipation is shown in Figure 906.									

5.6.1 Time-current characteristics, time-current zones

The time-current zones, excluding manufacturing tolerances, are given in Figures 901, 902, 903 and 904. The tolerance on time-current characteristics shall not deviate by more than 10 % in terms of current.

5.6.2 Conventional times and currents

The conventional times and currents are given in Table 2 of IEC 60269-1.

5.6.3 Gates

Subclause 5.6.3 of IEC 60269-1 does not apply to these fuse-links.

Correct discrimination is ensured by adherence to the standardized zones for time-current characteristics as specified in 5.6.1 and given in Figures 901, 902, 903 and 904.

5.7.2 Rated breaking capacity

The rated breaking capacity shall be a minimum of 50 kA a.c.

5.8 Cut-off current and I^2t characteristics

Subclause 5.8 of IEC 60269-1 applies; I^2t characteristics may alternatively be represented as a graph showing pre-arcing and total operating values as a function of rated current.

6 Markings

IEC 60269-1 applies with the following supplementary requirements.

6.1 Markings of fuse-holders

In addition to IEC 60269-1, the following marking applies:

– size.

6.2 Markings of fuse-links

In addition to IEC 60269-1, the following marking applies:

– size or reference;

– rated breaking capacity.

7 Standard conditions for construction

IEC 60269-1 applies with the following supplementary requirements.

7.1 Mechanical design

Dimensions of the fuse-links are given in Figure 905.

7.2 Insulating properties and suitability for insulation

The creepage distances and clearances of fuse-accessories shall meet the requirements of IEC 60664-1 for overvoltage category III.

7.5 Breaking capacity

The maximum arc voltages specified in Table 6 of IEC 60269-1 apply, with the following additional note.

NOTE For a.c., the arc voltage can reach up to $\sqrt{2}$ times the values given, provided that the period of excess does not exceed 1 ms.

7.7 I^2t characteristics

Subclause 7.7 of IEC 60269-1 applies with the values in Table 7 of IEC 60269-1 replaced by the values given in Table 902 for gU fuse-links. Values for other ratings are not specified but shall comply with the performance requirements for non-standardized current ratings given in 5.3 of IEC 60269-1.

Table 902 – Pre-arcing I^2t values for gU fuse-links at 0,01 s

I_n A	I^2t min. $10^3 \times (A^2s)$	I^2t max. $10^3 \times (A^2s)$
100	12,0	33,0
160	40,0	130,0
200	67,0	200,0
250	100,0	380,0
315	160,0	520,0
355	280,0	1 000,0
400	420,0	1 400,0
500	800,0	2 400,0
630	1 400,0	4 000,0

7.8 Overcurrent discrimination of the fuse-links

Correct discrimination is ensured by adherence to the standard zones for time-current characteristics as specified in 5.6.1 and given in Figures 901, 902, 903 and 904.

8 Tests

IEC 60269-1 applies with the following supplementary requirements.

8.1.1 Kind of tests

Subclause 8.1.1 of IEC 60269-1 applies, but where fuse-links of standardized dimensions and performance have been tested in accordance with this fuse system, the results of such tests shall also be regarded as comprising fuse-links of identical construction but having different contact dimensions and fixing centres, provided that the changes are not likely to result in inferior performance.

8.3.1 Arrangement of the fuse

Fuse-links shall be mounted in an appropriate carrier and tested in the test rig shown in Figure 906. For the connections to the fuse, Table 17 of IEC 60269-1 does not apply and for standardized ratings the connections on either side of the test rig shall be copper bars each not less than 1 m in length and selected in accordance with Table 903. For other ratings, the cross-section of the conductors shall be that applying to the next highest standardized current rating.

Table 903 – Cross-sectional area of conductors for power dissipation and temperature-rise tests

Rated current of fuse-links A	Cross-section[a] of conductors mm
100	20 × 1,6
160	20 × 2,5
200	20 × 3,15
250	20 × 5
315	25 × 5
355	25 × 6
400	25 × 8
500	40 × 6
630	40 × 10

[a] Approximate equivalents for these conductor sizes are acceptable.

8.3.3 Measurement of the power dissipation of the fuse-link

Subclause 8.3.3 of IEC 60269-1 applies. The points of measurement of the power dissipation are given in Figure 906.

8.4.1 Arrangement of the fuse

Fuse-links shall be mounted in an appropriate carrier and tested for time-current characteristics in the test rig shown in Figure 906.

8.4.3.3.2 Verification of gates

Correct discrimination is ensured by adherence to the standard zones for time-current characteristics for gU fuse-links as specified in 5.6.1 and given in Figures 901, 902, 903 and 904 verified as in 8.4.3.3.1 of IEC 60269-1.

8.5.1 Arrangement of the fuse

Fuse-links shall be tested for breaking capacity in the test rig shown in Figure 907. The arrangement of the test connections beyond the test rig is not specified.

8.5.2 Characteristics of the test circuit

Subclause 8.5.2 of IEC 60269-1 applies except that the d.c. tests are omitted.

8.5.5 Test method

Subclause 8.5.5.1 of IEC 60269-1 applies, except that the tests for d.c. shall be omitted. Where test facilities do not permit direct testing (for example, for $I_n \geq 200$ A), two-part testing may be used.

Subclause 8.5.5.2 of IEC 60269-1 applies, except that the tests for d.c. shall be omitted.

8.5.8 Acceptability of test results

Subclause 8.5.8 of IEC 60269-1 applies, and, in addition, fuse-links shall operate without melting of the fine-wire fuse which indicates arcing to the metal enclosure, and without mechanical damage to the test rig.

8.7.3 Verification of compliance for fuse-links at 0,01 s

Subclause 8.7.3 of IEC 60269-1 applies, except that compliance with Table 7 of IEC 60269-1 is replaced by compliance with Table 902 of this standard.

8.9 Verification of resistance to heat

Fuse-holders fitted with fuse-links having the maximum power dissipation corresponding to the power acceptance of the fuse-holder shall be cyclically loaded as pre treatment. The pre-treatment is specified in 8.4.3.2. of IEC 60269-1. After cooling to normal temperature, the breaking capacity shall be tested at I_1 in accordance with 8.5.

Fuse-links containing organic material in the body or filler shall be subjected to the same test as describe above. These fuse-links shall interrupt the test currents I_1 and I_5.

8.11 Mechanical and miscellaneous tests

8.11.1.1 Mechanical strength of fuse-holders

The fuse-holder, fitted with a fuse-link of the largest rated current and power dissipation that can be accommodated by the fuse-holder, shall be subjected to a temperature-rise test at rated current.

At the conclusion of the temperature-rise test, the fuse-link or the fuse-carrier as appropriate, shall be withdrawn and inserted into the fuse-base 100 times.

At the conclusion of these tests, all parts shall be intact and shall function normally.

Compliance shall be verified by a further temperature rise test at rated current at the conclusion of which the values obtained shall be not more than 5 K or 15 % (whichever is greater) above the values obtained from the temperature rise test prior to the commencement of the mechanical test.

8.11.2.2 Verification of resistance to abnormal heat and fire

Subclause 8.11.2.2 of IEC 60269-1 does not apply.

FIGURES

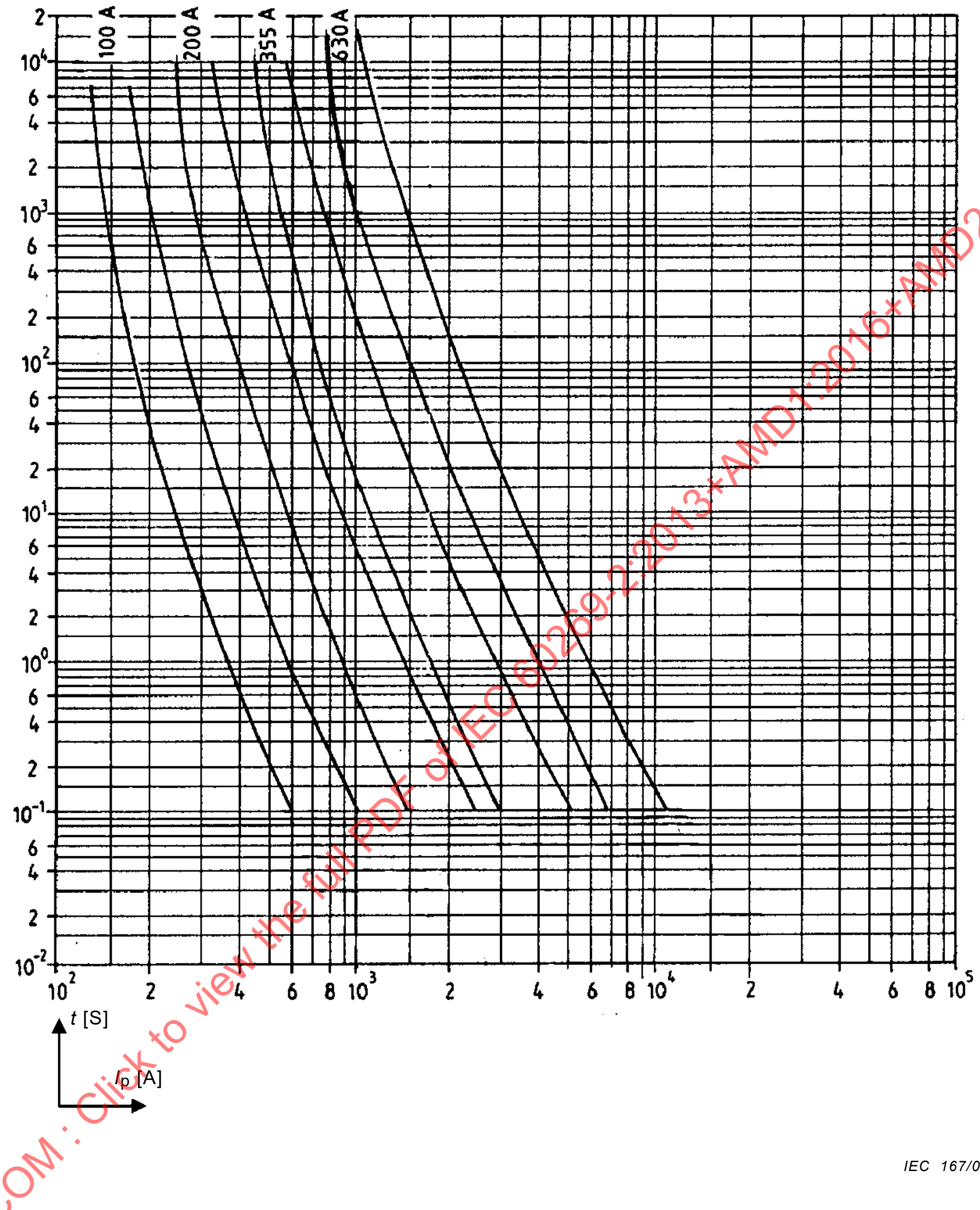


Figure 901 – Time-current zones for current ratings 100 A, 200 A, 355 A and 630 A

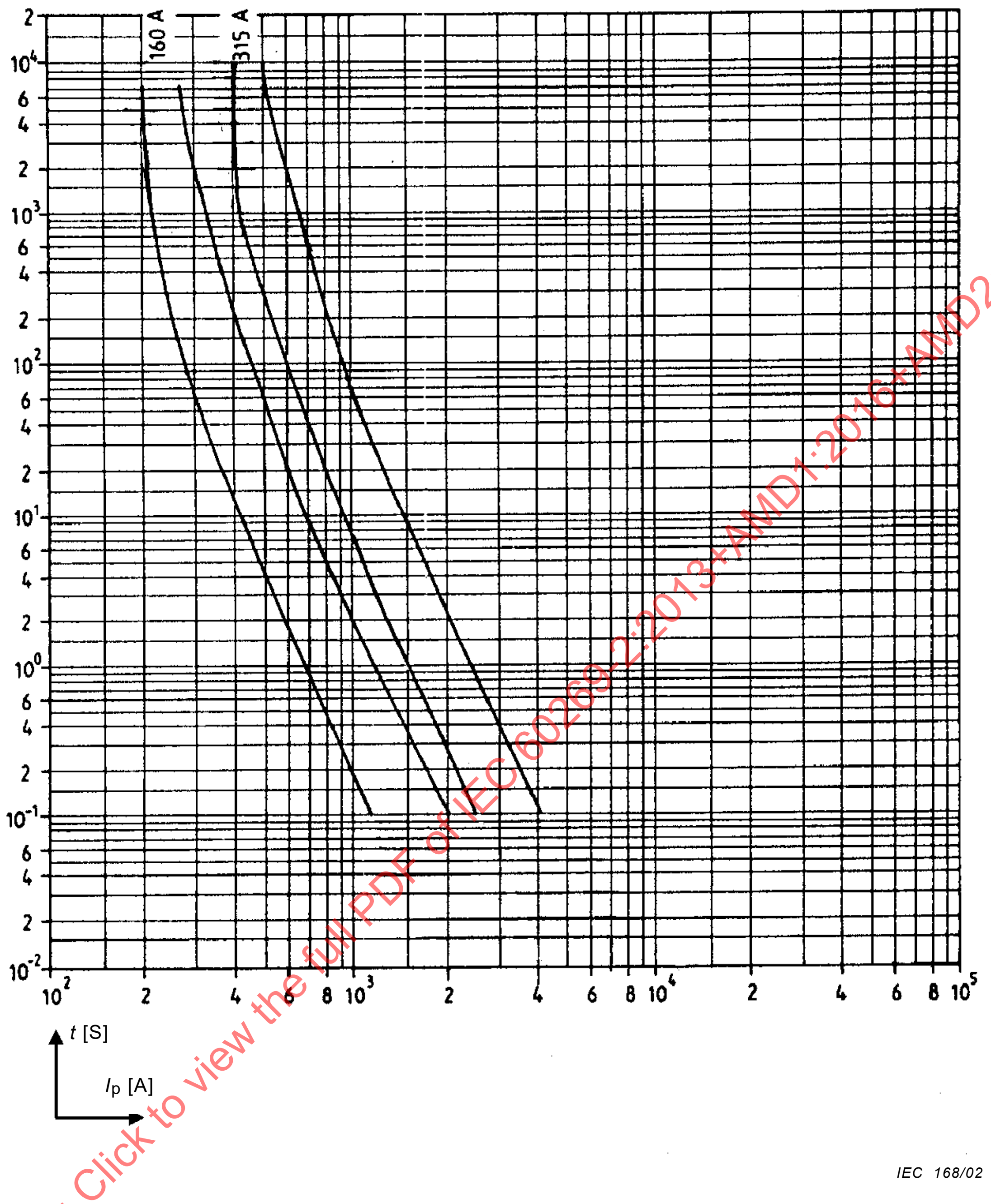


Figure 902 – Time-current zones for current ratings 160 A and 315 A

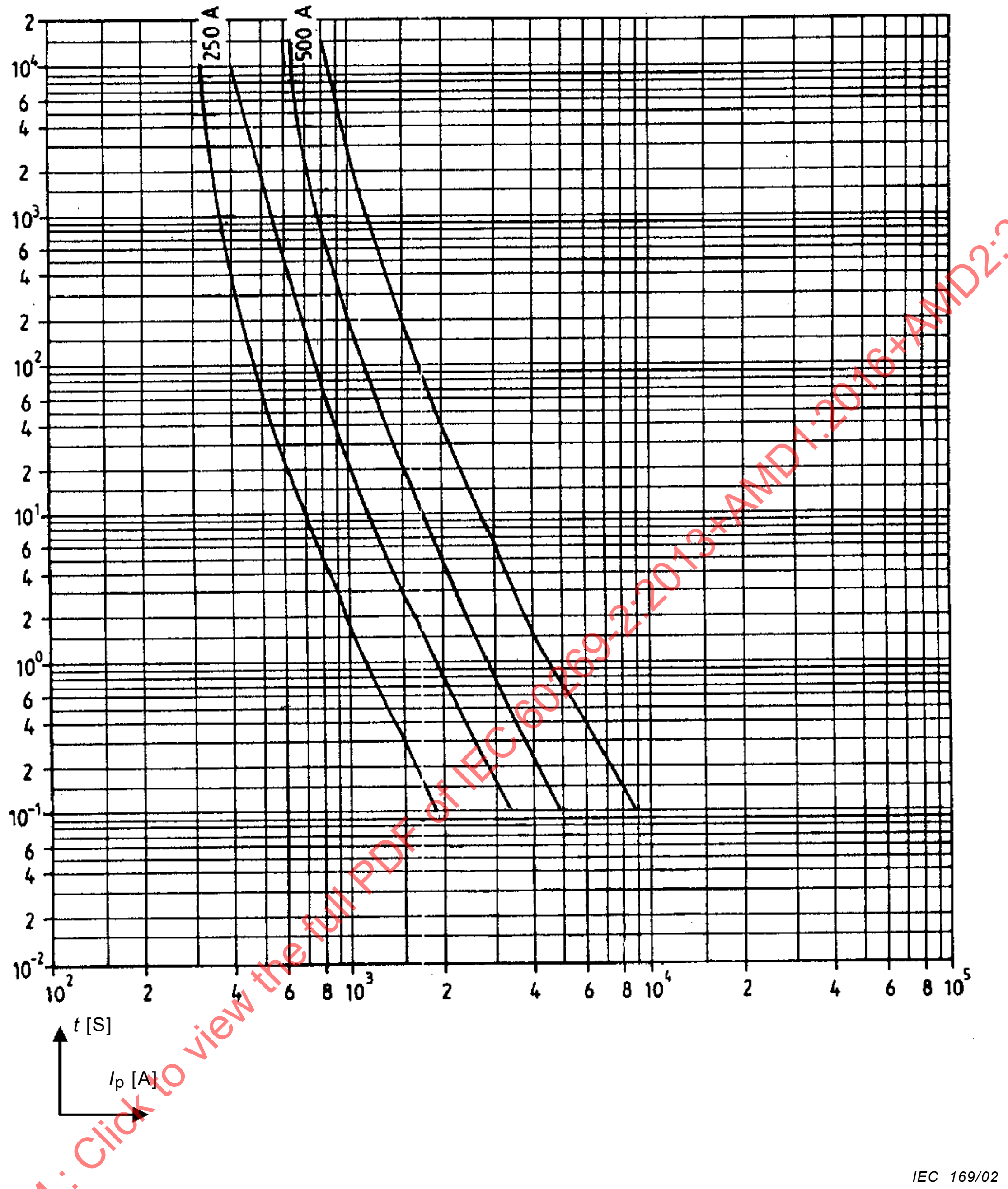


Figure 903 – Time-current zones for current ratings 250 A and 500 A

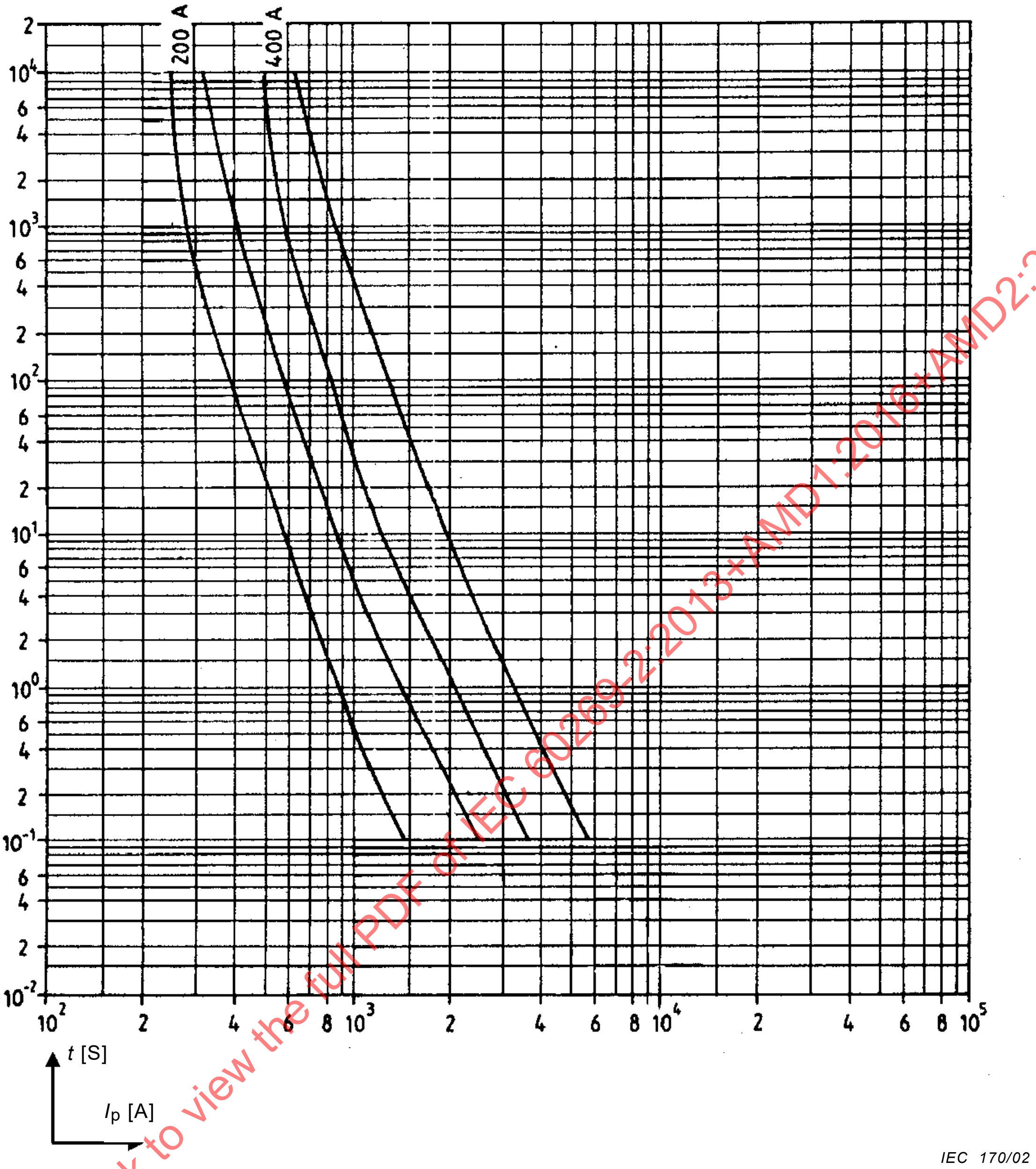
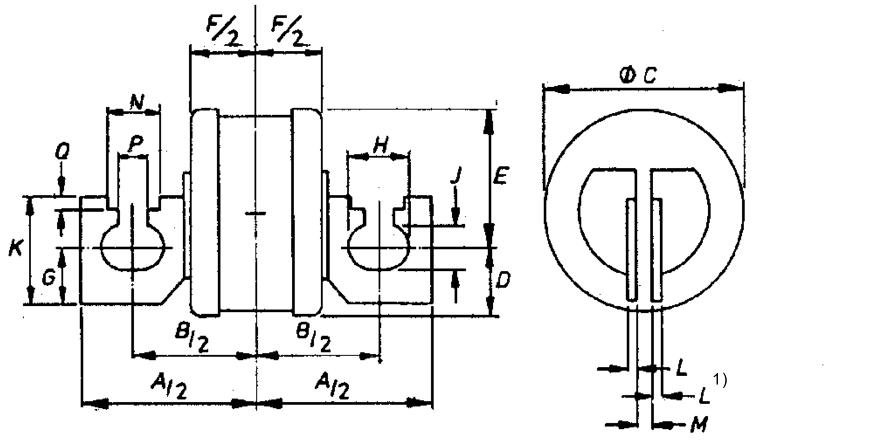
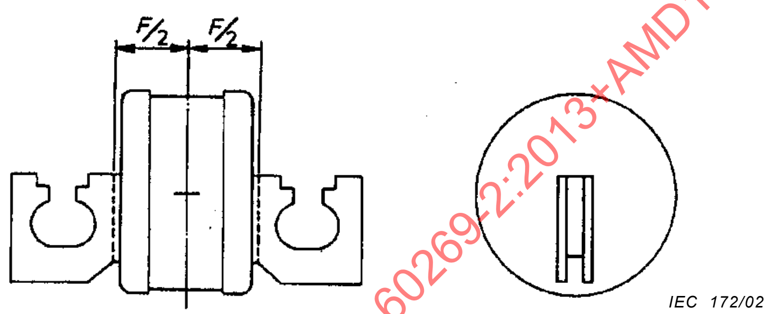


Figure 904 – Time-current zones for current ratings 200 A and 400 A



Fuse-links with L type tags   Typical form of tag construction

NOTE 1 *M* at 7 mm from surface of end cap.



Fuse-links with U type tags   Typical form of tag construction

The tags should be of the form shown to ensure compliance with the footnote below relating to dimension F.

Dimensions in millimetres

Maximum current rating A	**Fixing centres at 82 mm**														
	A Max.	*B* Nom.	*C* Max.	*D* Max.	*E* Max.	*F* [a] Max.	*G* Nom.	*H* Nom.	*J* Nom.	*K* Max.	*L* Nom.	*M* [b]	*N* Nom.	*P* Nom.	*Q* Nom.
400	112	82	61	25	36	48	19	17	14	35	2,4	6,53 6,45	13	10	3

[a] *F* represents the maximum dimension of the effective body length including rivet heads.

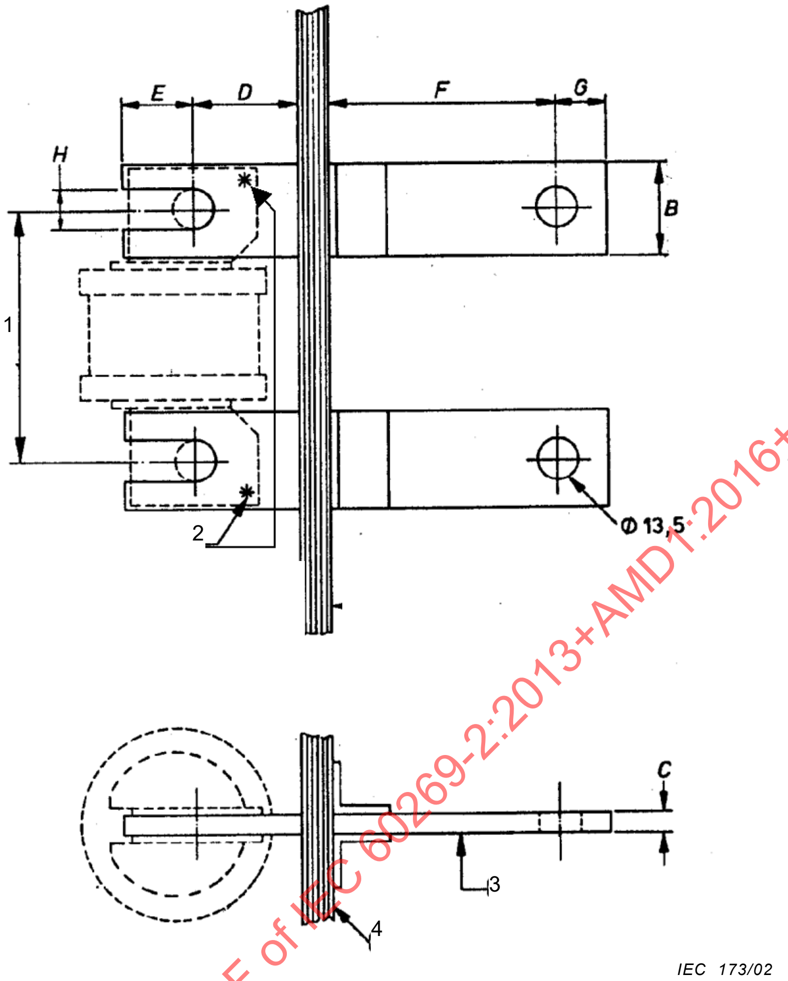
[b] *M* represents the maximum and minimum dimensions.

Maximum current rating A	**Fixing centres at 92 mm**														
	A Max.	*B* Nom.	*C* Max.	*D* Max.	*E* Max.	*F* [a] Max.	*G* Nom.	*H* Nom.	*J* Nom.	*K* Max.	*L* Nom.	*M* [b]	*N* Nom.	*P* Nom.	*Q* Nom.
630	132	92	75	25	50	48	24	20	17	42	3,2	8,13 8,05	16	11	3

[a] *F* represents the maximum dimension of the effective body length including rivet heads.

[b] *M* represents the maximum and minimum dimensions.

Figure 905 – Dimensions for fuse-links with L type and U type tags



Key

1 A (fixing centres)
2 Points for measuring voltage drop
3 Tinned copper
4 Insulating board

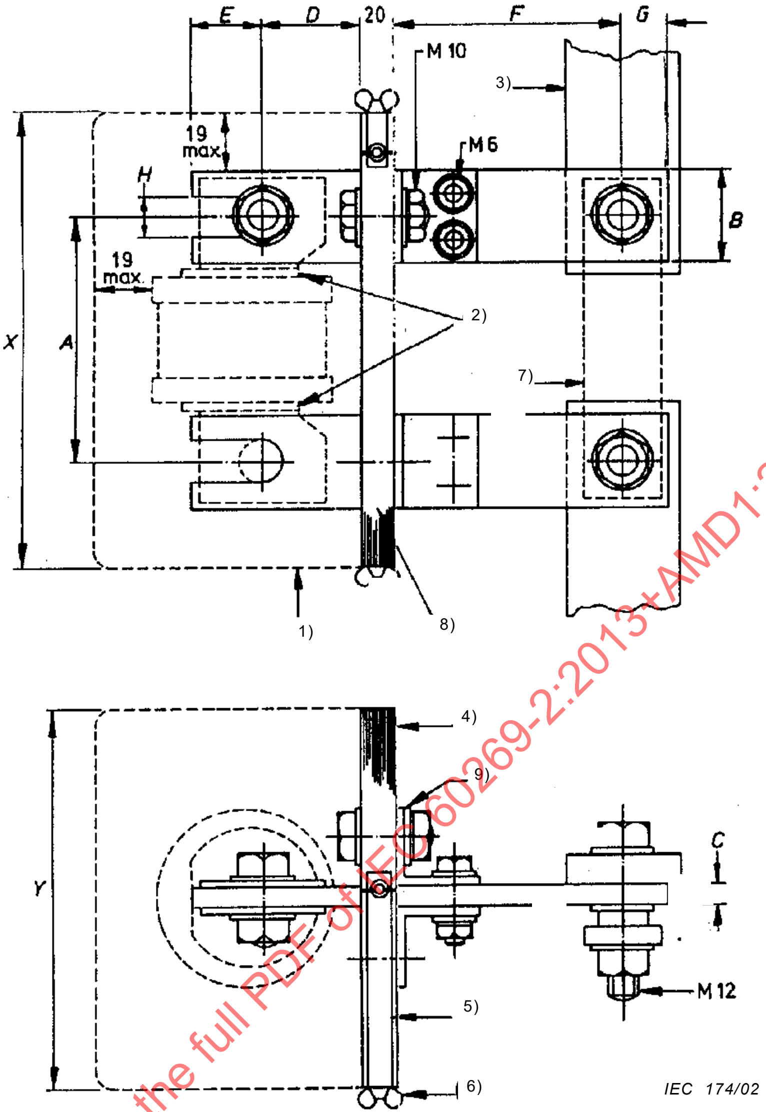
NOTE 1 Fixing bolts for external conductors as appropriate.

NOTE 2 Fuse-carrier omitted for clarity.

Dimensions in millimetres

Maximum current rating A	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*
400	82,0	31,5	6,3	35,0	24,0	76,2	16,0	13,5
630	92,0	40,0	8,0	41,3	28,6	76,2	22,3	17,5

Figure 906 – Power dissipation test rig



1) Detachable cover fabricated from woven wire cloth, mild sheet, or perforated mild steel sheet of such thicknesses as to ensure reasonable rigidity. Individual apertures in the wire cloth or perforated steel sheet not to exceed 8,5 mm^2 in area. The section of cover shown on the drawing is included by way of illustration only, and does not prejudice the use of other shapes or forms, provided that the minimum clearance between the cover and any live metal parts does not exceed 19 mm.

2) A visible gap at this position is essential to ensure that the end caps are not supported by the test rig contacts.

3) The size of the copper conductors is to be chosen by the testing laboratory and shall be appropriate to the breaking capacity.

4) The base, and the fixing of the test contacts to it, shall be of sufficient rigidity to withstand the forces encountered without applying external load to the fuse-link under test. A suitable material for the base is phenolic resin bonded paper laminated sheet.

5) Copper strip.

Figure 907 – Breaking capacity test rig *(1 of 2)*

6) Terminal for fine wire fuse. Fine wire fuse of copper wire approximately 0,1 mm in diameter, with a free length not less than 75 mm long connected between this terminal and one pole of the test supply.

7) Short-circuit link required for prospective current test. This may be slotted for easy connection. The size of the copper link is to be chosen by the test laboratory and shall be appropriate to the breaking capacity.

8) Insulating base board.

9) Mild steel angle bracket 32 × 32 × 5.

Dimensions in millimetres

Maximum current rating A	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*X*	*Y*	**Fuse-link fixing bolts**
400	82,0	31,5	6,3	35,0	24,0	76,2	16,0	13,5	152	124	M12
630	92,0	40,0	8,0	41,3	28,6	76,2	22,3	17,5	170	138	M16

Figure 907 *(2 of 2)*

Fuse system J –
Fuses with fuse-links having "gD class CC" and "gN class CC" characteristics (class CC time delay and non-time delay fuse types)

1 General

IEC 60269-1 applies with the following supplementary requirements.

1.1 Scope

The following additional requirements apply to "gD class CC" and "gN class CC" fuses which comply with the dimensions specified in Figures 1001 and 1002~~, 1003, and 1004~~. Such fuses have rated currents up to and including 30 A with cylindrical contacts. Rated voltage is 600 V a.c. and the breaking capacity is 200 kA.

Two distinct time-current characteristics, time delay and non-time delay, are inherent in this system. Both time-current characteristics comply with the same conventional fusing and non-fusing current limits and cut-off and maximum operating I^2t limits specified for the system.

The following characteristics of the fuses are specified in addition to the IEC 60269-1:

- minimum rated breaking capacities;
- time-current characteristics;
- I^2t characteristics;
- standard conditions of construction;
- power dissipation and acceptable power dissipation.

2 Terms and definitions

IEC 60269-1 applies.

3 Conditions for operation in service

IEC 60269-1 applies.

4 Classification

IEC 60269-1 applies.

5 Characteristics of fuses

IEC 60269-1 applies with the following supplementary requirements.

5.2 Rated voltage

The rated voltage is 600 V a.c.

5.3.1 Rated current of the fuse-link

In addition to the ratings specified in IEC 60269-1, suitable ratings may be selected from the R40 series and, in addition, the following ratings 5 A and 17,5 A are also acceptable. The maximum rated current is 30 A as given in Figure 1001.

5.3.2 Rated current of the fuse-holder

The maximum rated current of the fuse-holders is 30 A as given in Figure 1002.

5.5 Rated power dissipation of a fuse-link and rated acceptable power dissipation of a fuse-holder

The maximum value of rated power dissipation is given in Figure 1001. The rated acceptable power dissipation of the fuse-base shall be not less than the maximum value of rated power dissipation for the fuse-link.

5.6 Limits of the time-current characteristics

5.6.1 Time-current characteristics, time-current zones

In addition to the limits of pre-arcing time given by the gates and the conventional times and currents, the time-current zones, excluding manufacturing tolerances, are given in Figures 1005, 1006, 1007, 1008, 1009, and 1010. The tolerance on time-current characteristics shall not deviate by more than ±10 % in terms of current.

5.6.2 Conventional times and currents

For "gD class CC" and "gN class CC" fuse-links, the conventional times and currents given in Table 1001 shall apply.

Table 1001 – Conventional time and current for "gD class CC" and "gN class CC " fuse-links

Rated current I_n A	Conventional time h	Conventional current	
		I_{nf}	I_f
$I_n \leq 30$	1	1,1 I_n	1,35 I_n

5.6.3 Gates

For "gD class CC" and "gN class CC" fuse-links, the gates given in Table 1002 shall apply.

Table 1002 – Gates for specified pre-arcing times of "gD class CC" and "gN class CC " fuse-links

Fuse-link	I_n A	I_{min} (10 s)	I_{max} (5 s)	I_{min} (0,1 s)	I_{max} (0,1 s)
gD class CC	$1 \leq I_n \leq 30$	2,0 I_n	5,0 I_n	5,0 I_n	9,0 I_n
gN class CC	$1 \leq I_n \leq 30$	1,5 I_n	3,0 I_n	2,0 I_n	6,5 I_n

5.7.2 Rated breaking capacity

The rated a.c. breaking capacity shall be 200 kA.

6 Markings

IEC 60269-1 applies with the following supplementary requirements.

6.1 Markings of fuse-holders

In addition to IEC 60269-1, the following marking applies:

– size or reference.

6.2 Markings of fuse-links

In addition to IEC 60269-1, the following marking applies:

– size or reference
– rated breaking capacity.

7 Standard conditions for construction

IEC 60269-1 applies with the following supplementary requirements.

7.1 Mechanical design

The dimensions of fuse-links are given in Figure 1001 and the dimensions of fuse-bases are given in Figure 1002.

7.2 Insulating properties and suitability for insulation

The creepage distances and clearances of fuse-accessories shall meet the requirements of IEC 60664-1 for overvoltage category III.

7.5 Breaking capacity

The maximum arc voltage shown in Table 6 in IEC 60269-1 for "gN class CC" and "gD class CC" 600 V rated fuses is 3 000 V.

7.6 Cut-off current characteristics

The maximum values shall not exceed those given in Table 1005.

7.7 I^2t characteristics

The pre-arcing I^2t values at 0,01 s for "gD class CC" and "gN class CC" fuse-links shall lie within the limits indicated in Table 1003 below.

The maximum operating I^2t values are given in Table 1006.

Table 1003 – Pre-arcing I^2t values at 0,01 s for "gD class CC" and "gN class CC" fuse-links

I_n A	I^2t min. $10^3 \times A^2s$	I^2t max. $10^3 \times A^2s$
1	0,001 2	0,002 8
2	0,0035	0,008
3	0,007	0,017
4	0,015	0,035
5	0,02	0,051
6	0,03	0,072
7	0,04	0,1
9	0,06	0,15
10	0,08	0,23
12	0,11	0,32
15	0,17	0,49
17,5	0,24	0,70
20	0,31	0,93
25	0,50	1,4
30	0,70	2,1

7.8 Overcurrent discrimination

Discrimination between fuse links 15 A and over of the same type and utilization category is achieved by maintaining a 2:1 ratio between upstream fuse and downstream fuse current ratings. A ratio of 1,6:1 is possible between "gD class CC" and "gN class CC" fuse-links, provided the "gD class CC" fuse-link has the higher rated current. For rated currents smaller than 15 A, the manufacturer should be consulted.

7.9 Protection against electric shock

The protection against electric shock can be increased by means of partition walls and covers of the fuse contacts.

8 Tests

IEC 60269-1 applies with the following supplementary requirements.

8.3 Verification of temperature rise and power dissipation

8.3.1 Arrangement of the fuse

The fuse shall be mounted with its major axis in the horizontal position. The cross-sectional area of the conductor shall be 8,4 mm^2.

8.3.4.1 Temperature rise of the fuse-holder

Dummy fuse-links for class CC fuse links are shown in Figure 1003. The point at which the temperature rise is measured is marked by the letter A in Figure 1004, except dummy fuse links are used.

8.3.4.2 Power dissipation of a fuse-link

The measurement points for power dissipation are marked by the letter B in Figure 1004.

8.4 Verification of operation

8.4.1 Arrangement of the fuse

The test arrangement shall be as specified in 8.3.1.

8.4.3.3.2 Verification of gates

The following tests may be made at reduced voltage. Additional to the tests specified in 8.4.3.3.1 of IEC 60269-1, the following shall be verified for "gD class CC" and "gN class CC" fuse-links:

a) a fuse-link is subjected to the current of Table 1002, column 3 for 10 s. It shall not operate;
b) a fuse-link is subjected to the current of Table 1002, column 4. It shall operate within 5 s;
c) a fuse-link is subjected to the current of Table 1002, column 5 for 0,1 s. It shall not operate;
d) a fuse-link is subjected to the current of Table 1002, column 6. It shall operate within 0,1 s.

8.5.4 Recovery voltage

In Table 20 of IEC 60269-1 the a.c. power-frequency recovery voltage for "gN class CC" and "gD class CC" fuse links shall be (100^{+5}_{0}) % of the rated voltage, 600 V.

In Table 21 of IEC 60269-1 the d.c. mean value of recovery voltage for "gN class CC" and "gD class CC" fuse links shall be (100^{+5}_{0}) % of the rated voltage.

8.6 Verification of cut-off current characteristics

The cut-off current shall not exceed the limits shown in Table 1005.

The samples are to be arranged as for the breaking capacity test according to 8.5 and Table 20 of IEC 60269-1.

Table 1005 – Maximum cut-off current (I_c) for "gD class CC" and "gN class CC" fuse-links at 200 kA prospective current

I_n A	I_c kA
1	0,98
2	1,4
3	1,8
4	2,2
5	2,5
6	2,8
7	3,1
9	3,5
10	4,1
12	4,5
15	5,0
17,5	5,7
20	6,2
25	7,5
30	9,5

8.7 Verification of I^2t characteristics and overcurrent discrimination

The maximum operating I^2t values shall not exceed the limits shown in Table 1006. The samples are to be arranged as for the breaking capacity test according to 8.5 and Table 20 of IEC 60269-1.

Table 1006 – Maximum operating I^2t values for "gD class CC" and "gN class CC" fuse-links at 200 kA prospective current

I_n A	I^2t $10^3 \times A^2s$
1	0,0008
2	0,025
3	0,054
4	0,105
5	0,15
6	0,23
7	0,35
9	0,50
10	0,78
12	1,2
15	1,8
17,5	2,4
20	3,1
25	4,9
30	7,0

8.9 Verification of resistance to heat

Fuse-holders fitted with fuse-links having the maximum power dissipation corresponding to the power acceptance of the fuse-holder shall be cyclically loaded as pre-treatment. The pre-treatment is specified in 8.4.3.2 of IEC 60269-1. After cooling to normal temperature, the breaking capacity shall be tested at I_1 in accordance with 8.5.

Fuse-links containing organic material in the body or filler shall be subjected to the same test as described above. These fuse-links shall interrupt the test currents I_1 and I_5.

8.10 Verification of non-deterioration of contacts

Subclause 8.10 of IEC 60269-1 applies.

8.10.1 Arrangement of the fuse

Subclause 8.10.1 of IEC 60269-1 applies with the following addition.

The dummy fuse-links are given in Figure 1003, and shall have the dimensions and the maximum power dissipation, P_n(W), indicated in Figure 1001.The dummy fuse-links shall be constructed of unplated copper with exact dimensions according to the figure so that they do not operate during passage of the overload current I_{nf} .

8.10.2 Test method

The following test values shall be applied:

Test current:	non-fusing current I_{nf}
Load period:	25 % of the conventional time
No-load period:	10 % of the conventional time

A test voltage lower than the rated voltage may be used.

8.10.3 Acceptability of test results

After 250 cycles, the measured temperature-rise values shall not exceed the temperature rise measured at the beginning of the tests by more than 15 K.

After 750 cycles, if necessary, the temperature shall not exceed the values measured before the beginning of the tests by more than 20 K.

8.11 Mechanical and miscellaneous tests

8.11.1.1 Mechanical strength of fuse-holders

The fuse-holder, fitted with a dummy fuse-link according to Figure 1003 or fitted with a fuse-link of the largest rated current and power dissipation that can be accommodated by the fuse-holder, shall be subjected to a temperature-rise test at rated current.

At the conclusion of the temperature-rise test, the fuse-link or the fuse-carrier, as appropriate, shall be withdrawn and inserted into the fuse-base 100 times.

At the conclusion of these tests, all parts shall be intact and shall function normally.

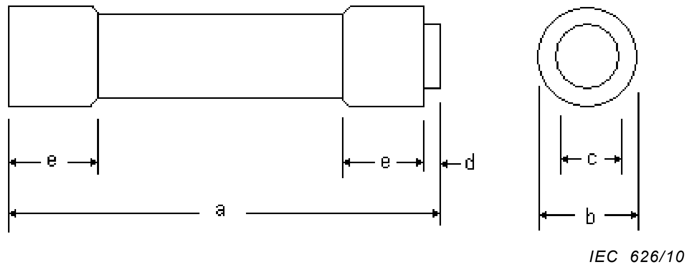
Compliance shall be verified by a further temperature-rise test at rated current at the conclusion of which the values obtained shall be not more than 5 K or 15 % (whichever is greater) above the values obtained from the temperature rise test prior to the commencement of the mechanical test.

8.11.2 Miscellaneous tests

8.11.2.2 Verification of resistance to abnormal heat and fire

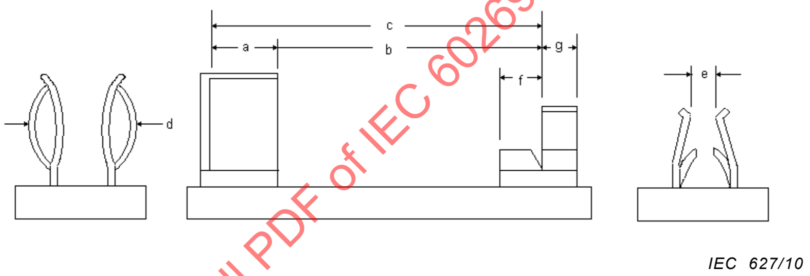
Under consideration.

FIGURES



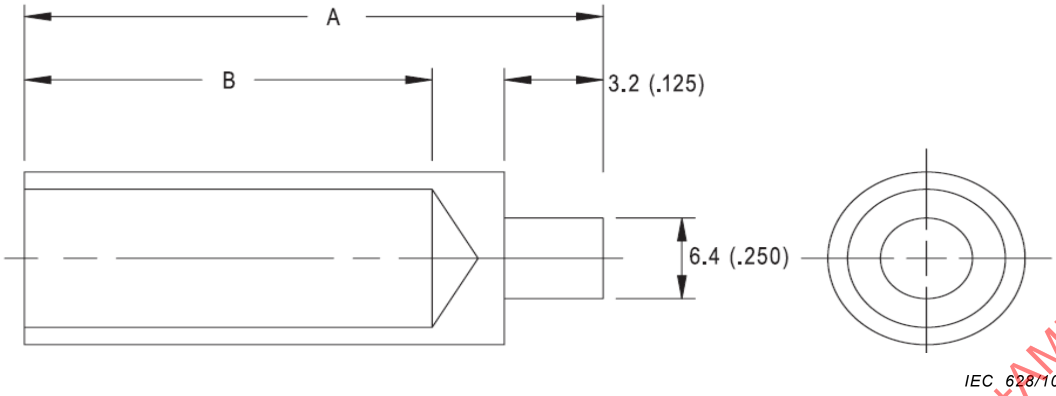
AC 600 V		Dimensions mm				
I_n A	P_n W	*a* ± 0,79	*b* ± 0,13	*c* ± 0,13	*d* Min.	*e* Min.
1 to 30	8	38,10	10,29	6,35	3,05	9,4

Figure 1001 – Class CC fuse-links (1 A to 30 A)



I_n max. A	Dimensions mm						
	a	*b*	*c*	*d*	*e*	*f*	*g*
	Minimum width contact clip	**Distance between contact clips**	**Minimum distance between end stop**	**Nominal diameter fuse-link contact**	**Nominal diameter fuse-link contact**	**Maximum width of fuse-link support**	**Minimum width contact clip**
30	9,4	25,65	34,26	10,29	6,35	9,4	3,05

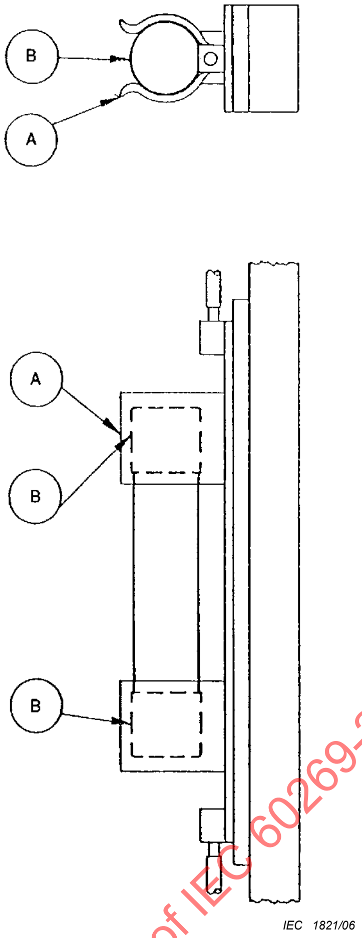
Figure 1002 – Fuse-base and contacts for class CC fuse-links 1 A to 30 A



Dimensions in mm (in)

Rating A	**Class of fuse**	**Shape**	**Dimensions** mm			
			Outside diameter	**Wall thickness**	***A***	***B***
30	CC	Tube	10,31	1,17	38,1 [a]	34,1 [a]
NOTE Dummy fuse-links are manufactured of unplated copper.						
[a] Tolerance ± 0,79.						

Figure 1003 – Class CC dummy fuse-link dimensions



Key

A measurement points for temperature

B measurement point for power dissipation

Figure 1004 – Temperature test arrangement

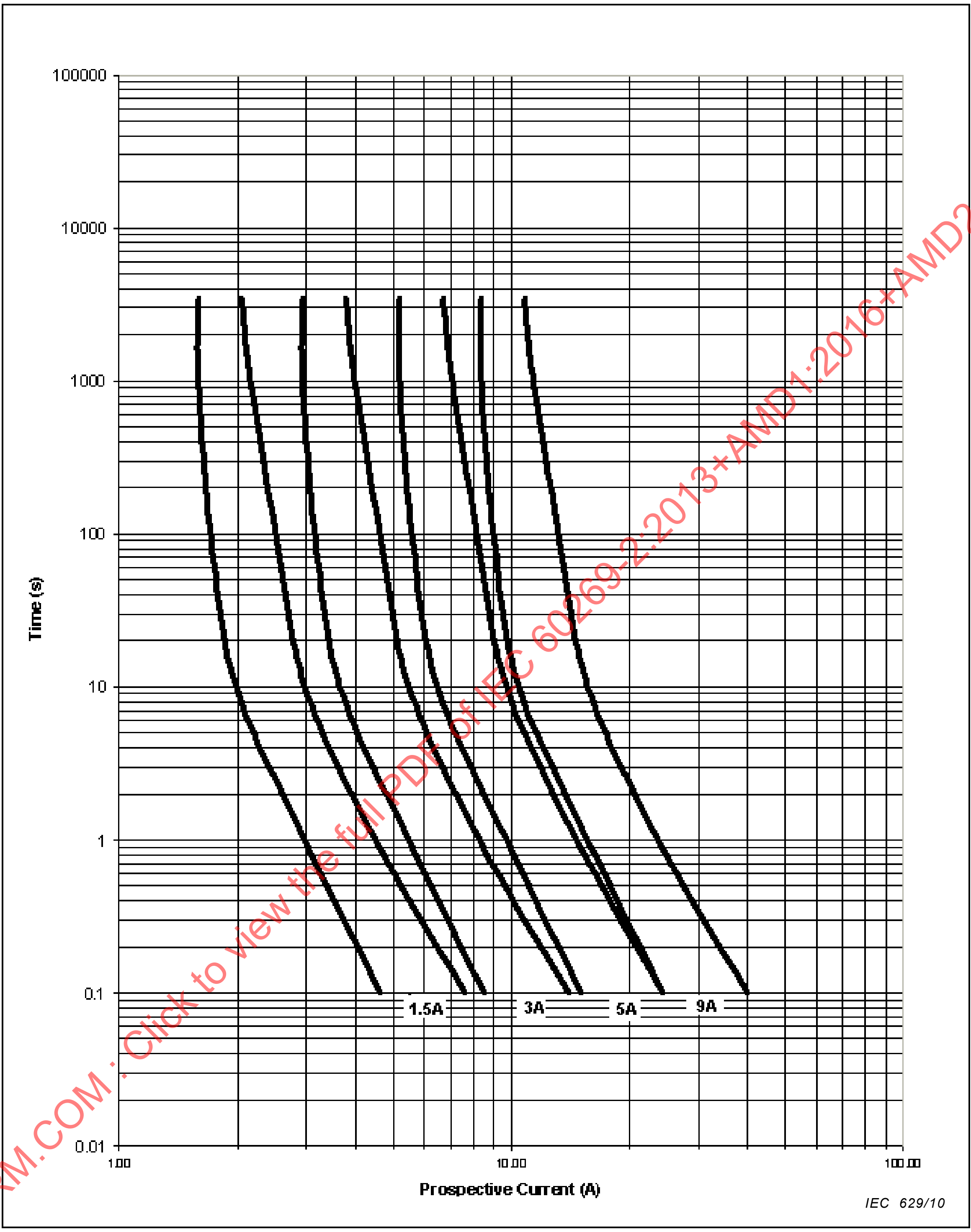


Figure 1005 – Time-current zones for class CC "gN" fuses

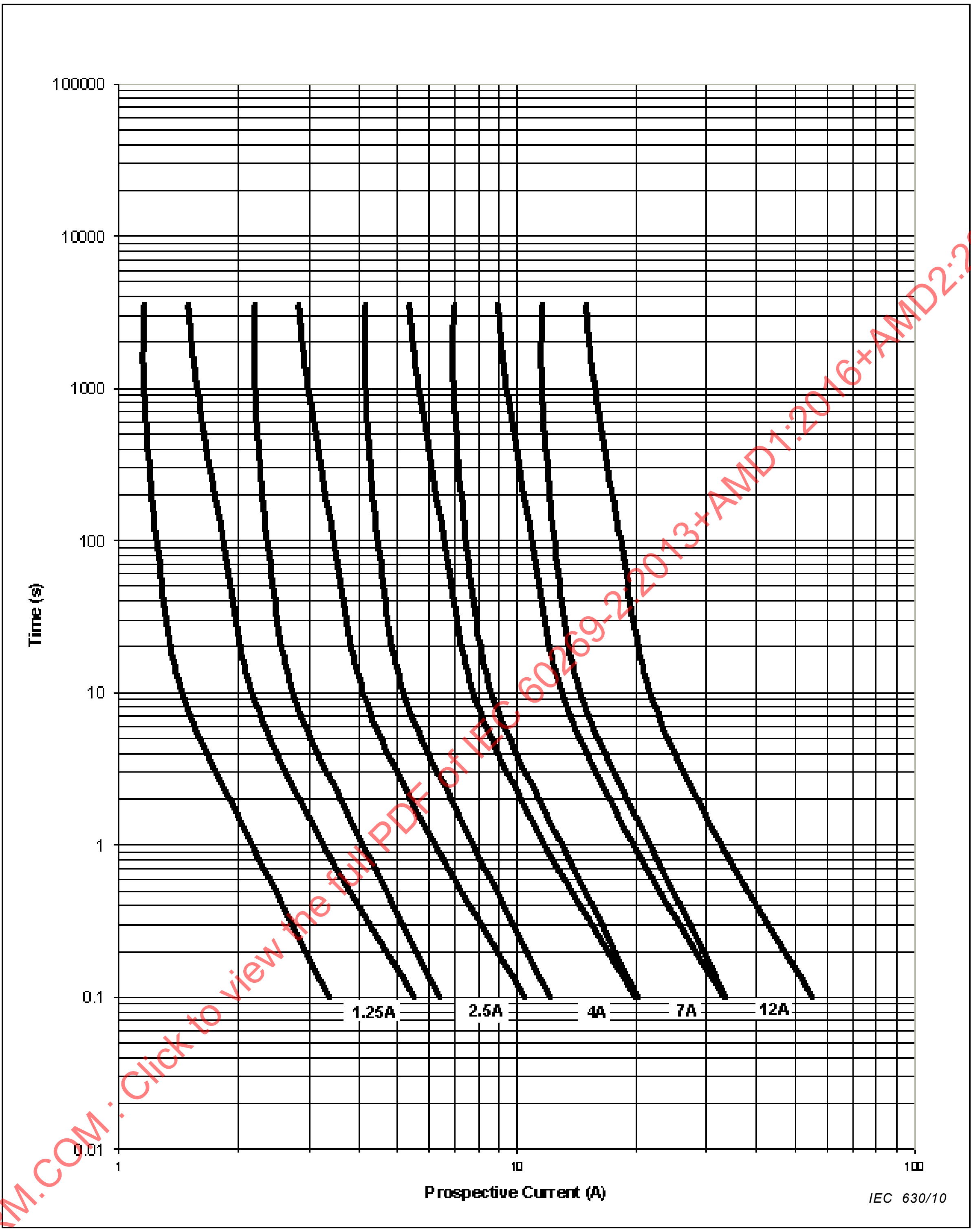
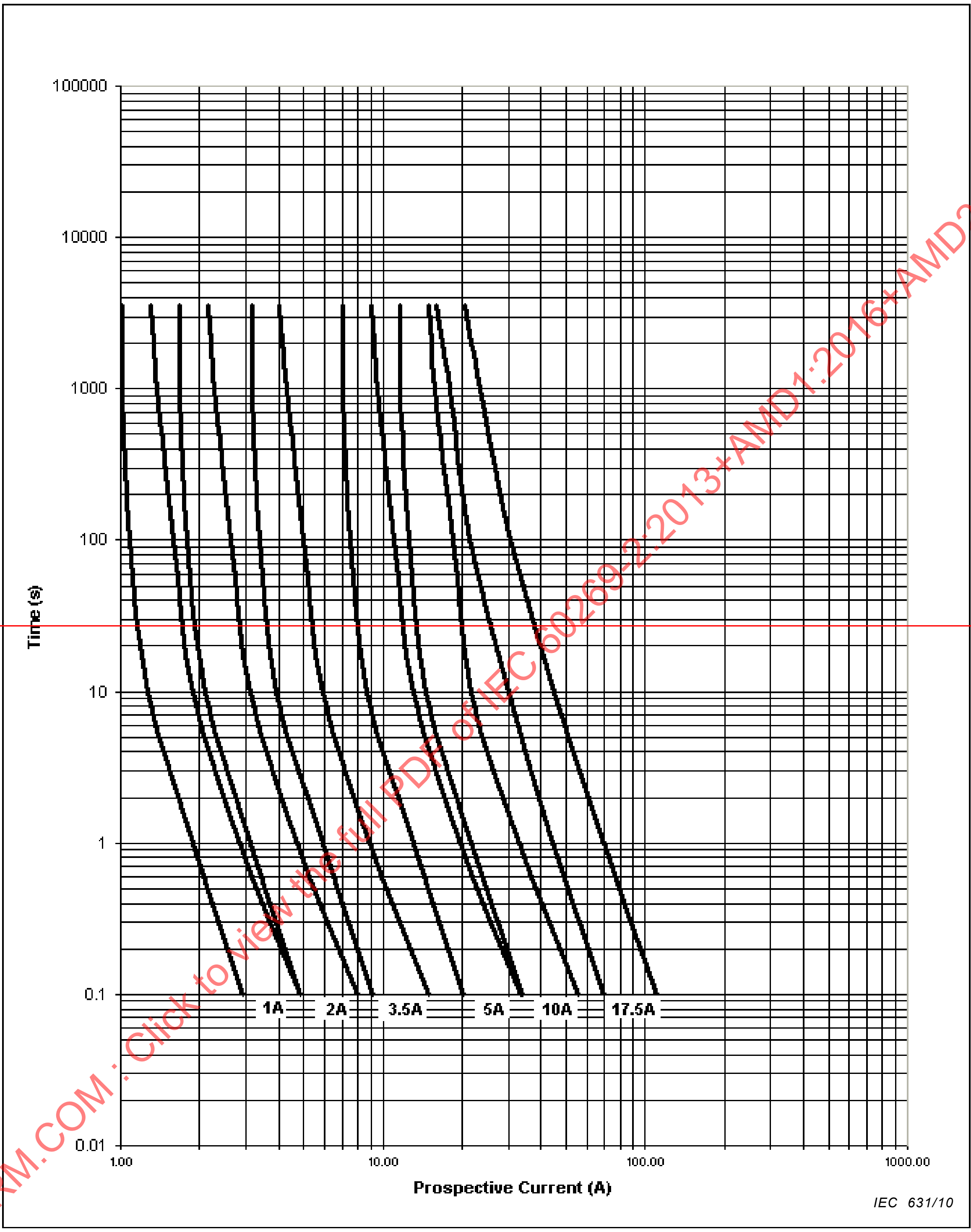


Figure 1006 – Time-current zones for class CC “gN” fuses


100000
10000
1000
100
10
1
0.1
0.01
Time (s)
1A
2A
3.5A
5A
10A
17.5A
1.00
10.00
100.00
1000.00
Prospective Current (A)
IEC 631/10

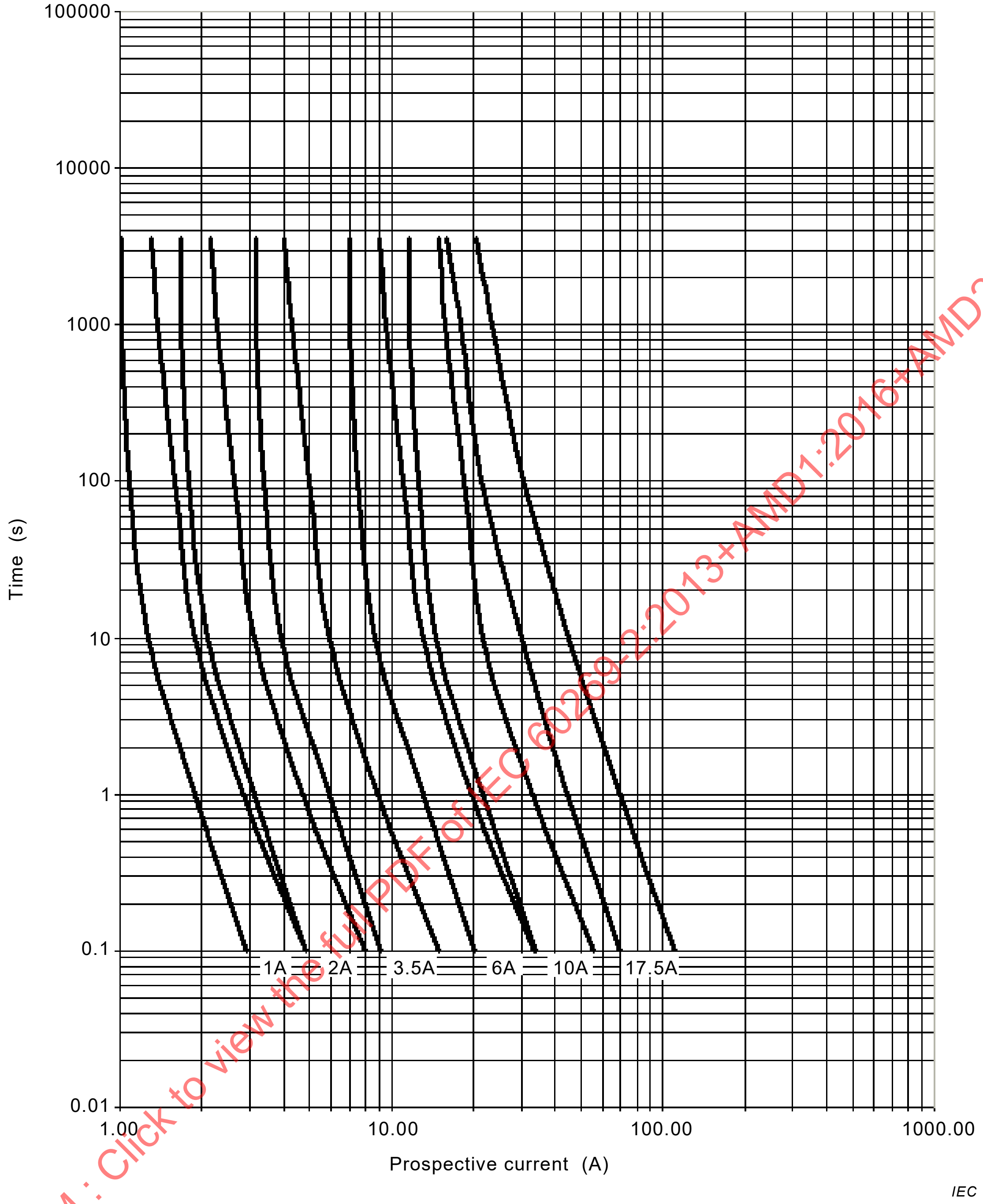


Figure 1007 – Time-current zones for class CC "gN" fuses

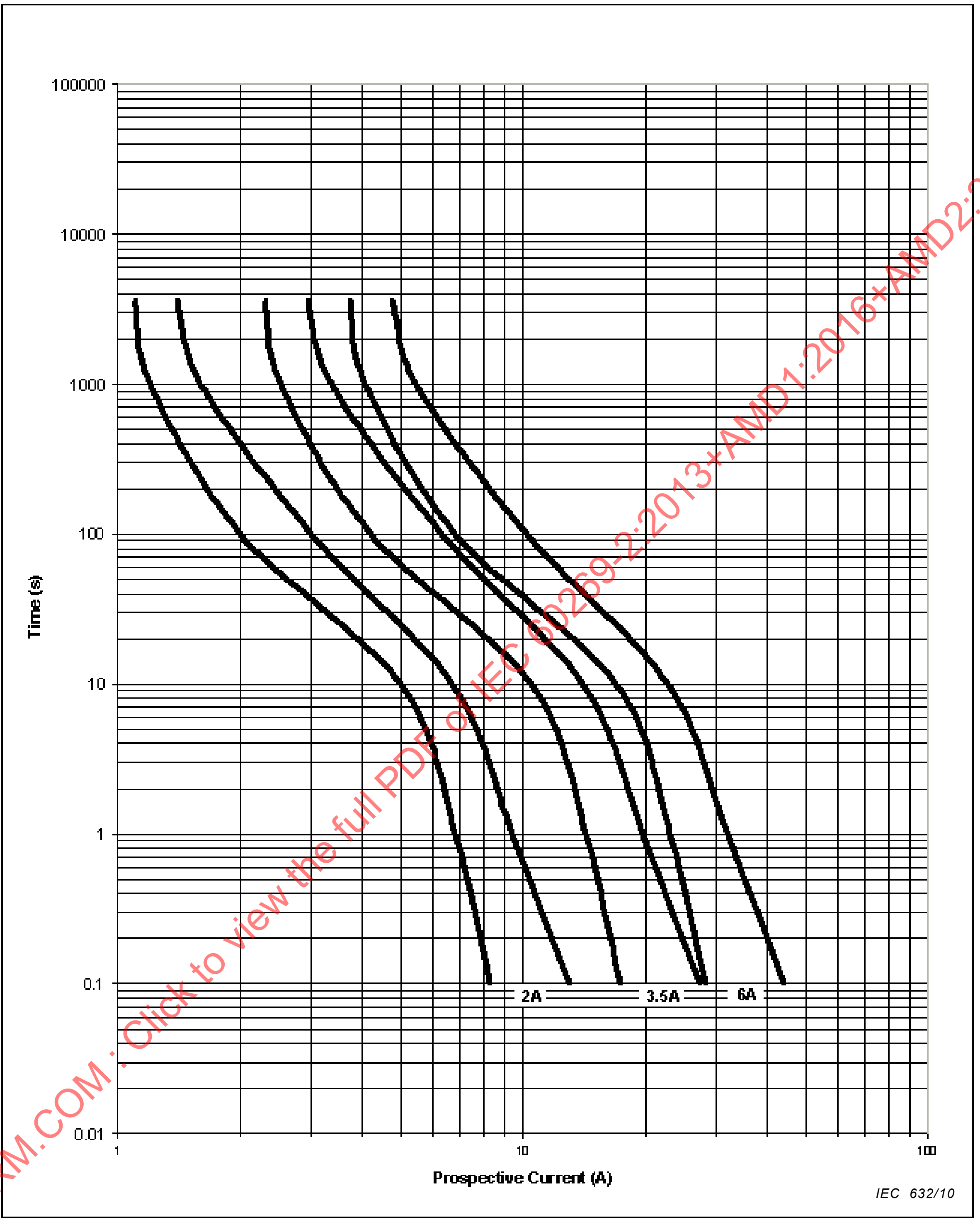


Figure 1008 – Time-current zones for class CC "gD" fuses

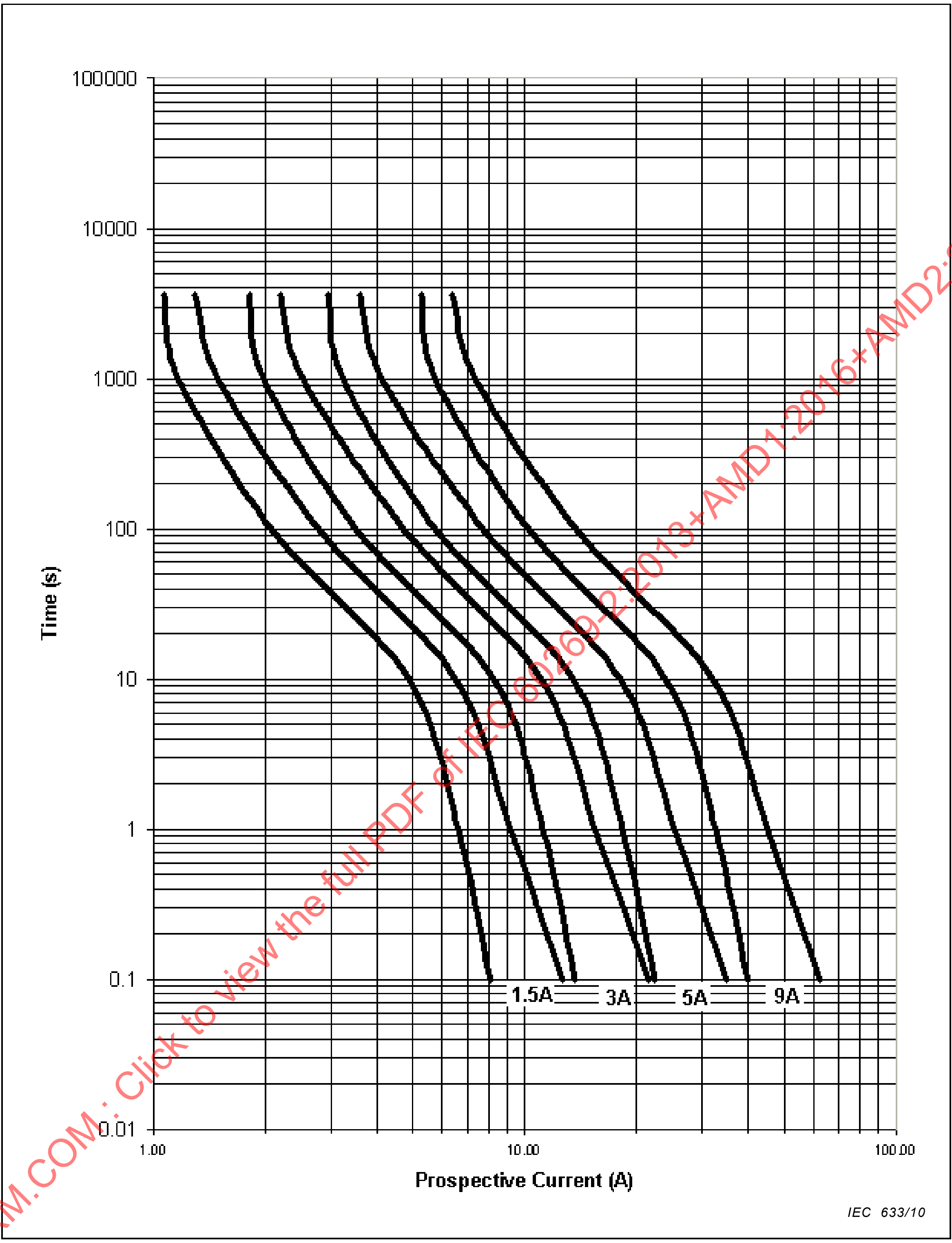


Figure 1009 – Time-current zones for class CC “gD” fuses

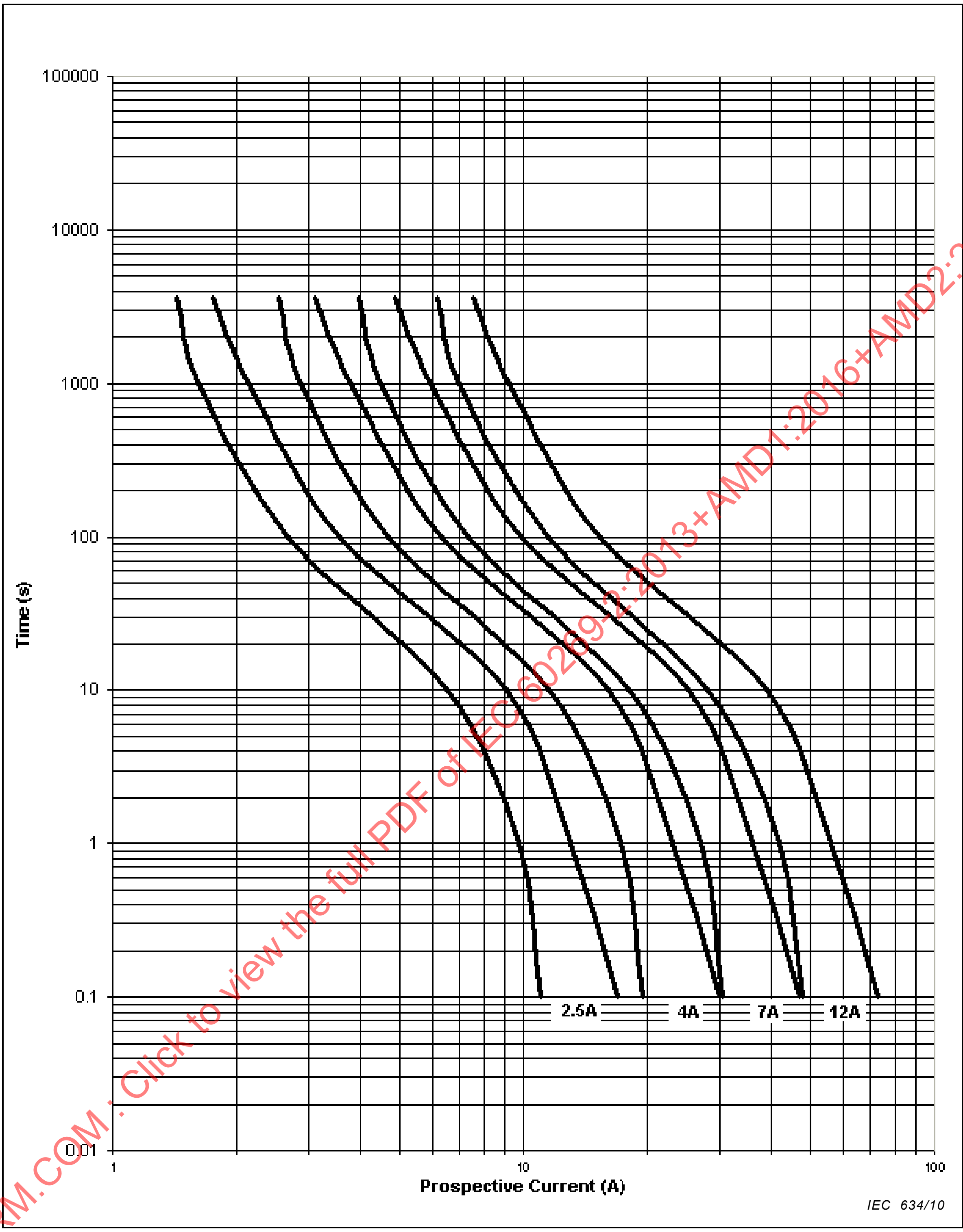


Figure 1010 – Time-current zones for class CC "gD" fuses

**Fuse system K –
gK fuse-links with blade contacts for bolted connections –
High current fuse-link ratings from 1 250 A up to 4 800A
(Master fuse-links)**

1 General

IEC 60269-1 applies with the following supplementary requirements.

1.1 Scope

The following additional requirements apply to "gK" fuse-links having blade contacts for bolted connections which complies with the dimensions specified in Figure 1101. Such fuses have rated currents from 1250 A up to 4800 A and rated voltage up to and including 690 V a.c. or 500 V d.c.

The following characteristics of the fuses are specified in addition to IEC 60269-1:

- rated values;
- power dissipation and acceptable power dissipation;
- time-current characteristics;
- minimum rated breaking capacities;
- cut-off current characteristics and their I^2t characteristics;
- standard conditions of construction.

2 Terms and definitions

IEC 60269-1 applies.

3 Conditions for operation in service

IEC 60269-1 applies with the following supplementary requirements.

3.9 Discrimination of fuse-links

Limits of discrimination for times greater than 0,1 s are given in Table 1103.

For “gK” fuse-links pre-arcing I^2t values and operating I^2t values are given in are given in Table 1105.

4 Classification

IEC 60269-1 applies.

5 Characteristics of fuses

IEC 60269-1 applies with the following supplementary requirements.

5.2 Rated voltage

For a.c., the standard values of rated voltage are 400 V, 500 V and 690 V. For d.c., the rated voltages are 250 V, 440 V and 500 V.

The standard values of d.c. rated voltage are not related to the standard values of a.c. rated voltage. For example the following standard combinations are possible: 500 V a.c. and 250 V d.c., 500 V a.c. and 500 V d.c., 690 V a.c. and 440 V d.c., etc.

5.3.1 Rated current of the fuse-link

In addition to the ratings specified in IEC 60269-1, the suitable ratings are selected from the series: 1 250 – 1 600 – 2 000 – 2 500 – 3 200 – 4 000 – 4 800.

For each size, the maximum rated current is given in Figure 1101.

5.3.2 Rated current of the fuse-holder

The maximum rated currents for different connecting dimensions are given in Figure 1102.

5.5 Rated power dissipation of a fuse-link and rated acceptable power dissipation of a fuse-holder

The maximum values of rated power dissipation permitted for fuse-links when tested in accordance with 8.3.1 are specified in Table 1101 when measured on the standard test rig shown in Figure 1102.

Table 1101 – Maximum power dissipation values for «gK» fuse-links

Fuse size Drawing	500 V a.c.		690 V a.c.	
	I_n A	P_n W	I_n A	P_n W
D			1 250	100
D			1 600	125
E	2 000	150	2 000	150
E	2 500	190	2 500	190
F	3 200	230	3 200	230
G	4 000	280		
G	4 800	330		

NOTE 1 The fuse size drawing is shown in Figure 1101.

NOTE 2 The point of measurement of voltage for determination of power dissipation is shown in Figure 1103.

5.6 Limits of the time-current characteristics

5.6.1 Time-current characteristics, time-current zones

The tolerance on time-current characteristics given by the manufacturer shall not deviate by more than ±10 % in terms of current. The time-current zones given in Figure 1104, including manufacturing tolerances shall be met by all pre-arcing and total times measured at the test voltage according to 8.7.

5.6.2 Conventional times and currents

The conventional times and currents are given in Table 1102.

Table 1102 – Conventional time and current for «gK» fuse-links

Rated current *I*n for «gK»	Conventional time	Conventional current	
A	h	I_{nf}	I_f
I_n >= 1 250	4	1,25 I_n	1,6 I_n

5.6.3 Gates

For "gK" fuse-links the gates given in Table 1103 apply,

Table 1103 – Gates for specified pre-arcing and operating times of "gK" fuse-links

I_n A	I_{min} (10 s) A	I_{max} (5 s) A	I_{min} (0,1 s) A	I_{max} (0,1 s) A
1 250	5 300	9 600	13 000	21 800
1 600	6 800	12 600	17 000	28 000
2 000	8 700	16 100	21 800	35 400
2 500	11 100	20 500	28 000	44 600
3 200	14 300	26 500	35 400	56 500
4 000	18 500	34 400	44 600	72 200
4 800	23 000	42 500	56 500	87 000

5.7.2 Rated breaking capacity

The minimum rated breaking capacities for "gK" fuse-links are specified in Table 1104.

Table 1104 – Minimum rated breaking capacities for "gK" fuse-links

Rated voltage	Minimum rated breaking capacities
≤ 500 V a.c.	200 kA
690 V a.c.	160 kA
≤ 500 V d.c.	100 kA

6 Markings

IEC 60269-1 applies with the following supplementary requirements.

Fuse-links which meet the requirements and tests of "gK" fuse system K of this standard may be marked with IEC 60269-2.

6.2 Markings of fuse-links

In addition to IEC 60269-1, the following marking applies:

– size or reference

7 Standard conditions for construction

IEC 60269-1 applies with the following supplementary requirements.

7.1 Mechanical design

The dimensions of "gK" fuse-links system K is given in Figure 1101. The connecting dimensions used for these is given in Figure 1102.

7.1.3 Fuse-contacts

The contact surfaces of fuse-links system K and bus bars should be silver-plated, otherwise it shall be verified that contacting is not impaired in normal operation.

7.6 Cut-off current characteristics

The maximum values shall not exceed those given in Table 1107.

7.7 I^2t characteristics

For the fuse-links covered by this "gK" fuse system K the pre-arcing I^2t values and operating I^2t values shall be within the limits given in Table 1105.

Table 1105 – Pre-arcing and operating I^2t values at 0,01 s for "gK" fuse-links

I_n A	I^2t_{min} k A²s	I^2t_{max} k A²s
1 250	2 700	7 900
1 600	4 760	13 700
2 000	7 900	23 800
2 500	13 700	40 000
3 200	23 800	66 000
4 000	40 000	120 000
4 800	66 000	185 000

7.8 Over-current selectivity of "gK" fuse-links

"gK" fuse-links with rated current ratio of 1:1,6 have to discriminate up to the values specified in 8.7.

7.9 Protection against electric shock

The protection against electric shock can be increased by means of partition walls and covers of the fuse contacts.

8 Tests

IEC 60269-1 applies with the following supplementary requirements.

8.3 Verification of temperature rise and power dissipation

8.3.1 Arrangement of the fuse

The fuse shall be mounted with its major axis in the horizontal position. Each terminal of the fuse-link shall be connected to a copper bus bar which is silver plated at the point of contact with dimensions in accordance with the values given in Figure 1102.

The cross-sectional area of the bus bar shall be selected in accordance with the values given in Table 1106 below.

Table 1106 – Cross-sectional area of copper conductors for tests corresponding to 8.3 and 8.4

Rated current A	Cross-sectional area mm^2
1 250	800
1 600	1 200
2 000	1 500
2 500	2 000
3 200	2 500
4 000	3 000
4 800	4 000

8.3.4.2 Power dissipation of a fuse-link

The measurement points for power dissipation are marked by the letter A in Figure 1103.

8.4.1 Arrangement of the fuse

The test arrangement shall be as specified in 8.3.1.

8.4.3.1 Verification of conventional non-fusing and fusing current

In case the non-fusing current test is also used for the verification of the time-current characteristic a second test specimen shall be used for b).

8.6 Verification of cut-off current characteristics

The cut-off current shall not exceed the limits shown in Table 1107.

The samples are to be arranged as for the breaking capacity test according to 8.5 and Table 20 of IEC 60269-1.

Table 1107 – Maximum cut-off current (I_c) for "gK"fuse-links (1 250 A to 4 800 A) at 100 kA prospective current

I_n A	I_c kA
1 250	92
1 600	110
2 000	135
2 500	150
3 200	200
4 000	230
4 800	260

8.7 Verification of I^2t characteristics and over-current selectivity

The over-current selectivity of 1:1,6 for "gK" fuse-links is verified by the I^2t values evaluated from the recorded test results.

The samples are arranged as for the breaking capacity test according to 8.5 and Table 20 and Table 21 of IEC 60269-1 regarding the test circuit and tolerance of current.

Four samples are tested, two samples are tested at the r.m.s. prospective test current I, corresponding to the minimum pre-arcing I^2t values (see Table 1108), the other samples at the r.m.s. prospective test current I, corresponding to the operating I^2t values (see Table 1108).

~~The test voltage tolerance for 690 V fuses is 100 +10/ 0 %.~~

~~The test voltage tolerance for all other fuses is 100 +15/ 0 %.~~

The test voltage tolerance for all fuses is $\frac{1{,}1 \times U_n}{\sqrt{3}}$ with tolerances of –3 % / +2 %.

Table 1108 – Test currents and I^2t limits for "gK" fuse-links selectivity test

I_n	Minimum pre-arcing I^2t		Maximum operating I^2t		Discrimination ration
	Prospective I r.m.s.	I^2t	Prospective I r.m.s.	I^2t	
A	kA	kA²s	kA	kA²s	
1 250	24	2 300	41	6 700	
1 600	32	4 100	54	11 700	
2 000	41	6 700	71	20 000	
2 500	54	11 700	92	34 000	1 : 1,6
3 150	71	20 000	120	55 000	
4 000	92	34 000	160	102 000	
4 800	116	55 000	197	155 000	

The evaluated I^2t values shall lie within the corresponding I^2t limits specified in Table 1108.

NOTE The over-current selectivity for "gK" fuse-links system K is 1:3,2 with the "gG" fuse-links, fuse system A, B, C and D.

8.9 Verification of resistance to heat

Busbars fitted with fuse-links having the maximum power dissipation shall be cyclically loaded as pre treatment. The pre-treatment is specified in 8.4.3.2 of IEC 60269-1. After cooling to normal temperature the breaking capacity shall be tested at I_1 in accordance with 8.5 of IEC 60269-1.

Fuse-links containing organic material in the body or filler shall be subjected to the same test as describe above. These fuse-links shall interrupt the test currents I_1 and I_5.

8.10 Verification of non-deterioration of contacts

Subclause 8.10 of IEC 60269-1 applies.

8.10.1 Arrangement of the fuse

Subclause 8.10.1 of IEC 60269-1 applies with the following addition.

The fuse-links shall have the dimensions indicated in Figure 1101 and the maximum power dissipation, P_n(W), indicated in Table 1101.

The fuse-links shall not operate during passage of the overload current I_{nf}.

8.10.2 Test method

Subclause 8.10.2 of IEC 60269-1 applies with the following test values:

Test current	non-fusing current I_{nf}
Load period	25 % of the conventional time
No-load period	10 % of the conventional time

A test voltage lower than the rated voltage may be used.

8.10.3 Acceptability of test results

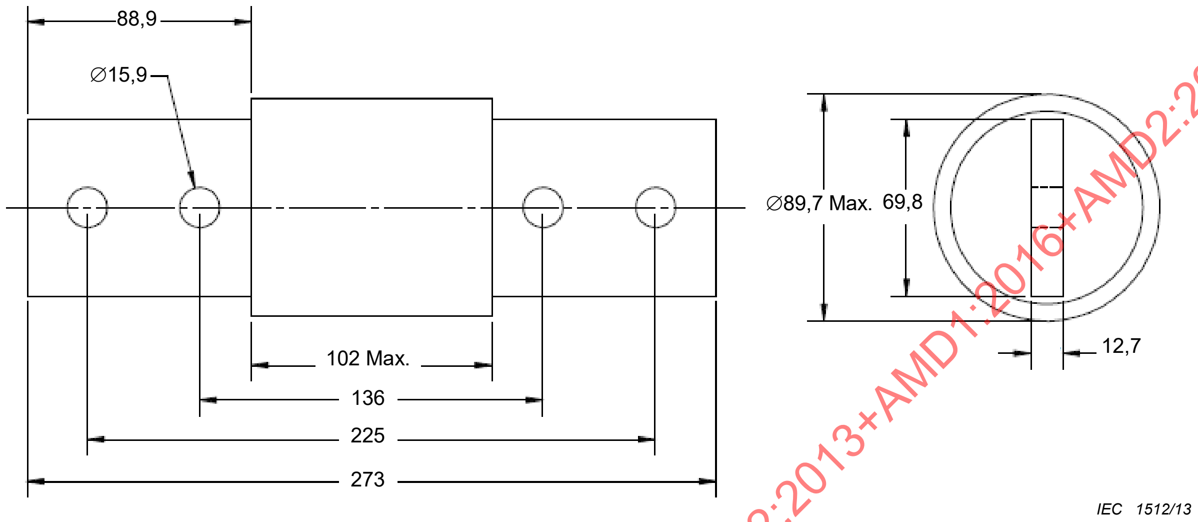
The permissible changes given are based on laboratory experience. The final criterion shall be met; it is not the summation of the intermediate criteria.

8.11.2.2 Verification of resistance to abnormal heat and fire

Under consideration.

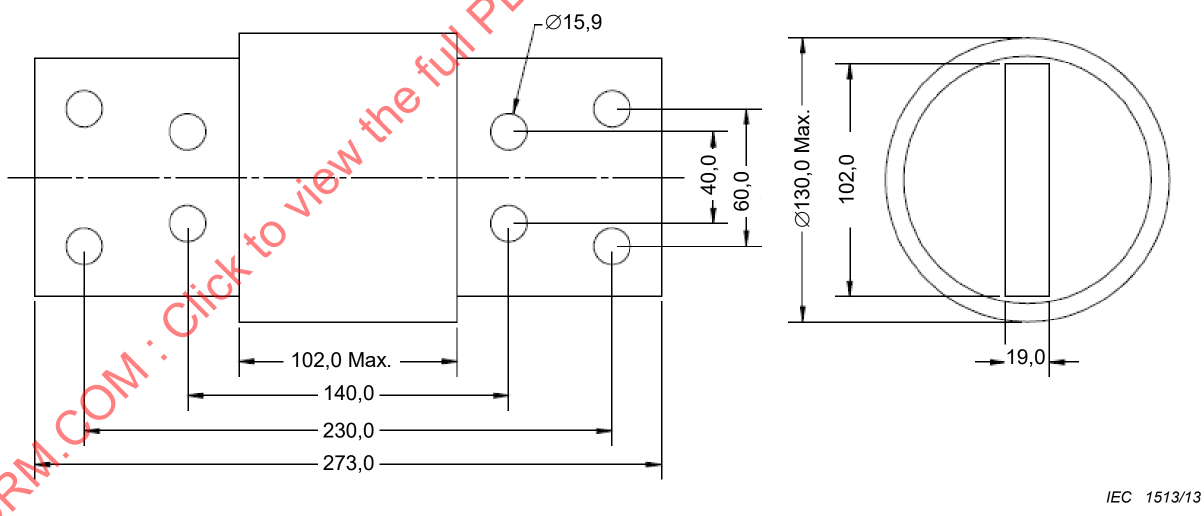
FIGURES

Dimensions in millimetres - tolerance ± 1 mm



D (1 250 A to 1 600 A)

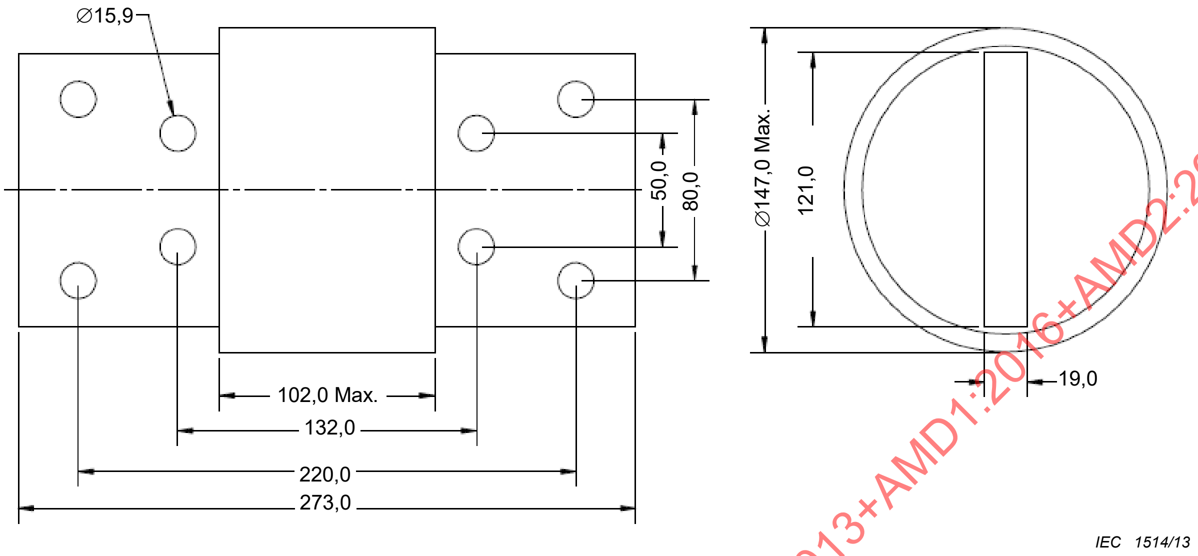
Dimensions in millimetres - tolerance ± 1 mm



E (2 000 A to 2 500 A)

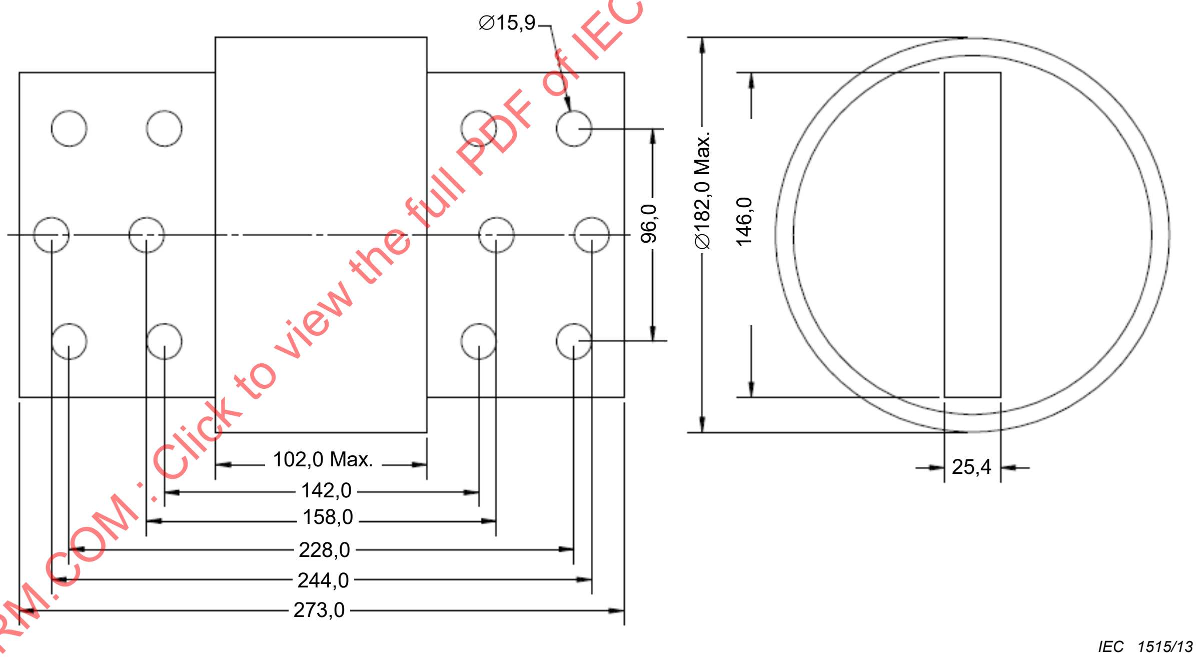
Figure 1101 – "gK" fuse-links *(1 of 2)*

Dimensions in millimetres - tolerance ±1 mm



F (3 200 A)

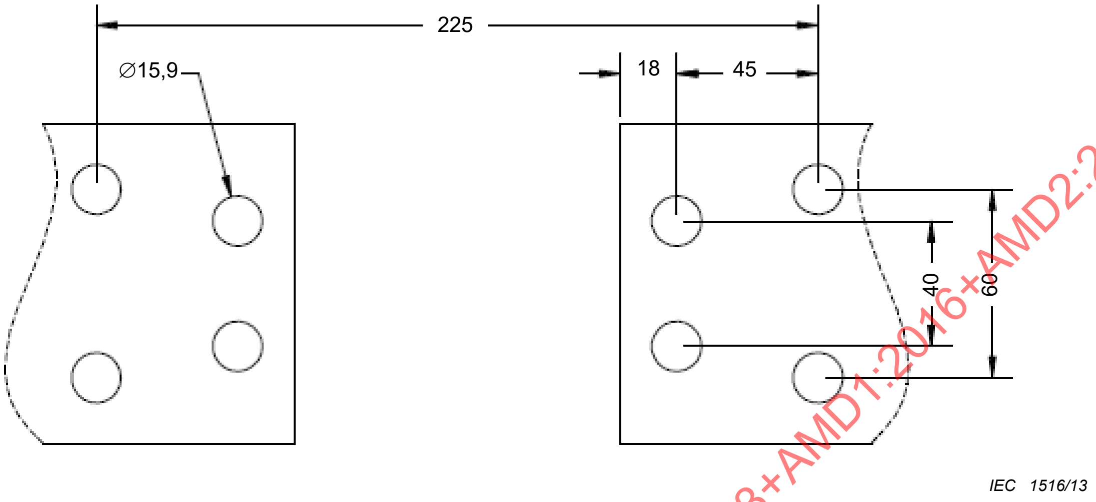
Dimensions in millimetres - tolerance ±1 mm



G (4 000 A to 4 800 A)

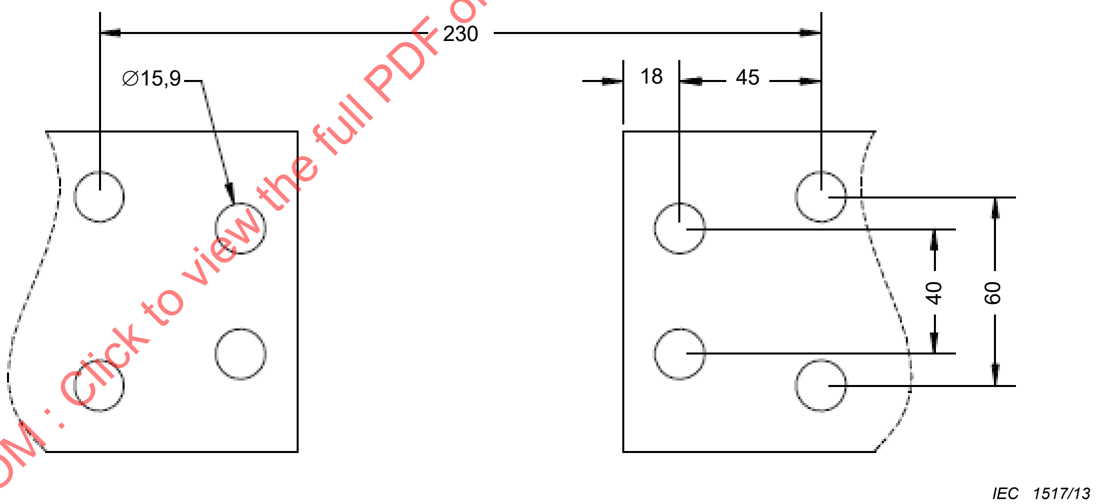
Figure 1101 *(2 of 2)*

Dimensions in millimetres - tolerance +/- 1 mm



D (1 250 A to 1 600 A)

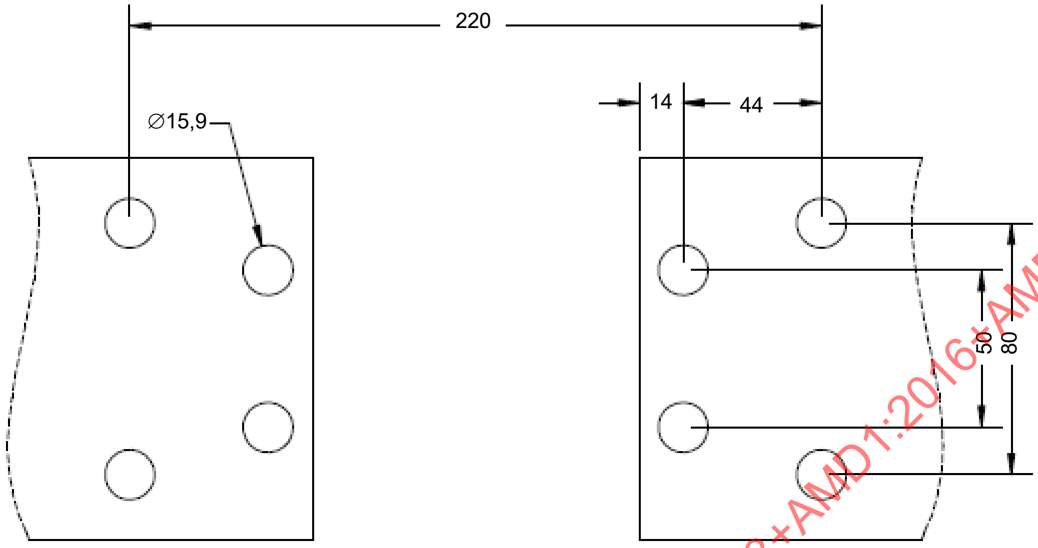
Dimensions in millimetres - tolerance +/- 1 mm



E (2 000 A to 2 500 A)

Figure 1102 – Connecting dimensions for "gK" fuse-links *(1 of 3)*

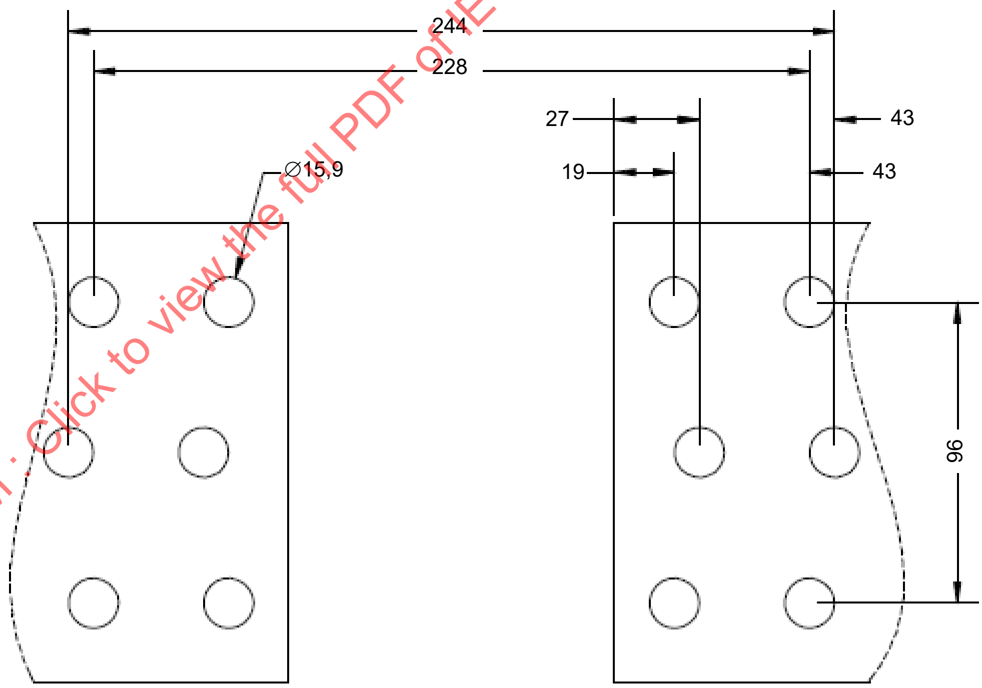
Dimensions in millimetres - tolerance mm



IEC 1518/13

F (3 200 A)

Dimensions in millimetres - tolerance ± 1 mm



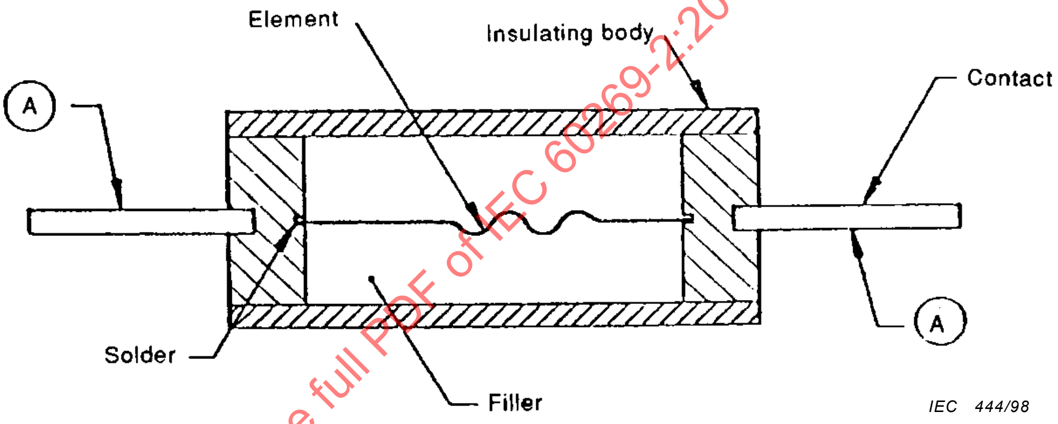
IEC 1519/13

G (4 000 A to 4 800 A)

Figure 1102 *(2 of 3)*

Fuse size Drawing	Rated current of fuse-links A	Contact width mm
D	1 250	60
	1 600	70
E	2 000	90
	2 500	100
F	3 200	120
G	4 000	130
	4 800	150

Figure 1102 *(3 of 3)*



A – Measurement points for voltage

Figure 1103 – Dummy fuse-link

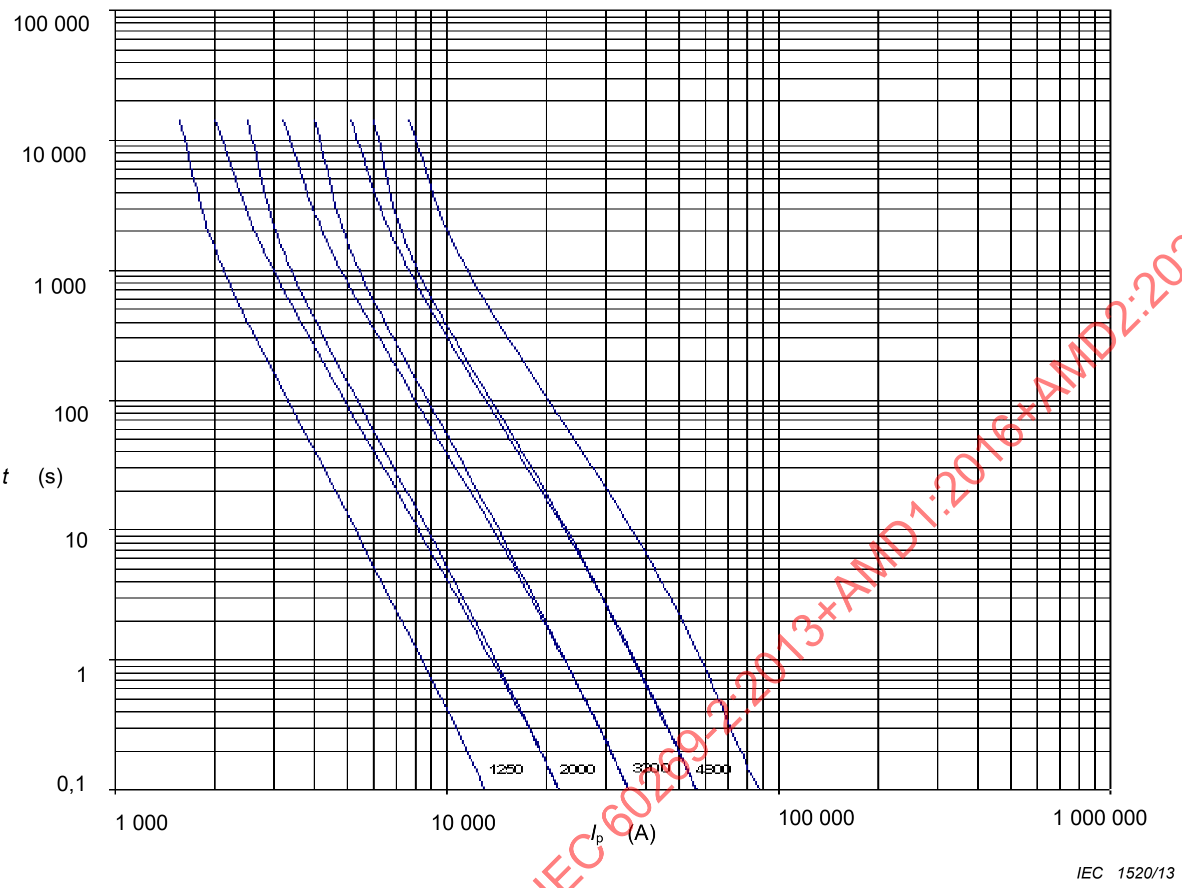


Figure 1104 – Time-current zones for “gK” fuse system K *(1 of 2)*

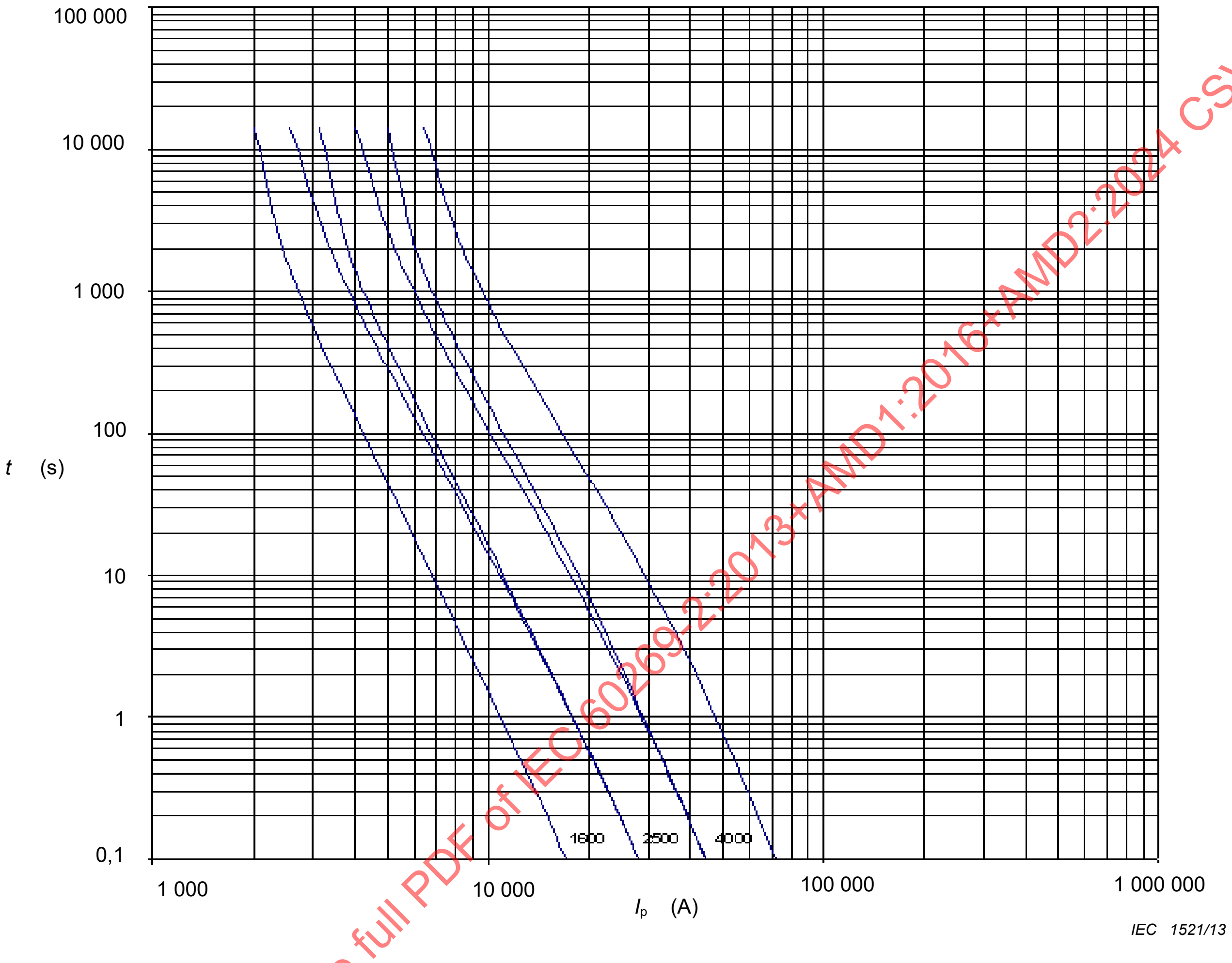


Figure 1104 *(2 of 2)*

Bibliography

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

IEC 60060-2, *High-voltage test techniques – Part 2: Measuring systems*

IEC 60060-3, *High-voltage test techniques – Part 3: Definitions and requirements for on-site testing*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60672-1, *Ceramic and glass insulating materials – Part 1: Definitions and classification*

IEC 60672-2, *Ceramic and glass insulating materials – Part 2: Methods of test*

IEC 60672-3, *Ceramic and glass insulating materials – Part 3: Specifications for individual materials*

IEC/TR 60943, *Guidance concerning the permissible temperature rise for parts of electrical equipment, in particular for terminals.*

IEC 62262, *Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)*

ISO 898-1, *Mechanical properties of fasteners made of carbon steel and alloy steel – Part 1: Bolts, screws and studs with specified property classes – Coarse thread and fine pitch thread*

ISO 1207, *Slotted cheese head screws – Product grade A*

ISO 4589-1, *Plastics – Determination of burning behaviour by oxygen index – Part 1: Guidance*

EN 50102, *Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)*

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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LOW-VOLTAGE FUSES –

Part 2: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) – Examples of standardized systems of fuses A to K

FOREWORD

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This consolidated version of the official IEC Standard and its amendments has been prepared for user convenience.

IEC 60269-2 edition 5.2 contains the fifth edition (2013-07) [documents 32B/611/FDIS and 32B/615/RVD], its amendment 1 (2016-08) [documents 32B/641/CDV and 32B/648/RVC] and its amendment 2 (2024-06) [documents 32B/743/FDIS and 32B/755/RVD].

This Final version does not show where the technical content is modified by amendments 1 and 2. A separate Redline version with all changes highlighted is available in this publication.

International Standard IEC 60269-2 has been prepared by subcommittee 32B: Low-voltage fuses, of IEC technical committee 32: Fuses.

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

a) fuse systems A and B: modified values for the power dissipation of NH aM fuse-links;

b) fuse systems A and B: introduction of dimension r for NH fuse-links;

c) addition of new fuse system K: gK fuse-links with contacts for bolted connections.

This part is to be used in conjunction with IEC 60269-1:2006, *Low-voltage fuses – Part 1: General requirements* and its Amendment 1 (2009).

This Part 2 supplements or modifies the corresponding clauses or subclauses of Part 1.

Where no change is necessary, this Part 2 indicates that the relevant clause or subclause applies.

Tables and figures which are additional to those in Part 1 are numbered starting from 101 in fuse system A, from 201 in fuse system B, etc. Additional annexes are numbered AA, BB, etc.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 60269 series, published under the general title *Low-voltage fuses*, can be found on the IEC website.

The committee has decided that the contents of this document and its amendments will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

IMPORTANT – The *'colour inside'* logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

IEC 60269 consists of the following parts, under the general title *Low-voltage fuses*:

Part 1: General requirements

Part 2: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) – Examples of standardized systems of fuses A to K

Part 3: Supplementary requirements for fuses for use by unskilled persons (fuses mainly for household or similar application) – Examples of standardized systems of fuses A to F

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

Part 5: Guidance for the application of low-voltage fuses

Part 6: Supplementary requirements for fuse-links for the protection of solar photovoltaic energy systems

LOW-VOLTAGE FUSES –

Part 2: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) – Examples of standardized systems of fuses A to K

1 General scope

1.1 Scope

Fuses for use by authorized persons are generally designed to be used in installations where the fuse-links are accessible to, and may be replaced by, authorized persons only.

Fuses for use by authorized persons according to the following fuse systems also comply with the requirements of the corresponding subclauses of IEC 60269-1, unless otherwise defined in this standard.

This standard is divided into fuse systems, each dealing with a specific example of standardized fuses for use by authorized persons:

Fuse system A:	Fuses with fuse-links with blade contacts (NH fuse system)
Fuse system B:	Fuses with striker fuse-links with blade contacts (NH fuse system)
Fuse system C:	Fuse-rails (NH fuse system)
Fuse system D:	Fuse-bases for busbar mounting (NH fuse system)
Fuse system E:	Fuses with fuse-links for bolted connections (BS bolted fuse system)
Fuse system F:	Fuses with fuse-links having cylindrical contact caps (NF cylindrical fuse system)
Fuse system G:	Fuses with fuse-links with offset blade contacts (BS clip-in fuse system)
Fuse system H:	Fuses with fuse-links having "gD" and "gN" characteristic (class J class L and class T time delay and non time delay fuse types)
Fuse system I:	gU fuse-links with wedge tightening contacts
Fuse system J:	Fuses with fuse-links having "gD class CC" and "gN class CC" characteristics (class CC time delay and non-time delay fuse types)
Fuse system K:	gK fuse-links with blade for bolted connections – High fuse-link ratings from 1 250 A up to 4 800 A (master fuse-links)

NOTE The above-mentioned fuse systems are standardized systems in respect to their safety aspects. The National Committees can select from the examples of standardized fuses one or more systems for their own standards.

1.2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60112, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

IEC 60269-1, *Low-voltage fuses – Part 1: General requirements*

IEC 60664-1, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 60999 (all parts), *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units*

IEC 60999-1, *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 1: General requirements and particular requirements for clamping units for conductors from 0,2 mm^2 up to 35 mm^2 (included)*

IEC 60999-2, *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 2: Particular requirements for clamping units for conductors above 35 mm^2 up to 300 mm^2 (included)*

ISO 22479, *Corrosion of metals and alloys – Sulfur dioxide test in a humid atmosphere (fixed gas method)*

Fuse system A –
Fuses with fuse-links with blade contacts
(NH fuse system)

1 General

IEC 60269-1 applies with the following supplementary requirements and modified requirements.

1.1 Scope

The following additional requirements apply to fuses with fuse-links having blade contacts intended to be replaced by means of a device, for example, replacement handle (see Figure 103), which complies with the dimensions specified in Figures 101 and 102. Such fuses have rated currents up to and including 1 600 A and rated voltages up to and including 1 000 V a.c. or 1 500 V d.c.

The following characteristics of the fuses are specified in addition to IEC 60269-1:

- minimum rated breaking capacities;
- time-current characteristics;
- I^2t characteristics;
- standard conditions of construction;
- power dissipation and acceptable power dissipation.

2 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60269-1, as well as the following, apply.

2.1.101
gripping-lugs
parts of a fuse-link which are engaged with the replacement handle or the fuse-carrier

Note 1 to entry: Gripping-lugs may be made of metal or insulating material. Metal gripping-lugs may be live or not live under service conditions.

2.1.102
live gripping-lugs
metal gripping-lugs electrically connected to the blade contacts of the fuse-link

Note 1 to entry: Metal gripping-lugs without electrical contact to the blade contacts are also deemed to be live in case of inadequate creepage distances and clearances according to this standard.

2.1.103
isolated gripping-lugs
not-live gripping-lugs made of insulating material or metal

Note 1 to entry: If they are made of metal the required creepage distances and clearances according to the relevant overvoltage category should be met between the gripping-lugs and the blade contacts as well as between the gripping-lugs and the fuse-base contacts.

3 Conditions for operation in service

IEC 60269-1 applies.

4 Classification

IEC 60269-1 applies.

5 Characteristics of fuses

IEC 60269-1 applies with the following supplementary requirements.

5.2 Rated voltage

For a.c., the standard values of rated voltage are 400 V, 500 V and 690 V. For d.c., the rated voltages are 250 V and 440 V. The standard values of d.c. rated voltage are not related to the standard values of a.c. rated voltage. For example, the following standard combinations are possible: 500 V a.c. and 250 V d.c., 500 V a.c. and 440 V d.c., 500 V a.c., etc.

The rated voltage of fuse-bases according to Figure 102 is 690 V or higher.

5.3.1 Rated current of the fuse-link

For each size the maximum rated currents are given in Figure 101. These values depend upon the utilization categories and rated voltages.

5.3.2 Rated current of the fuse-holder

The rated current for the different sizes of the fuse-bases is given in Figure 102.

5.5 Rated power dissipation of a fuse-link and rated acceptable power dissipation of a fuse-holder

The maximum values of rated power dissipation for the different sizes of fuse-links are specified in Figure 101. The values apply to the maximum rated currents of the fuse-links. The values of rated acceptable power dissipation of fuse-bases are given in Figure 102.

5.6 Limits of time-current characteristics

5.6.1 Time-current characteristics, time-current zones and overload curves

The tolerance on time-current characteristics given by the manufacturer shall not deviate by more than ±10 % in terms of current. The time-current zones given in Figure 104, including manufacturing tolerances shall be met by all pre-arcing and total times measured at the test voltage according to 8.7.4.

5.6.2 Conventional times and currents

The conventional times and currents, in addition to the values of IEC 60269-1, are given in Table 101.

Table 101 – Conventional time and current for "gG" fuse-links with rated current lower than 16 A

Rated current I_n A	Conventional time h	Conventional current I_{nf}	Conventional current I_f
$I_n \leq 4$	1	1,5 I_n	2,1 I_n
$4 < I_n < 16$	1	1,5 I_n	1,9 I_n

5.6.3 Gates

For "gG" fuse-links the gates given in Table 102 apply in addition to the gates of IEC 60269-1.

Table 102 – Gates for specified pre-arcing and operating times of "gG" fuse-links

I_n A	I_{min} (10 s) A	I_{max} (5 s) A	I_{min} (0,1 s) A	I_{max} (0,1 s) A
2	3,7	9,2	6,0	23,0
4	7,8	18,5	14,0	47,0
6	11,0	28,0	26,0	72,0
8	16,0	35,2	41,6	92,0
10	22,0	46,5	58,0	110,0
12	24,0	55,2	69,6	140,4

5.7.2 Rated breaking capacity

The minimum rated breaking capacities are specified in Table 103.

Table 103 – Minimum rated breaking capacities

Rated voltage	Minimum rated breaking capacities
≤ 690 V AC	50 kA
690 V AC < U ≤ 1 000 V AC	20 kA
≤ 750 V DC	25 kA
750 V < U ≤ 1 500 V DC	10 kA

6 Markings

IEC 60269-1 applies with the following supplementary requirements.

Fuse-links and fuse-holders which meet the requirements and tests of fuse system A of this standard may be marked with IEC 60269-2.

6.1 Markings of fuse-holders

In addition to IEC 60269-1, the following marking applies:

– size.

The marking of the rated current and the rated voltage shall be discernible from the front when a fuse-link has not been fitted.

6.2 Markings of fuse-links

In addition to IEC 60269-1, the following marking applies:

– size or reference;

– rated breaking capacity.

The marking of the rated current and the rated voltage shall be discernible from the front. Furthermore, fuse-links shall be marked as described in Table 104.

Table 104 – Marking of fuse-links

Characteristic	gG		aM	
Colour of marking	Black		Green	
Kind of print	Strip with inverse print	Normal print	Strip with inverse print	Normal print
Voltage				
400 V [a]	X		X	
500 V		X		X
690 V	X		X	
[a] For 400 V gG, a blue colour is also permitted.				

Fuse-links with isolated gripping-lugs may be marked in a place easily visible from the front with the graphical symbol of a gripping-lug in a square. If marked, conformity of these fuse-links is verified according to 7.2.

NOTE See Figure 112 for detailed dimensions of the symbol.

7 Standard conditions for construction

IEC 60269-1 applies with the following supplementary requirements.

7.1 Mechanical design

The dimensions of fuse-links and fuse-bases are given in Figures 101 and 102.

7.1.2 Connections, including terminals

There are different kinds of terminals. As far as lug terminals are concerned, the range of cross-sections which the terminals shall be capable of accepting results from the following ranges of rated currents of fuse-links of each size.

Terminals designed for unprepared conductors shall be capable of accepting as a minimum three consecutive sizes of conductors within the cross-sectional ranges given in Table 105. In case the terminal is a lug terminal (see IEC 60999 series), the torques which shall be applied are given in Table 111. Torque values for other terminals should be given in the manufacturer’s instructions.

Table 105 – Minimum cross-sectional ranges of unprepared conductors

Size	Range of the rated currents of the fuse-links A	Cross-sectional area ranges mm²	
		Copper	Aluminium
000	2 to 160	6 to 70	25 to 95
00	2 to 160	6 to 70	25 to 95
1	80 to 250	25 to 120	35 to 150
2	125 to 400	50 to 240	70 to 300
3	315 to 630	50 to 2 × 185	70 to 2 × 240
4	500 to 1 250	stated in the manufacturer's literature	
4a	500 to 1 600	stated in the manufacturer's literature	

Connections of larger and/or smaller cross-sectional area may be necessary. This can be achieved either by the construction of the terminal or by additional means of connection as recommended by the manufacturer.

Whether the terminals for unprepared conductors are suitable for copper, aluminium or copper and aluminium shall be marked accordingly. Furthermore, the range of cross-sections shall be marked on or near to the clamping saddle or given in the manufacturer's literature.

7.1.3 Fuse-contacts

The contact surfaces of fuse-links and fuse-bases should be silver-plated; If the surface plating of the blade contacts of a fuse-link or the contacts of the fuse-base is other than silver, the test according to 8.10 shall be conducted with dummy fuse-links as described in 8.10.1. Permissable combinations of surface plating shall be defined by the manufacturer.

If fuse-links are intended to be removed or inserted under load, the construction of the fuse, in particular the fuse-contacts, should be suitable for this purpose.

7.1.6 Construction of fuse-bases

The dynamic short-circuit withstand of the fuse shall – whenever needed – meet the cut-off currents as given in Table 112.

Fuse-bases shall meet the temperature rise test according to 8.3 including all protective covers intended to be used.

7.1.7 Construction of a fuse-link

The preferred construction is as follows: the blade contacts shall be made of solid material. If any other construction of blade contacts is used the manufacturer shall demonstrate that this construction is adequate for the purpose.

With the exception of the attachment for the replacement handle, the endplates are not permitted to protrude radially from the insulation body. For some applications it is preferable to insulate the gripping-lugs from live parts.

Fuse-links shall have an indicator. Electrically conductive parts of indicators shall not be ejected from the fuse-link during operation.

7.2 Insulating properties and suitability for insulation

The creepage distances and clearances of the fuses and fuse-accessories shall meet the requirements of IEC 60664-1 for overvoltage category III and pollution degree 3. The minimum clearances are also applicable to metal parts which are not permanently live but may be touched. They shall not be diminished during replacement of the fuse-link. The creepage distances between isolated metal gripping-lugs and live parts are chosen according to the rated voltage divided by $\sqrt{3}$.

For insulation stressed only for a short time, the creepage distances of isolated metal gripping-lugs corresponding to two voltage steps lower may be used.

Insulating parts of the fuse-base supporting live parts have to pass the test at PTI 400 carried out according to IEC 60112 using test solution A.

7.7 I^2t characteristics

For the fuse-links covered by this fuse system, the maximum pre-arcing I^2t values given in Table 7 of IEC 60269-1 apply for the maximum operating I^2t values. Values for rated currents lower than 16 A are given in Table 106.

Table 106 – Pre-arcing and operating I^2t values at 0,01 s for "gG" fuse-links

I_n A	I^2t_{min} A^2s	I^2t_{max} A^2s
2	1	23
4	6,25	90,25
6	24	225
8	49	420
10	100	576
12	160	750

The maximum operating I^2t values are given in Table 107 for the stated test value.

Table 107 – Maximum operating I^2t values for “aM” fuse-links

Rated voltage U_n V a.c.	I^2t max A^2s
$U_n \leq 400$	18 I_n^2
$400 < U_n \leq 500$	24 I_n^2
$500 < U_n \leq 690$	35 I_n^2
NOTE For a voltage of 230 V a.c. the maximum operating I^2t value is 12 I_n^2	

These values apply for the prospective currents corresponding to pre-arcing times less than 0,01 s.

7.8 Overcurrent discrimination of fuse-links

gG fuse-links in series with rated current ratio of 1:1,6 and rated currents 16 A and above have to discriminate up to the values specified in 8.7.4.

With regard to discrimination when circuit-breakers are used, the following I^2t values in Table 108 shall be followed.

Table 108 – Pre-arcing I^2t values for discrimination of gG fuse-links

I_n A	I^2t_{min} A^2s	at I_p A
16	250	500
20	450	670
25	810	900
32	1 400	1 180
40	2 500	1 580
50	4 000	2 000
63	6 300	2 510
80	10 000	3 160
100	16 000	4 000
125	24 000	4 900
160	42 500	6 520
200	78 000	8 830

7.9 Protection against electric shock

The protection against electric shock can be increased by means of partition walls and covers of the fuse-contacts.

Operation of the fuse-links is considered safe when carried out by authorized persons, instructed in electrical matters, using replacement handles according to this fuse system or linked fuse-carriers. Insulating covers and/or phase separators may be used where applicable.

8 Tests

IEC 60269-1 applies with the following supplementary requirements.

8.1.4 Arrangement of the fuse and dimensions

The requirements of 7.2 are verified on fuse-bases. The fuse-bases are connected to conductors having the minimum and maximum cross-sections of the range as given in Table 105.

In the case of isolated metal gripping-lugs, the creepage distances and clearances of the fuse-link according to 7.2 are verified. The clearances are also verified on a fuse-link inserted into a reference fuse-base according to Figure 111.

8.1.6 Testing of fuse-holders

In addition to the test given in IEC 60269-1, the fuse-holders shall be subjected to the tests according to Table 109.

Table 109 – Survey of tests on fuse-holders and number of fuse-holders to be tested

Test according to subclause		Number of fuse-holders				
		3	**1**	**1**	**1**	**5**
8.5.5.1	Verification of the peak withstand current of a fuse-base		X	X		
8.9	Verification of resistance to heat				X	
8.10.1.2	Direct terminal clamps					X
8.11.1.2	Mechanical strength of the fuse-base	X				
8.11.2.4	Non-deterioration of insulating parts of fuse-link and fuse-base	X				

8.2.2.1 Points of application of the test voltage

In addition to IEC 60269-1 the following applies:

e) between isolated metal gripping-lugs and the terminals of the reference fuse-base.

8.2.3.2 Value of test voltage

The insulating properties of isolated metal gripping-lugs may optionally be verified by an impulse withstand voltage test. The relevant rated impulse withstand voltage is given in Table 110 with reference to the rated voltage of the fuse-link.

Table 110 – Rated impulse withstand voltage

Rated voltage V	Rated impulse withstand voltage kV
400	4
500	4
690	6

8.2.3.3 Test method

Five impulses of both polarities and of the shape 1,2/50 μs according to IEC 60060-1 and at the rated withstand voltage level according to Table 110 are applied to the test object. The minimum period between the impulses shall be 1 s.

If not otherwise specified, the impedance of the impulse generator should not exceed 500 Ω.

NOTE See IEC 60060-1, IEC 60060-2 and IEC 60060-3 for a detailed description of the test equipment.

8.2.4 Acceptability of test results

8.2.4.3 No flash-over or puncture shall occur during the test. Partial discharges are ignored.

Fuse-links with metal gripping-lugs without electrical contact to the blade contacts which do not comply with the requirements of 7.2 are not considered as isolated in service. They need, however, to fulfil the requirements of 8.9.2 and 8.11.1.8.

8.2.5 Resistance to tracking

The test of insulating parts supporting live parts of the fuse-links (fuse body) and fuse-bases is carried out according to IEC 60112 using test solution A. Five specimens shall be tested and shall pass at PTI 400. Ceramic isolators need not to be tested.

8.3 Verification of temperature rise and power dissipation

8.3.1 Arrangement of the fuse and dimensions

If the manufacturer specifies values of torque, they shall be used for the tests of 8.3 and 8.10. If not, the screws or nuts of the terminals shall be fastened in accordance with Table 111.

In case the test arrangement contains more than one fuse, the test specimens are mounted in the conventional service position on a wooden plate or other insulating material at a distance between centre lines of 3 times e_2 according to Figure 101.

Copper bars as used for 500 A to 1 600 A test currents shall be painted mat black.

Table 111 – Torque to be applied to the terminal screws

I_n A	Size	Size of screws	Torque Nm
160	000	M 8	10
160	00	M 8	10
250	1	M 10	32
400	2	M 10/12	32/40
630	3	M 10/12	32/40
1 250	4	M 12	40
1 600	4a	2 × M 12 or 1 × M16	40 56

8.3.2 Measurement of the temperature rise

Protective covers and fuse-carriers as provided by the manufacturer shall be mounted.

8.3.4.1 Temperature rise of the fuse-holder

The dummy is given in Figure 105. The point at which the temperature rise is measured is marked with E in Figure 106.

8.3.4.2 Power dissipation of a fuse-link

The points between which the power dissipation of a fuse-link is measured are marked with S in Figure 106.

8.4.3.1 Verification of conventional non-fusing and fusing current

In the case where the non-fusing current test is also used for the verification of the time current characteristic, a second test specimen shall be used for b) (see Table 11 – Survey of complete tests on fuse-links and number of fuse-links to be tested of IEC 60269-1:2024).

8.4.3.5 Conventional cable overload protection test (for "gG" fuse-links only)

NOTE The tests in IEC 60269-1 are deemed to give satisfactory results at 1,45 I_n in typical three-phase applications at an ambient temperature of 30 °C. A special test can be required by some countries to prove that fuses and miniature circuit-breakers (MCBs) are equivalent protective devices. Details of the special test are given in Annex AA.

8.5.5 Test method

Subclause 8.5.5 of IEC 60269-1 applies with the following additions.

8.5.5.1 Verification of the peak withstand current of a fuse-base

The verification of the peak withstand current of a fuse-base need not be carried out, if this has already been verified during the breaking capacity test of the fuse-links with the highest rating of the size.

8.5.5.1.1 Arrangement of the fuse

The test shall be of the single-phase type. The test set-up for the fuse-base shall be in line with 8.5.1 of IEC 60269-1.

The current shall be limited by a fuse-link of the highest rating for the particular size. The peak values of the test currents attained shall lie in the ranges shown in Table 112.

Table 112 – Test currents

Size	Cut-off current kA
000	22…24
00	22…24
1	34…37
2	44…48
3	65…70

The maximum values may be exceeded as long as the requirements stated under 8.5.5.1.3 are met.

If the cut-off current range cannot be attained with the highest rating of the size, correspondingly higher series connected fuse shall be used. In this case the test specimen shall be equipped with a dummy fuse-link. Its external dimensions correspond to the dimensions given in Figure101.

8.5.5.1.2 Test method

The test shall be performed on two fuse-bases. In the case of fuse-base no. 1, a hardened and polished test knife of steel, shown in Figure 107, shall be inserted by hand in order to open up the contacts to a certain extent. The purpose of this test is to ensure that the resilient spring travel is limited to the elastic range. The contacts shall be opened up three times. This test will be dispensed with if a mechanical stop limits the gap to less than 7 mm so that the test blade cannot be correctly fitted by hand. Fuse-base no. 2 is tested in accordance with 8.11.1.2. The values of F_{max} according to Table 118 shall be adhered to. After these pre-tests the above-mentioned current test shall be performed.

8.5.5.1.3 Acceptability of test results

The fuse-links shall not be ejected. There shall be no signs of arcing or welding or other damage likely to prevent further use of the fuse-bases. Pitting marks on the contacts are permissible. The fuse or the circuit-breaker of the source shall not operate.

8.7.4 Verification of overcurrent selectivity

The overcurrent discrimination for fuses with rated current up to 12 A and the overcurrent discrimination ratio of 1:1,6 for fuses with rated currents higher than 12 A is verified by the I^2t values evaluated from the recorded test results.

The samples are arranged as for the breaking capacity tests according to 8.5. Regarding the power factor Table 20, Test No.2, of IEC 60269-1:2024 applies.

The tolerances for prospective currents for minimum pre-arcing I^2t and maximum operating I^2t tests are +/–5 %.

Four samples are tested, two samples are tested at the r.m.s. prospective test current I, corresponding to the minimum pre-arcing I^2t values, the other samples at the r.m.s. prospective test current I, corresponding to the operating I^2t values.

The test voltage for all fuses is $\frac{1{,}1 \cdot U_n}{\sqrt{3}}$ with tolerances of –3 % / +2 %.

Table 113 – Test currents and I^2t limits for selectivity test

I_n	Minimum pre-arcing I^2t		Maximum operating I^2t		Selectivity ratio
	Prospective I RMS	I^2t	Prospective I RMS	I^2t	
A	kA	A^2s	kA	A^2s	
2	0,013	0,67	0,064	16,4	
4	0,035			67,6	
6	0,064			193,6	
8	0,1	40	0,31	390	Can be calculated
10	0,13	67,6	0,4	640	
12	0,18	130	0,45	820	
13	0,18	190	0,55	950	
16	0,27	291	0,55	1 210	
20	0,4	640	0,79	2 500	
25	0,55	1 210	1	4 000	
32	0,79	2 500	1,2	5 750	
35	0,79	3 000	1,5	7 000	
40	1	4 000	1,5	9 000	
50	1,2	5 750	1,85	13 700	
63	1,5	9 000	2,3	21 200	
80	1,85	13 700	3	36 000	
100	2,3	21 200	4	64 000	
125	3	36 000	5,1	104 000	
160	4	64 000	6,8	185 000	
200	5,1	104 000	8,7	302 000	
224	5,9	139 000	10,2	412 000	1:1,6
250	6,8	185 000	11,8	557 000	
300	8,7	302 000	15	900 000	
315	8,7	302 000	15	900 000	
355	10,2	412 000	20	1 200 000	
400	11,8	557 000	20	1 600 000	
425	11,8	650 000	26	1 900 000	
500	15	900 000	26	2 700 000	
630	20	1 600 000	37	5 470 000	
800	26	2 700 000	50	10 000 000	
1 000	37	5 470 000	66	17 400 000	
1 250	50	10 000 000	90	33 100 000	
1 600	66	17 400 000	120	50 000 000	

The evaluated I^2t values shall lie within the corresponding I^2t limits specified in Table 113.

8.9 Verification of resistance to heat

These tests apply to fuse-links and fuse-bases.

Fuse-holders fitted with fuse-links having the maximum power dissipation corresponding to the acceptable power dissipation of the fuse-holder shall be cyclically loaded as pre-treatment. The pre-treatment is specified in 8.4.3.2 of IEC 60269-1. After cooling to normal temperature the breaking capacity shall be tested at I_1 in accordance with 8.5 of IEC 60269-1.

Fuse-links containing organic material in the body or filler shall be subjected to the same test as described above. These fuse-links shall interrupt the test currents I_1 and I_5.

8.9.1 Fuse-base

The test given below should be applied if it is not obvious that the components are not affected adversely by the given temperature and withdrawal forces.

8.9.1.1 Test arrangement

A dummy fuse-link according to Figure 105 is fitted into a fuse-base and also suspended from a measuring device as shown, for example, in Figure 108. The manner in which the dummy is fitted and secured (for example, by locking pins), in fuse-bases shall ensure that heat dissipation is not seriously affected. The conductor cross-section depends upon the rated current (see IEC 60269-1, Table 17), and the connections outside the heating chamber shall be at least 1 m long. The test set-up is installed in such a heating chamber or below a heatable cowl of at least 50 l capacity, care being taken to see that the bushings etc. for the measuring facility and connections are suitably sealed. The heaters shall be such as to ensure that during the test sequence described below a temperature of (80^{+5}_{0}) °C is maintained with or without the test current, the temperature being measured at a horizontal distance of 150 mm from the dummy centre point.

8.9.1.2 Test method

The temperature in the heating chamber is raised to (80^{+5}_{0}) °C, and maintained for 2 h. The dummy is then loaded with approximately 160 % rated current with a tolerance of ±2 % for 2 h. The test may be carried out at reduced voltage.

After loading and 3 min after switching off, a tensile force F_{max} (see Table 118) is applied smoothly to the dummy. The force F_{max} is exerted for a period of 15 s.

8.9.1.3 Acceptability of test results

After this test the contact pieces of the fuse-base shall not have moved to such an extent as to affect the further use of the fuse-base. After pulling out of the dummy the dimensions of Figure 102 are to be considered. The insulating mounting part of the fuse-base shall neither be broken nor shall it show any signs of cracks.

8.9.2 Fuse-links with gripping-lugs of moulded material or of metal fixed in moulded material

8.9.2.1 Test arrangement

A fuse-link of the highest rating for a size is fitted into a fuse-base; it shall be arrested there and also suspended from a measuring device as shown in Figure 108.

8.9.2.2 Test method

The temperature in the heating chamber is raised to (80^{+5}_{0}) °C and maintained for 2 h. The fuse-link is then loaded with 150 % rated current until it operates, but the test is restricted to the conventional time. A reduced test voltage may be used. Three minutes after the fuse-link has operated or the conventional testing time has expired, a tensile force F_{max} (see

Table 118) is applied smoothly to the gripping-lugs. The force is exerted for a period of about 15 s.

8.9.2.3 Acceptability of test results

The gripping-lugs shall remain fully operational, and the length of the neck ($2,5^{+0,5}_{0}$) mm in particular shall not be exceeded by more than 2 mm, in keeping with the dimensions d of Figure 101. The same applies to the maximum values of dimension c_2.

8.10 Verification of non-deterioration of contacts

8.10.1 Arrangement of the fuse

The dummy fuse-link is given in Figure 105. The dummy fuse-link shown with silver-plated blade contacts is representative for fuse-links with silver-plated blade contacts. If the non-deterioration test proves that a surface plating of the blade contacts of a fuse-link other than silver fulfils the requirements, then the surface of the blade contacts of the dummy fuse-link shall be plated accordingly.

For lug terminals, the torques are given in Table 111.

The insulation of the conductors shall be removed over the whole length. All covers of contacts and terminals shall be removed for this test only.

8.10.1.1 Contacts

Subclause 8.10.1 of IEC 60269-1 applies.

8.10.1.2 Direct terminal clamps

Subclause 8.10.1 of IEC 60269-1 applies with the following additions:

The test shall be performed on 10 direct terminal clamps of five fuse-bases.

The test arrangement shall be as follows: the fuse-bases shall be mounted in a vertical position, side by side with a distance between the fuse-base centres of at least three times e_2, shown in Figure 101. The test of direct terminal clamps which can be used for copper as well as aluminium conductors shall be made with aluminium conductors.

If there is no information given by the manufacturer, the screws of the direct terminal clamps shall be tightened with a torque according to Table 114.

NOTE 1 The torques are based on a friction coefficient of μ = 0,12 for thread and head of the screw and a maximum elongation of $R_{P\,0,2}$ according to ISO 898-1. The shaft of the screws will be stressed up to 90 % of these values during tightening. The torques are based on class 5.6 screws.

NOTE 2 Torques for lug terminals are given in Table 111.

Table 114 – Torques to be applied when no values are given by the manufacturer

Thread	Torque Nm
M5	2,6
M6	4,5
M8	11
M10	21
M12	38

Direct terminal clamps only for copper conductors are tested like direct terminal clamps for aluminium with the exception that cleaning and storage are not necessary. Furthermore, for copper clamps, the test can be part of the test of contacts. If the requirements for the contacts after 250 cycles (see 8.10.2.1) are met, the clamps for copper have satisfied this requirement.

The conductor cross-section depends upon the rated current (for copper conductors see Table 17 of IEC 60269-1).

The relevant cross-sections for aluminium conductors are given in Table 115.

Table 115 – Cross-sectional area of aluminium conductors for tests corresponding to 8.10

Rated current A	Cross-sectional area mm^2
40	25
50	25
63	35
80	50
100	70
125	95
160	95
200	150
250	185
315	240
400	300

In case of insulation piercing clamping units, only the insulation outside the clamping area will be removed.

The contact area of six conductors shall be prepared as follows.

The conductors shall be cleaned with a suitable abrasive and connected within a time not greater than 5 min.

The remaining four conductors, after removing only the insulation and the grease, shall be stored indoors for 14 days. These uncleaned conductors shall not be treated before being connected.

The bolts of the clamps shall be fixed as stated by the manufacturer. A readjustment of the bolts during the tests is not allowed.

For stranded aluminium conductors, it shall be ensured that the test current goes into the cross-section as equally as possible. This can be achieved by welding or compressing the conductor in the middle of its length.

8.10.2 Test method

A test cycle consists of a load period and a no-load period referred to as the conventional time. The test currents for the load period and the no-load period are specified as follows.

Test current: conventional non-fusing current I_{nf}

Load period: 25 % of the conventional time see Table 2 of IEC 60269-1

No-load period: 10 % of the conventional time

A test voltage lower than the rated voltage may be used.

During the no-load period the samples are cooled down to a temperature lower than 35 °C; additional cooling (for example, a fan) is allowed.

The temperature rise is measured in accordance with 8.10.2 of IEC 60269-1at rated current.

The voltage drop shall be measured after 50 cycles and 250 cycles and, if necessary, after 500 cycles and 750 cycles.

The voltage drop is measured at direct current of I_m = (0,05 to 0,20) I_{nf}. However, measuring the current I_m shall be chosen so as to give a voltage drop of at least 100 µV. If it is necessary, the upper limit of I_m may be increased to 0,30 I_{nf}.

The tolerance of I_m during the measurement shall not be greater than ${}^{+1}_{0}$ %.

The voltage drop shall be changed into the resistance of the contacts. Before measurement, the sample shall be cooled down to room temperature. If the room temperature T during the measurement deviates from 20 °C, the following formula may be applied:

$$R_{20} = \frac{R_T}{1 + \alpha_{20}(T - 20)}$$

The relevant coefficient α_{20} according to the conductor material (aluminium or copper) shall be used.

8.10.2.1 Contacts

The points between which the voltage drop is measured are marked as A and B in Figure 106.

At the conclusion of the test after 250 cycles and 750 cycles, the withdrawal forces are measured. For this purpose a hardened and polished steel test knife as shown in Figure 107 shall be inserted in order, if possible, to open the contacts up, to a certain extent (see 8.5.5.1.2).

Afterwards, the withdrawal forces are measured with a test link made of hardened steel as described in 8.11.1.2. The test link is inserted three times in the fuse-base. The withdrawal forces shall be within the limits of Table 118. If the measured values are too low, the dynamic test in accordance with 8.5.5.1 shall be performed.

8.10.2.2 Direct terminal clamps

The points between which the voltage drop ΔU of the test sample is measured are given in Figure 110. The point of measurement on the conductor F shall be a centre punch point where solid conductors are concerned or a bare wire wrapped around stranded conductors. For aluminium conductors, special precautions shall be implemented by use, for example, of a welded equalizer (the aluminium cable is cut; the conductors of each part are welded together, then the two parts are welded and the measure can be carried out in a hole drilled in a welded part).

Additionally, for aluminium conductors the voltage drop before starting the cycle test shall be measured. In any case for aluminium conductors, the test shall be performed for 750 cycles.

The test sequence for all types of conductors (aluminium and copper) is given in Table 116.

Table 116 – Test sequence for direct terminal clamps

Verification of temperature rise at I_n
Measurement of $R_{cl\ 0}$
50 cycles
Measurement of $R_{cl\ 50}$
200 cycles
Measurement of $R_{cl\ 250}$
Verification of temperature rise at I_n
250 cycles
Measurement of $R_{cl\ 500}$
250 cycles
Measurement of $R_{cl\ 750}$
Verification of temperature rise at I_n

At the end of the cycle test, the verification of the temperature rise shall be performed in accordance with 8.3.4.1. The conductor with removed insulation used for the cycle test remains fastened. The point F at which the temperature rise is measured on the conductor is at a distance of 10 mm from the clamp (see Figure 110).

8.10.3 Acceptability of test results

The permissible changes given are based on laboratory experience. The final criterion shall be met; it is not the summation of the intermediate criteria.

8.10.3.1 Contacts

If at the end of the 250th cycle the measured values do not exceed the following limit, the fuse-base is considered to have passed the test and the test may be stopped:

$$\frac{R_{250} - R_{50}}{R_{50}} \leq 15\%$$

If at the end of the 250th cycle the above limit is exceeded, the test is continued. After 500 cycles the following limit shall not be exceeded:

$$\frac{R_{500} - R_{250}}{R_{250}} \leq 30\%$$

If the limit is exceeded, the test is not satisfied. If the limit is not exceeded, the test is continued up to 750 cycles. At the end of the 750th cycle the following limit shall not be exceeded:

$$\frac{R_{750} - R_{50}}{R_{50}} \leq 40\%$$

The difference of the temperature rise between the last and the first measurement shall be less than 20 K.

8.10.3.2 Direct terminal clamps

The permissible tolerance for the resistance $R_{\text{cl 0}}$ for test samples with cleaned aluminium conductors is the following:

$$R_{\text{cl 0 max}} \leq 2\ R_{\text{cl 0 min}}$$

The changes of the resistance from $R_{\text{cl 50}}$ to $R_{\text{cl 750}}$ shall meet the following values in Table 117.

Table 117 – Permissible changes of the resistance

	Permissible changes %	
	Copper conductors or cleaned aluminium conductors	**Uncleaned aluminium conductors**
$\frac{R_{\text{cl 250}} - R_{\text{cl 50}}}{R_{\text{cl 50}}} \times 100$	15	30
$\frac{R_{\text{cl 500}} - R_{\text{cl 250}}}{R_{\text{cl 250}}} \times 100$	20	40
$\frac{R_{\text{cl 750}} - R_{\text{cl 500}}}{R_{\text{cl 500}}} \times 100$	15	30
$\frac{R_{\text{cl 750}} - R_{\text{cl 50}}}{R_{\text{cl 50}}} \times 100$	40	80

The temperature rise measured at test spot F shall be lower than 75 K.

8.11 Mechanical and miscellaneous tests

8.11.1.1 Mechanical strength of fuse-holders

The fuse-holder, fitted with a dummy fuse-link of Figure 105 or fitted with a fuse-link of the largest rated current and power dissipation that can be accommodated by the fuse-holder, shall be subjected to a temperature rise test at rated current.

At the conclusion of the temperature-rise test, the fuse-link or the fuse-carrier as appropriate, shall be withdrawn and inserted into the fuse-base 100 times.

At the conclusion of these tests, all parts shall be intact and shall function normally.

Compliance shall be verified by a further temperature-rise test at rated current at the conclusion of which the values obtained shall be not more than 5 K or 15 % (whichever is greater) above the values obtained from the temperature rise test prior to the commencement of the mechanical test.

8.11.1.2 Mechanical strength of the fuse-base

The mechanical strength of the fuse-bases and their components is verified by the following tests.

The test to verify the contact force of fuse-bases is performed with three unused fuse-bases as supplied. A test-link made of hardened steel with polished and chrome-plated surfaces is inserted three times in the fuse-base. The dimensions of the blade contacts of the fuse-link are identical with the dimensions according to Figure 101.

When pulling steadily by means of suitable test equipment, the withdrawal force F measured (see Figure 108) shall be found to lie within the limits as specified in Table 118.

Table 118 – Force to withdraw the fuse-link from the fuse-base contacts

Size	Withdrawal force	
	F_{min} N	F_{max} N
00	60	250
1	110	350
2	150	400
3	210	400
4[1)]	Not applicable	Not applicable
4a[2)]	Not applicable	Not applicable

[1)] Fuse-link is fixed with screws in the fuse base

[2)] This fuse-base is locked in the on position

In order to verify that the fuse-base contacts are firmly seated, steel screws (class 8.8) are fastened at the terminals. They are fastened three times by applying a torque of 1,2 times the value specified by the manufacturer or, where no value is specified, 1,2 times the value of Table 111. For flat connections requiring a nut, steps shall be taken to prevent, by suitable means, the nut from turning round.

After this test the contact pieces of the fuse-base shall not have moved to such an extent as to affect the further use of the fuse-base. The insulating mounting part of the fuse-base shall neither be broken nor shall it show any signs of cracks.

If the measured values are too low, the dynamic test in accordance with 8.5.5.1 (fuse system C) shall be performed.

8.11.1.8 Impact resistance of gripping-lugs of moulded material or of metal fixed in moulded material

8.11.1.8.1 Test arrangement

The facility to verify impact resistance is given in Figure 109. The weight of the drop hammer is 300 g, the height of fall between the impact-mandrel and the gripping-lug is 300 mm.

8.11.1.8.2 Test method

One fuse-link is exposed to (150 ± 5) °C for 168 h and another one to –15 °C for 72 h. The fuse-link exposed to heat is to be cooled off to room temperature before being subjected to the dynamic stress. For the sample exposed to cooling, the time interval between the taking out and the dynamic stress shall not be longer than 1 min.

The samples are placed in the test facility of Figure 109 in such a way that the direction of the stroke is parallel to the longitudinal axis of the fuse-link. Each of the gripping-lugs is only once exposed to stress at which the place of impact shall be the middle of the gripping-lug-neck. It shall be guaranteed that each time only the upper gripping-lug is stressed by the impact.

8.11.1.8.3 Acceptability of test results

The gripping-lugs shall show no damage capable of hindering their further use. Each of the gripping-lugs shall not be bent out by more than 3 mm measured before and after the impact; furthermore, the coupling with a handle according to Figure 103, shall not be hindered.

8.11.2.3 Verification of resistance to rusting

8.11.2.3.1 The test shall be carried out according to ISO 6988 with cyclic moist atmosphere containing 0,2 % SO_2 (SFW 0,2 S); number of cycles: 1.

For reasons of test economy this test may be carried out on the test samples used for the non-deterioration test of contacts according to 8.10 after completion of the test.

8.11.2.3.2 The following test is an optional test to be agreed between manufacturer and customer. It considers severe environmental conditions.

Fuse-links and fuse-bases intended to be used in an environment of pollution degree ≥ 3 according to IEC 60664-1 shall be tested with SFW 2,0 S for 5 cycles. They shall be marked accordingly.

8.11.2.4 Non-deterioration of insulating parts of fuse-link and fuse-base

8.11.2.4.1 Test method

Three fuse-links and three fuse-bases to be tested shall be exposed to the following temperatures:

for a period of 168 h

(150 ± 5) °C for fuse-links and fuse-bases comprising moulded elements intended to support live parts,

(100 ± 5) °C for covers,

for a period greater than 1 h

(150 ± 5) °C over 1 h for sealing compounds; stability of the marking.

After cooling to ambient temperature the following shall be tested.

Fuse-links: verification of the breaking capacity with I_1 and I_2 in accordance with 8.5 of IEC 60269-1.

Fuse-base: verification of the mechanical strength in accordance with 8.11.1.2.

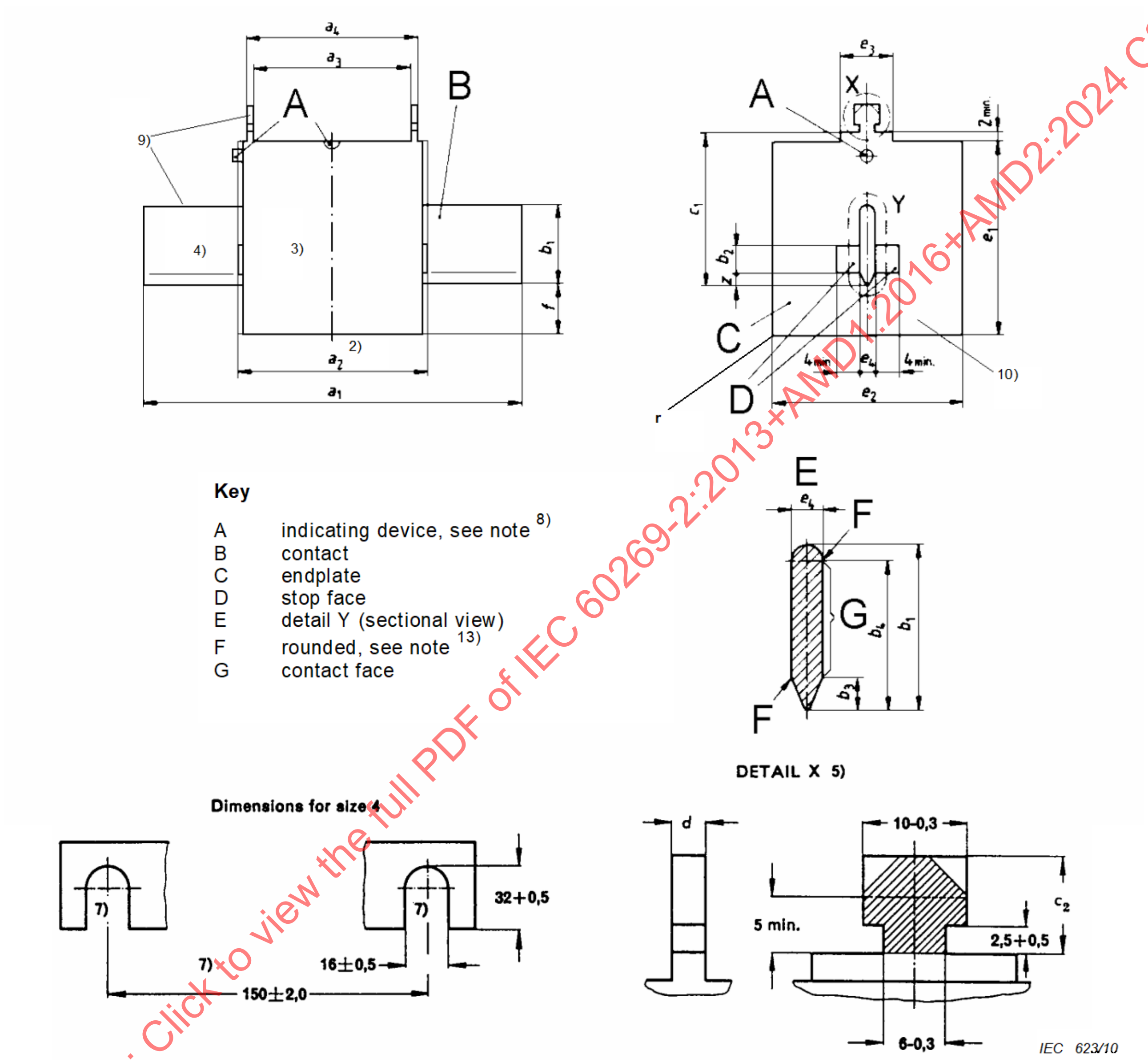
8.11.2.4.2 Acceptability of test results

The positions of the fuse-base contacts taking the fuse-link shall not have changed in a manner likely to affect its correct functioning. The insulating body on which the terminals are fixed shall neither fracture nor show any signs of a fracture. The mechanical strength of cemented joints shall not have been impaired. Sealing compounds shall not have shifted to an extent permitting live parts to be exposed. The fuse-links shall operate correctly.

The marking shall be durable and easily legible.

FIGURES

Dimensions in millimetres



The drawings are not intended to govern the design except as regards the notes and dimensions shown.

Figure 101 – Fuse-links with blade contacts *(1 of 3)*

Maximum values of the rated power dissipation P_n

Size	gG						aM			
	400 V a.c.		500 V a.c.		690 V a.c.		400 and 500 V a.c.		690 V a.c.	
	I_n A	P_n W	I_n A	P_n W	I_n A	P_n W	I_n A	P_n W	I_n A	P_n W
000	100 160	6 10	100 125	7,5 9	63	12	100	7	80	6,5
00	160	12	160	12	100	12	100/160	7/11	160	11
0	160	12	160	16	100	25	160	13	100	10
1	250	18	250	23	200	32	250	18	250	22
2	400	28	400	34	315	45	400	35	400	40
3	630	40	630	48	500	60	630	50	630	53
4	-	-	1 000	90	800	90	1 000	80	1 000	80
4a	1 250	90	1 250	110	1 000	110	1 250	110	1 250	110

Figure 101 *(2 of 3)*

Size	a_1 1)	a_2 2)	a_3 1)	a_4 1)	b_1 min. 12)	b_2 min. 12)	b_3 max. 12)	b_4 min. 12)	c_1 ±0,8	c_2	d 5)	e_1 max. 6)	e_2 max. 6)	e_3	e_4 ±0,2	f max.	r min.	z max.
000	78,5 ±1,5	54 −6	45 ±1,5	49 ±1,5	15	4,5	5	12	35	10 −1	2 +1 −0,5	41	21	16 +5 −2	6	8	1	3
00	78,5 ±1,5	54 −6	45 ±1,5	49 ±1,5	15	4,5	5	12	35	10 −1	2 +1 −0,5	48	30	20 ±5	6	15	2	3
0	125 ±2,5	68 −8	62 +3 −1,5	68 +1,5 −3	15	4,5	5	12	35	11 −2	2 +1,5 −0,5	48	40	20 ±5	6	15	2	3
1	135 ±2,5	75 −10	62 ±2,5	68 ±2,5	20	5	6	17	40	11 −2	2,5 +1,5 −0,5	53	52	20 +5 −2	6	15	4	5
2	150 ±2,5	75 −10	62 ±2,5	68 ±2,5	25	8	6	22	48	11 −2	2,5 +1,5 −0,5	61	60	20 +5 −2	6	15	5	5
3	150 ±2,5	75 −10	62 ±2,5	68 ±2,5	32	11	6	29	60	11 −2	2,5 +1,5 −0,5	76	75	20 +5 −2	6	18	7	5
4 7)	200 ±3	90 max.	62 ±2,5	68 ±2,5	49	19,5	8	45	87	11 −2	2,5 +1,5 −0,5	110	105	20 +5 −2	8	25	10	5
4a 11)	200 ±3	100 max.	84 ±3	90 ±3	49	–	8	45	84 ±3	11 −2	2,5 +1,5 −0,5	110	102	30 ±10	6	30	10	–

1) The centres of the dimensions a_1, a_3 and a_4 shall not deviate from the centre of a_2 by more than 1,5 mm.

2) The dimension a_2 shall be observed within the total area of the stop faces (b_2 × 4 min.) on both sides of the blades. Outside of these areas the maximum dimension a_2 applies.

3) Insulating material.

4) The blade contacts shall be axially aligned and contact surfaces shall be plane.

5) Attachment for replacement handle (detail X).

6) Maximum dimensions of the enclosure of the fuse-link with the radiuses r. Within these limits, the fuse-links may be of any form, for example, square, rectangular, circular, oval polygonal, etc.

7) The slots are mandatory for size 4 fuse-links.

8) Indicating device. Position of the indicating device as chosen by the manufacturer.

9) Live parts, gripping-lugs can be insulated.

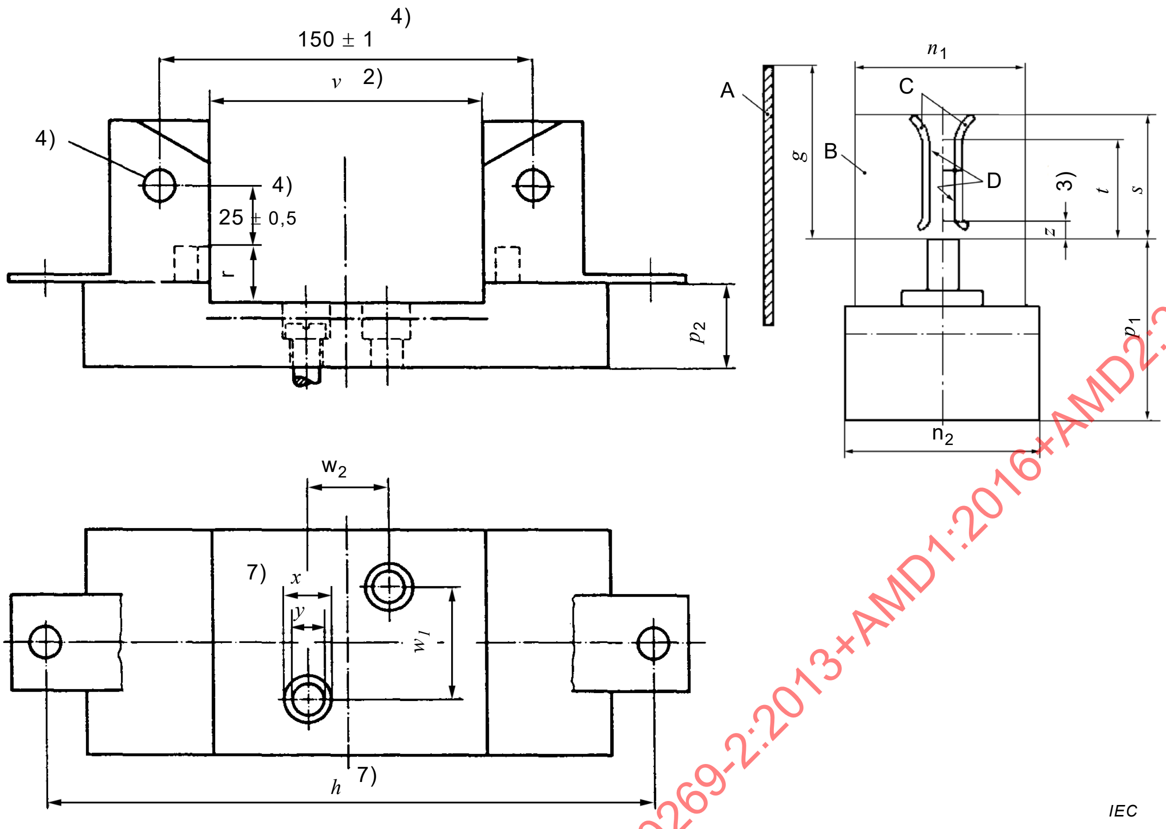
10) With the exception of the attachment for the replacement handle (detail X), the endplates are not permitted to protrude radially from the insulation body.

11) Only to be used with a swivel unit having an interlocking device.

12) As far as overlapping of rated currents exists within the sizes 0, 1, 2 and 3 the dimension of the smaller size is permitted.

13) All corners shall be rounded to prevent damage to the contact surface of the base contacts.

Figure 101 *(3 of 3)*



Key

A partition wall

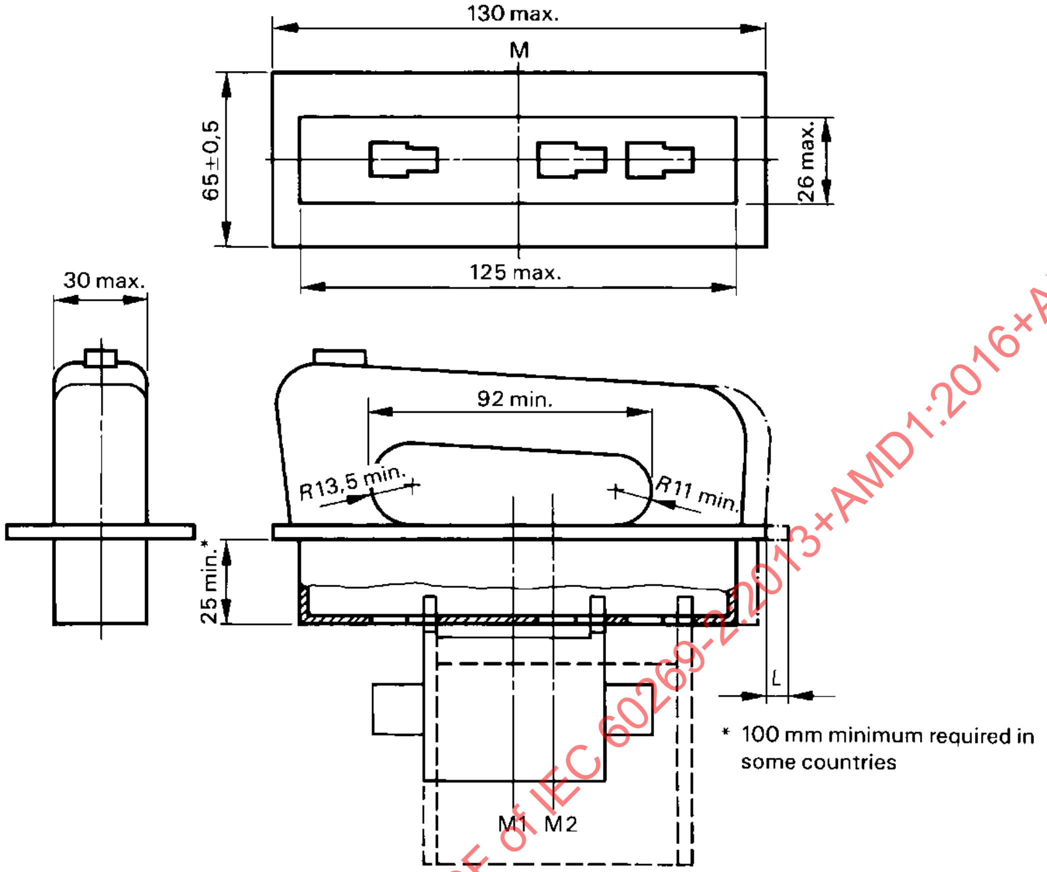
B see note 1)

C contacts

D contact surface, see note 5)

Figure 102 – Fuse-bases for fuse-links with blade contacts

Dimensions in millimetres



IEC 407/98

The drawings are not intended to govern the design of the handle except as regards the notes and dimensions shown.

Size	*L* mm	Distance M – M1 mm	Distance M – M2 mm
000/00	14	0 ± 3	
1 3	16		9 ± 5
The basic position of the fuse-link for measurement of the handle is defined by the manufacturer.			

Centre of the set-in and blocked-up fuse-link:

M1 for sizes 000/00

M2 for the sizes 1...3

M = centre of the coupling

L = permitted lift for setting in and taking out of the fuse-link

Figure 103 – Replacement handle

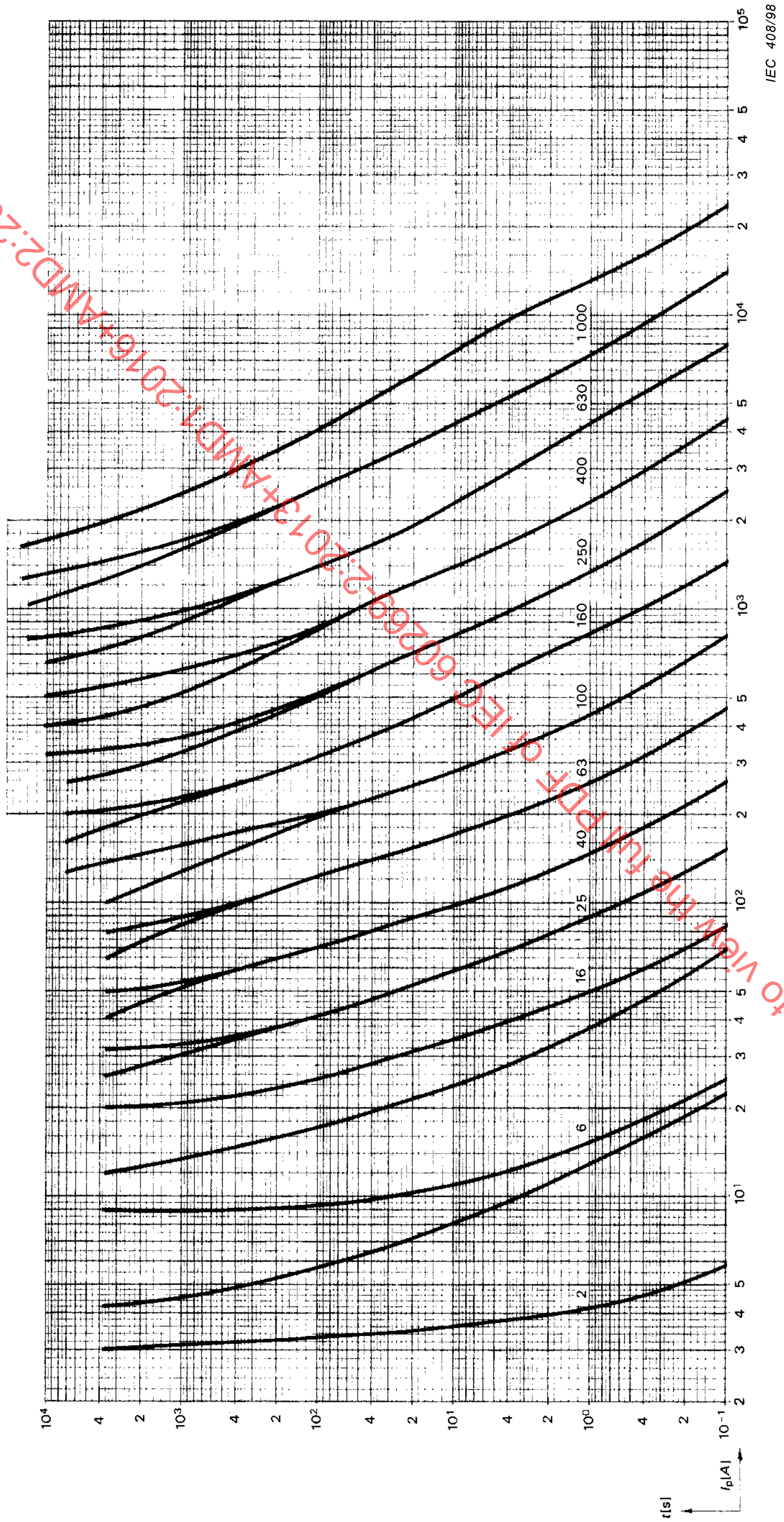


Figure 104 – Time-current zones for "gG" fuse-links *(1 of 5)*

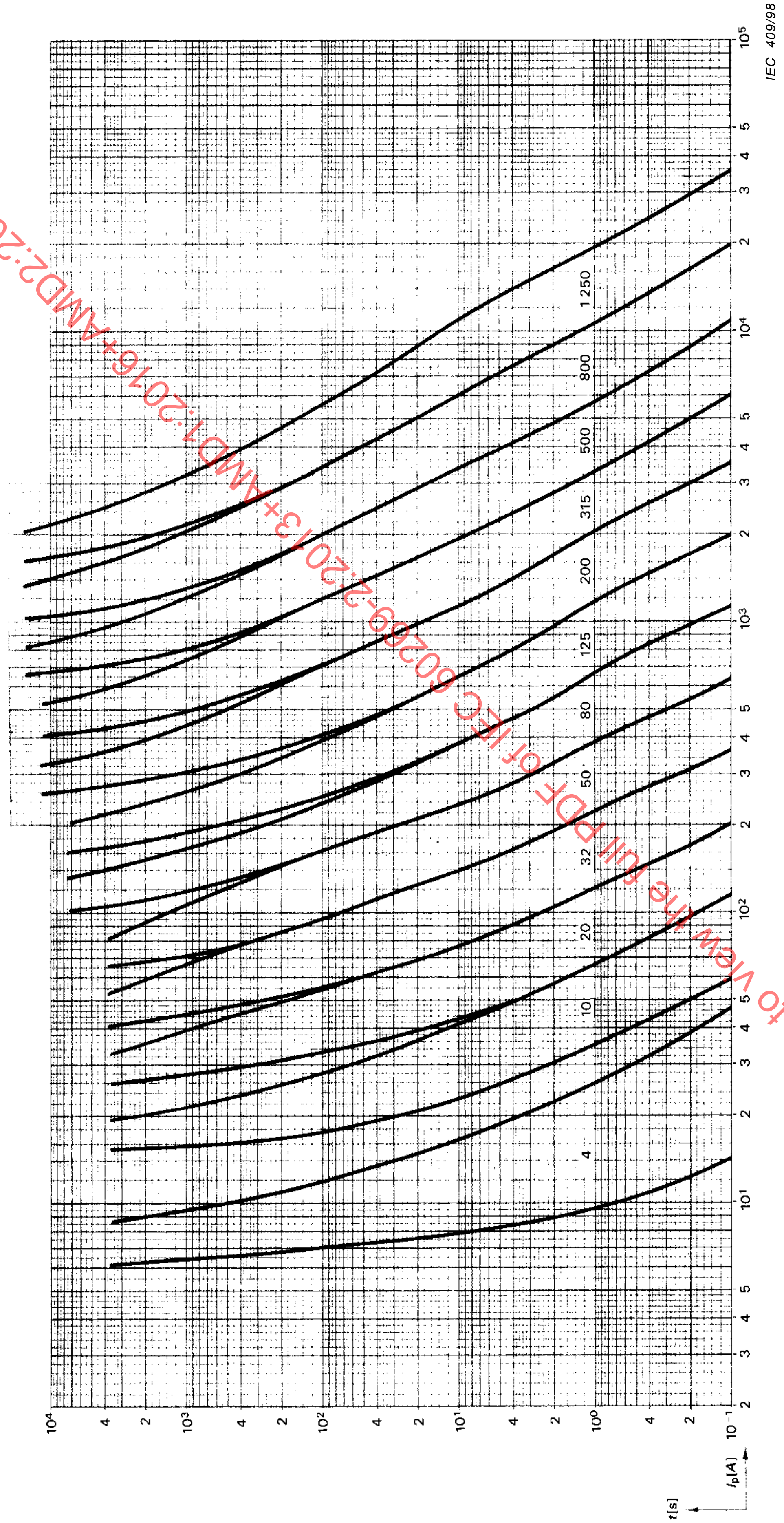


Figure 104 *(2 of 5)*

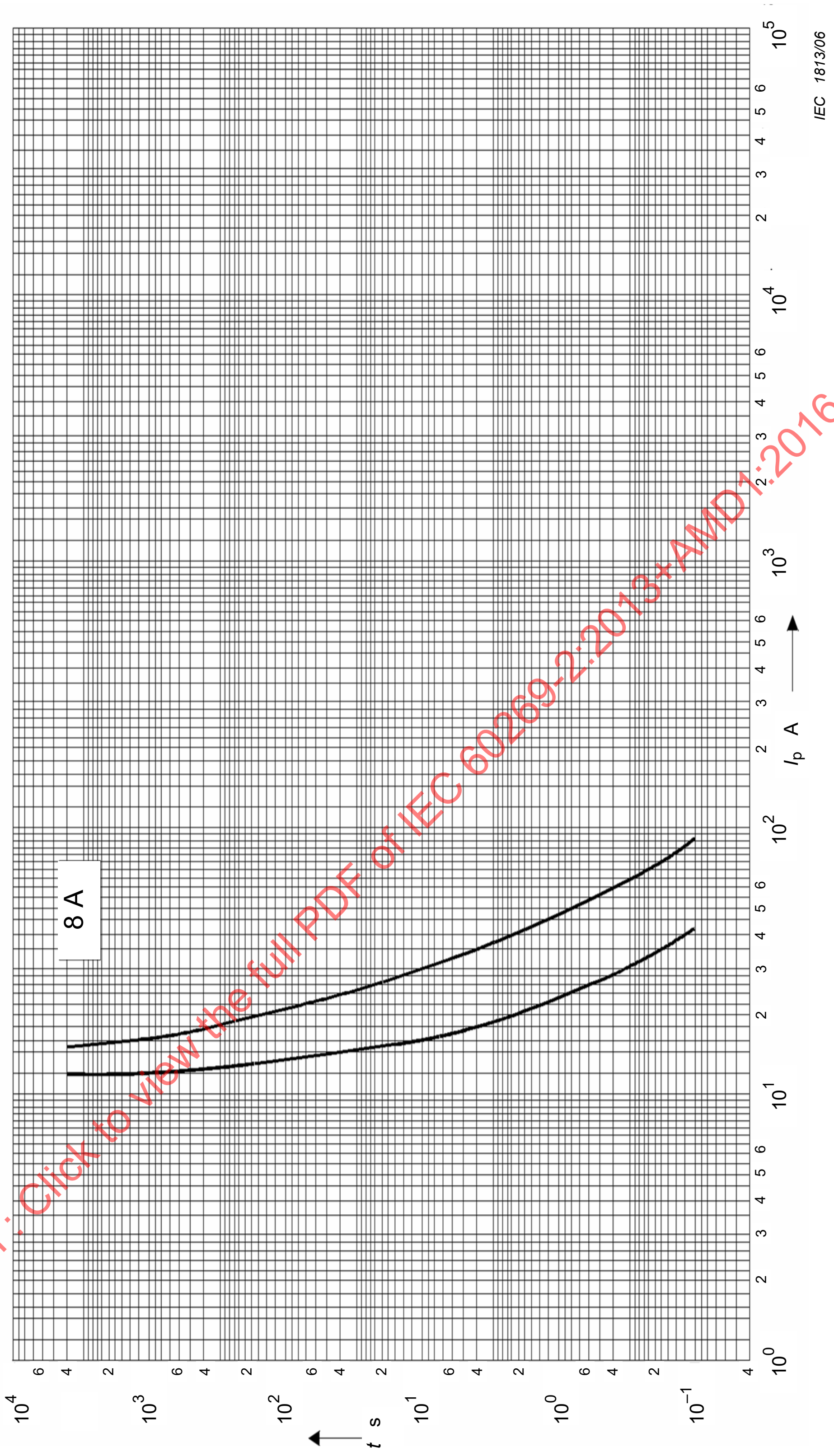


Figure 104 *(3 of 5)*

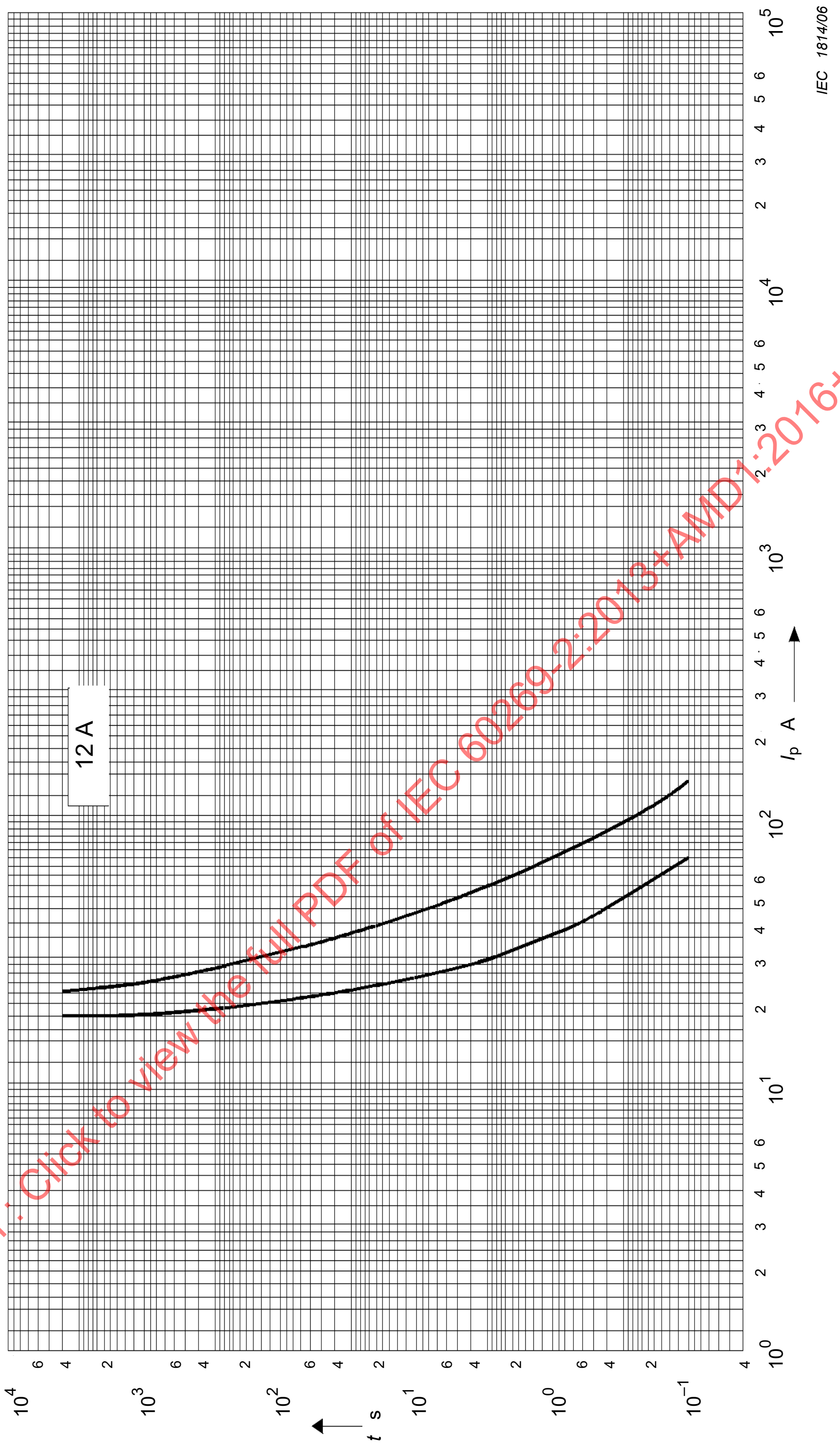


Figure 104 *(4 of 5)*

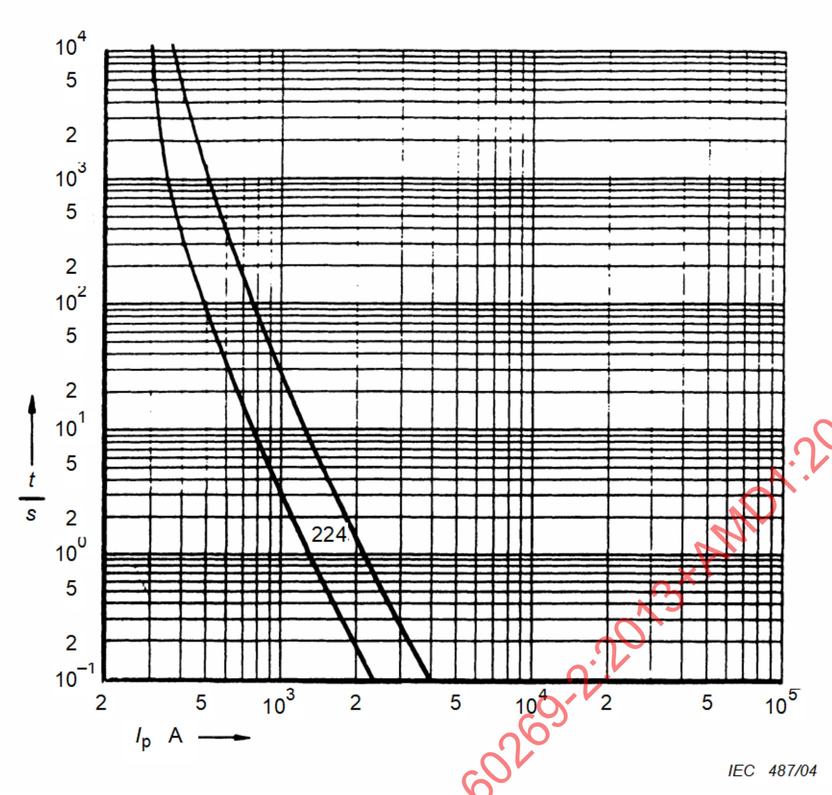
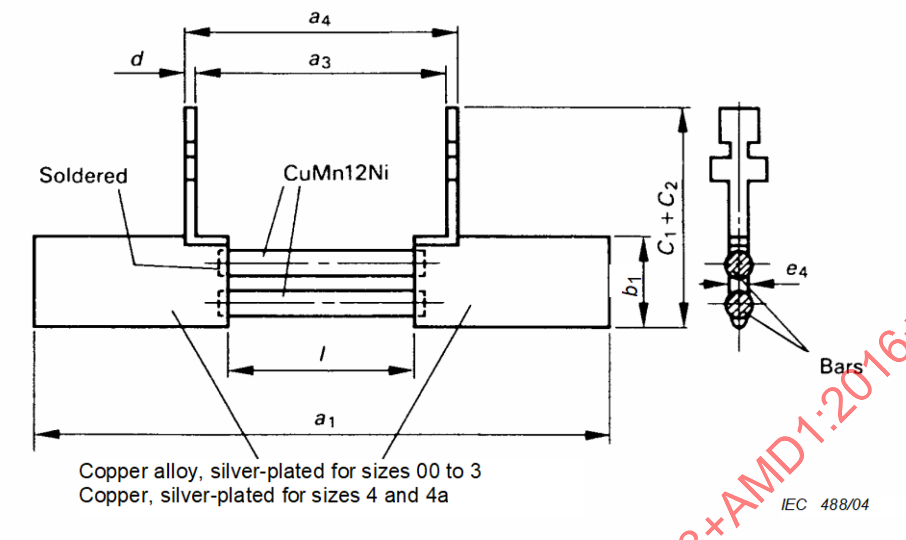


Figure 104 *(5 of 5)*

Dimensions in millimetres

For dimensions of the gripping-lugs, see Figure 101.



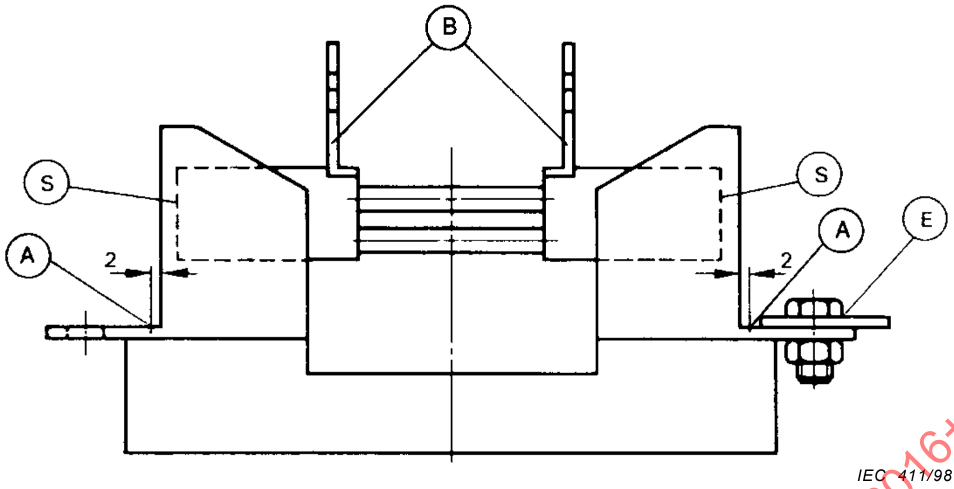
For other dimensions, see Figure 101.

Size	I	P a) W	R b) mΩ	Bars	
				Number	Diameter
00	$30{,}5\ ^{0}_{-3}$	12	0,47	1	7
1	$46\ ^{0}_{-4}$	32	0,51	1	8
2	$46\ ^{0}_{-4}$	45	0,281	2	8
3	$46\ ^{0}_{-4}$	60	0,151	3	9
4	$54\ ^{0}_{-6}$	90	0,09	3	12
4a	$54\ ^{0}_{-6}$	110	0,07	4	12

a) At the largest rated current of the size.

b) Measured at the gripping-lugs; equalized with a tolerance of ±2 %.

Figure 105 – Dummy fuse-link according to 8.3.4.1, 8.9.1 and 8.10



Dimensions in millimetres

Figure 106 – Measuring points according to 8.3.4 of IEC 60269-1, 8.3.4.1, 8.3.4.2 and 8.10.2 of fuse system A

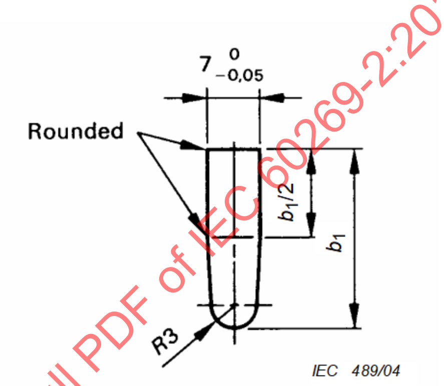
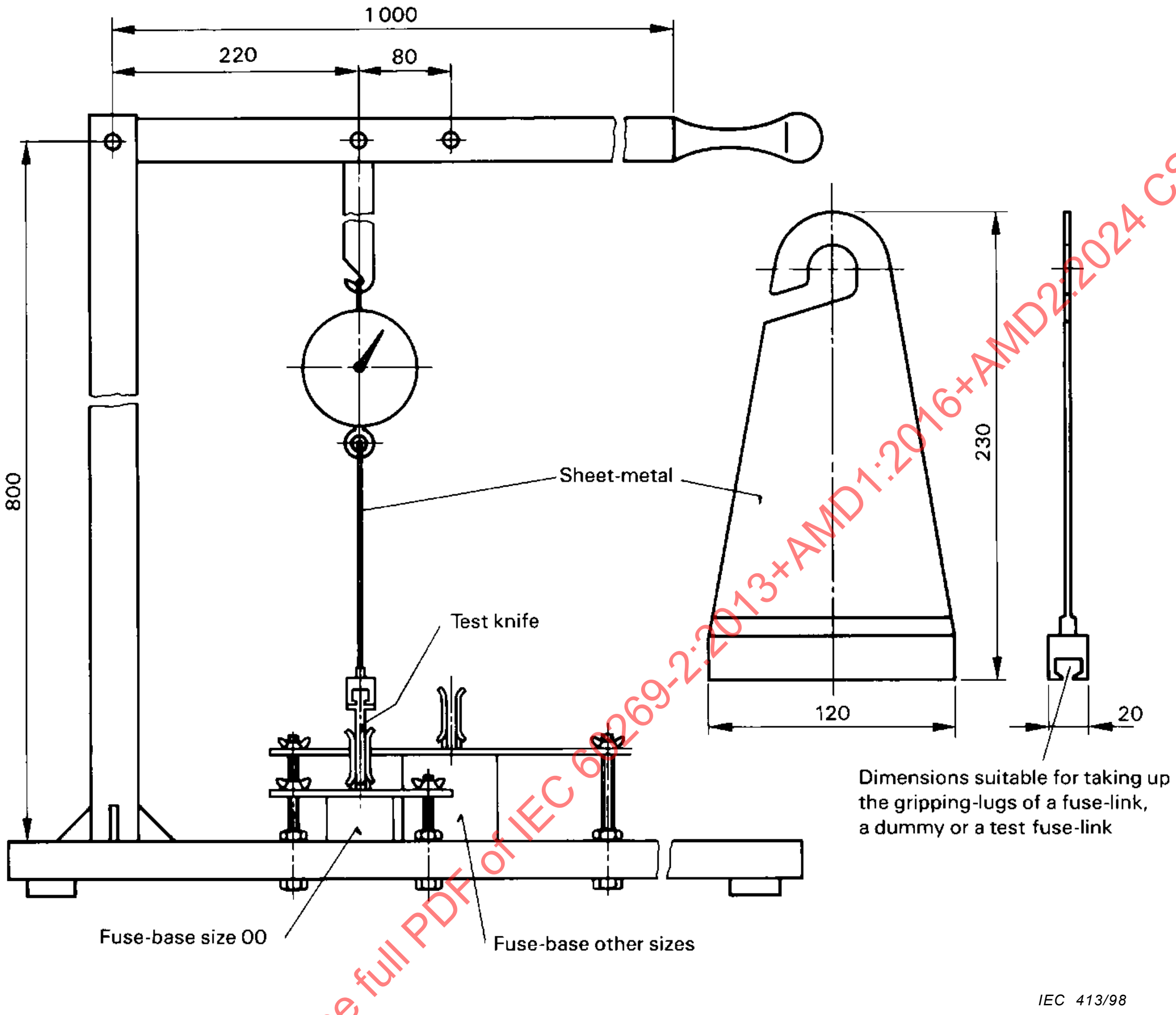
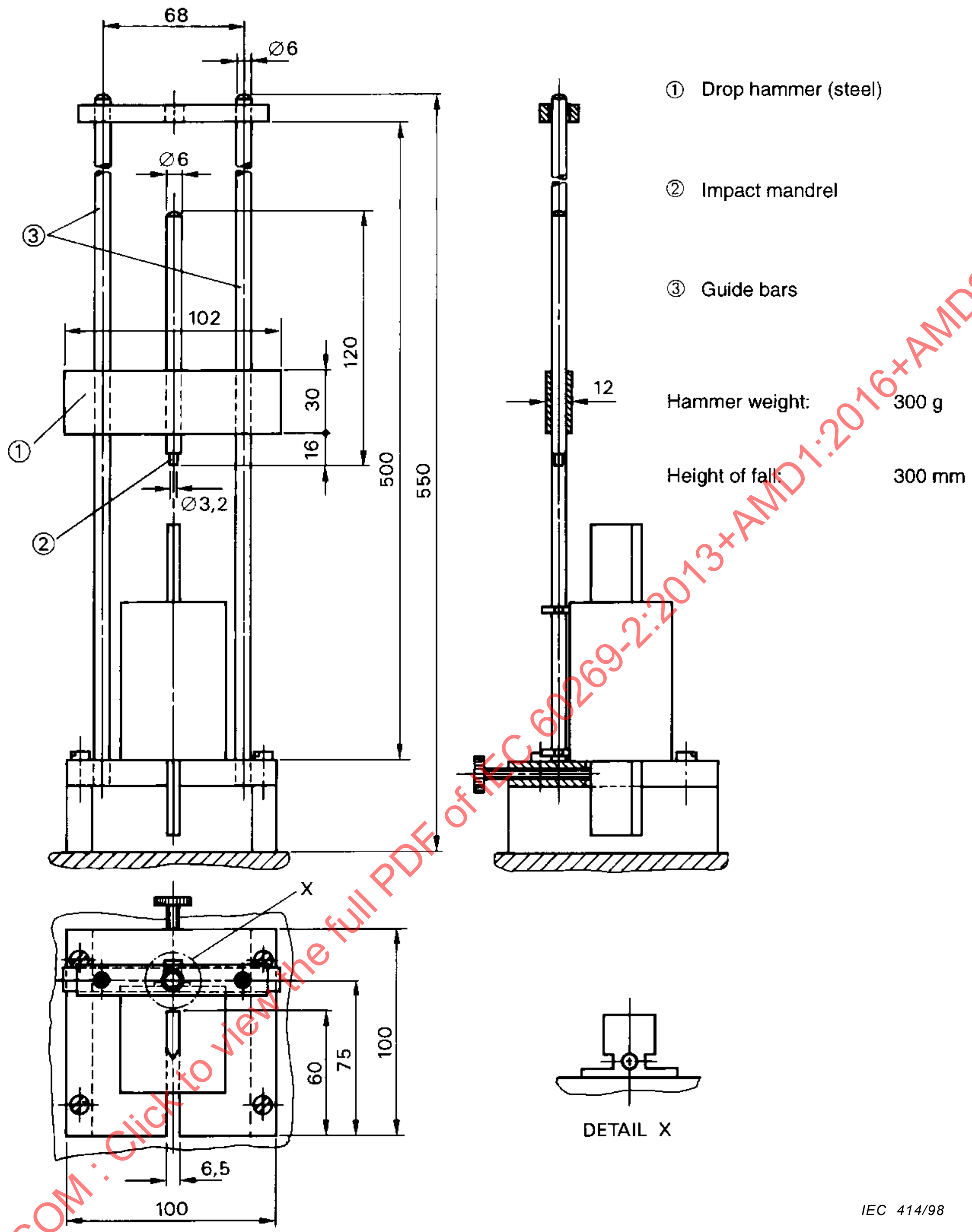


Figure 107 – Test knife according to 8.5.5.1.2



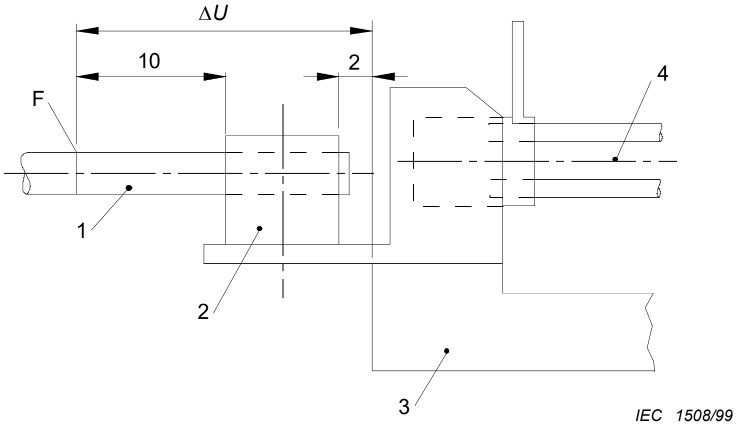
Dimensions in millimetres

Figure 108 – Example of a measuring device for determining the withdrawal forces according to 8.9.1 and 8.11.1.2



Dimensions in millimetres

Figure 109 – Facility for verifying the mechanical strength of gripping-lugs (see 8.11.1.8)



Dimensions in millimetres

Key

1 conductor
2 clamp
3 fuse-base
4 dummy fuse-link

Figure 110 – Measuring points according to 8.10.2

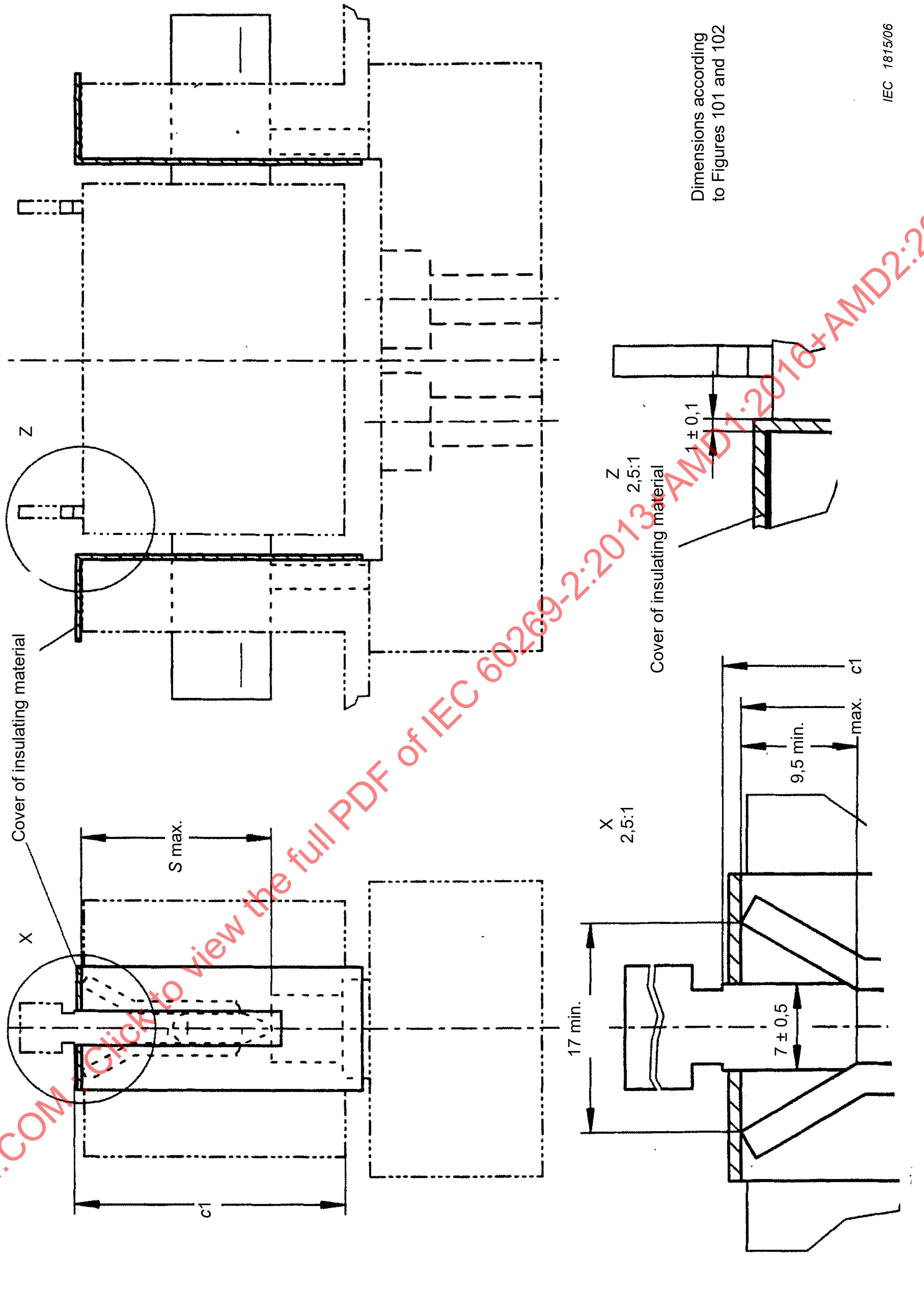
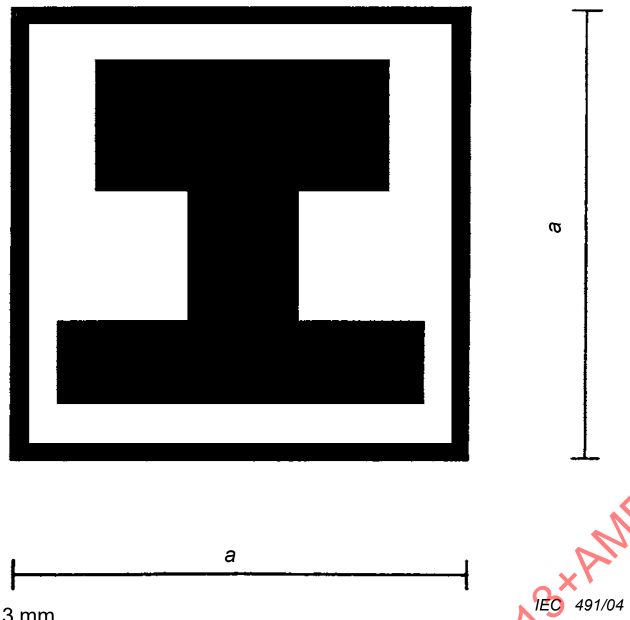


Figure 111 – Reference fuse-base



a ≥ 3 mm

Figure 112 – Design mark for isolated gripping-lugs

Annex AA
(informative)

Special test for cable overload protection

NOTE See note in 8.4.3.5 of fuse system A.

Fuses with $I_n > 16$ A of the sizes 000, 00, 0, 1 and 2 shall be tested as follows.

AA.1 Arrangement of the fuse

Three fuse-links of the same rated current and the same size are tested in fuse-bases according to Figure 102, mounted in a box at a distance between pole centres corresponding to the dimension $n_{2\ max}$ according to Figure 102.

The connection is determined by the rated current of the fuse-link (see Table 19 of IEC 60269-1). The connecting cables are made of black PVC insulated copper conductors. The fuses are connected in series to one power source (stabilized). The ambient air temperature outside the fuse box shall be $(30\,^{+5}_{\ 0})$ °C.

NOTE A lower temperature can be used with the manufacturer's consent.

The box walls shall consist of 10 mm thick insulating material. Openings for the connecting cables shall be sealed during the test. The inside volume of the box is:

$2{,}5 \times 10^{-3}$ m^3 for size 000/00;

9×10^{-3} m^3 for size 1;

12×10^{-3} m^3 for size 2.

The dimension of the boxes shall correspond to the enveloping dimensions of the fuse-bases.

AA.2 Test method and acceptability of test results

A test current equal to 1,13 I_n flows through the fuse-links during the conventional time, as given in Table 2 of IEC 60269-1. None of the fuse-links shall operate. The test current is then raised without interruption within 5 s to I_t = 1,45 I_n. One fuse-link shall operate within the conventional time.

Fuse system B – Fuses with striker fuse-links with blade contacts (NH fuse system)

1 General

IEC 60269-1 applies with the following supplementary requirements.

1.1 Scope

The following additional requirements apply to fuses with striker fuse-links with blade contacts, intended to be replaced by means of a device, such as a replacement handle, which comply with the dimensions specified in Figures 201 and 202. Such fuses have rated currents up to and including 1 250 A and rated voltages up to and including 1 000 V a.c. or 1 500 V d.c.

Owing to the different operating features of fuses with strikers a distinction is made in this fuse system between references A and B.

The following characteristics of the fuses are specified in addition to IEC 60269-1:

- minimum rated breaking capacities;
- time-current characteristics;
- I^2t characteristics;
- standard conditions of construction;
- power dissipation and acceptable power dissipation.

2 Terms and definitions

IEC 60269-1 applies.

3 Conditions for operation in service

IEC 60269-1 applies.

4 Classification

IEC 60269-1 applies.

5 Characteristics of fuses

IEC 60269-1 applies with the following supplementary requirements.

5.2 Rated voltage

See 5.2 of fuse system A.

5.3.1 Rated current of the fuse-link

For each size, the maximum rated currents are given in Figure 201. These values depend upon the utilization categories and rated voltages.

5.3.2 Rated current of the fuse-holder

The rated current for the different sizes of the fuse-bases is given in Figure 202.

5.5 Rated power dissipation of a fuse-link and rated acceptable power dissipation of a fuse-holder

The maximum values of rated power dissipation for the different sizes of fuse-links are specified in Figure 201. The values apply to the maximum rated current of the fuse-links. The values of rated acceptable power dissipation of fuse-bases are given in Figure 202.

5.6 Limits of time-current characteristics

See 5.6 of fuse system A.

5.7.2 Rated breaking capacity

See 5.7.2 of fuse system A.

6 Markings

IEC 60269-1 applies with the following supplementary requirements.

See Clause 6 of fuse system A.

7 Standard conditions for construction

IEC 60269-1 applies with the following supplementary requirements.

7.1 Mechanical design

The dimensions of fuse-links and fuse-bases are given in Figures 201 and 202.

The control devices and the contacts acted by the striker are fixed on the fuse-base in such a way that

– the fuse-base can receive any fuse-link with striker of the same reference complying with this fuse system, as well as any fuse-link of the same size without striker complying with fuse system A;
– minimum clearances between the surface from the protruding of the striker considered as a live part and all metallic parts shall comply with IEC 60664-1 (see Figure 201).

7.1.2 Connections, including terminals

See 7.1.2 of fuse system A.

7.1.3 Fuse-contacts

See 7.1.3 of fuse system A.

7.1.7 Construction of a fuse-link

Subclause 7.1.7 of fuse system A applies with the following addition:

The striker of a fuse-link is considered an indicator.

7.2 Insulating properties and suitability for insulation

See 7.2 of fuse system A.

7.7 I^2t characteristics

See 7.7 of fuse system A.

7.8 Overcurrent discrimination of "gG" fuse-links

See 7.8 of fuse system A.

7.9 Protection against electric shock

See 7.9 of fuse system A.

8 Tests

IEC 60269-1 applies with the following supplementary requirements.

8.1.6 Testing of fuse-holders

See 8.1.6 of fuse system A.

8.3 Verification of temperature rise and power dissipation

See 8.3 of fuse system A.

8.4.3.6 Operation of indicating devices and striker, if any

Subclause 8.4.3.6 of IEC 60269-1 applies with the following addition:

After operation, the striker shall remain captive.

Table 201 shows the position and the force of the striker for both references.

Table 201 – Position and force of the striker

Size		Reference A	Reference B	
		0 to 4	1 to 4a	000/00
$S_{0\ max}$	mm	1	1	1
S_1	mm	13 to 20	10 min.	5,5 min.
F_{min} between positions 0 and 1	N	8	1	1
F_{max} in position 1	N	20	20	20

S_0 : projection of the striker before operation (position 0)
S_1 : projection of the striker after operation (position 1)
F : force of the striker

8.5.5.1 Verification of the peak withstand current of a fuse-base

See 8.5.5.1 of fuse system A.

8.7.4 Verification of overcurrent discrimination

See 8.7.4 of fuse system A.

8.9 Verification of resistance to heat

See 8.9 of fuse system A.

8.9.1 Fuse-base

See 8.9.1 of fuse system A.

8.9.1.1 Test arrangement

See 8.9.1.1 of fuse system A.

8.9.1.2 Test method

See 8.9.1.2 of fuse system A.

8.9.1.3 Acceptability of test results

After this test, the contact pieces of the fuse-base shall not have moved to such an extent as to affect the further use of the fuse-base. After extracting the dummy, the dimensions of Figure 202 shall be considered. The insulating mounting part of the fuse-base shall neither be broken nor shall it show any signs of cracks.

8.9.2.1 Test arrangement

See 8.9.2.1 of fuse system A.

8.9.2.2 Test method

See 8.9.2.2 of fuse system A.

8.9.2.3 Acceptability of test results

The gripping-lugs shall remain fully operational, and the length of the neck (2,5 + 0,5/0) mm in particular shall not be exceeded by more than 2 mm, in keeping with the dimensions d of Figure 201. The same applies to the maximum values of dimension c_2.

8.11.1.1 Mechanical strength of fuse-holder

See 8.11.1.1 of fuse system A.

8.11.1.2 Mechanical strength of the fuse-base

The mechanical strength of the fuse-bases and their components is verified by the following tests.

The test to verify the contact force of fuse-bases is performed on three unused fuse-bases as supplied. A test-link made of hardened steel with polished and chrome-plated surfaces is inserted three times in the fuse-base. The dimensions of the blade contacts of the fuse-link are identical with the dimensions given in Figure 201.

When pulling steadily by means of suitable test equipment, the withdrawal force F measured (see Figure 108) shall be found to lie within the limits specified in Table 118 of fuse system A.

In order to verify that the fuse-base contacts are firmly seated, steel screws (class 8.8) are fastened at the terminals. They are fastened three times by applying a torque of 1,2 times the value specified by the manufacturer or where no value is specified 1,2 times the value of Table 111 of fuse system A. For flat connections requiring a nut, appropriate steps shall be taken to prevent the nut from turning round.

After this test, the contact pieces of the fuse-base shall not have moved to such an extent as to affect the further use of the fuse-base. The insulating mounting part of the fuse-base shall neither be broken nor show any cracks.

If the measured values are too low, the dynamic test in accordance with 8.5.5.1 (fuse system C) shall be performed.

8.11.1.8 Impact resistance of gripping-lugs of moulded material or of metal fixed in moulded material

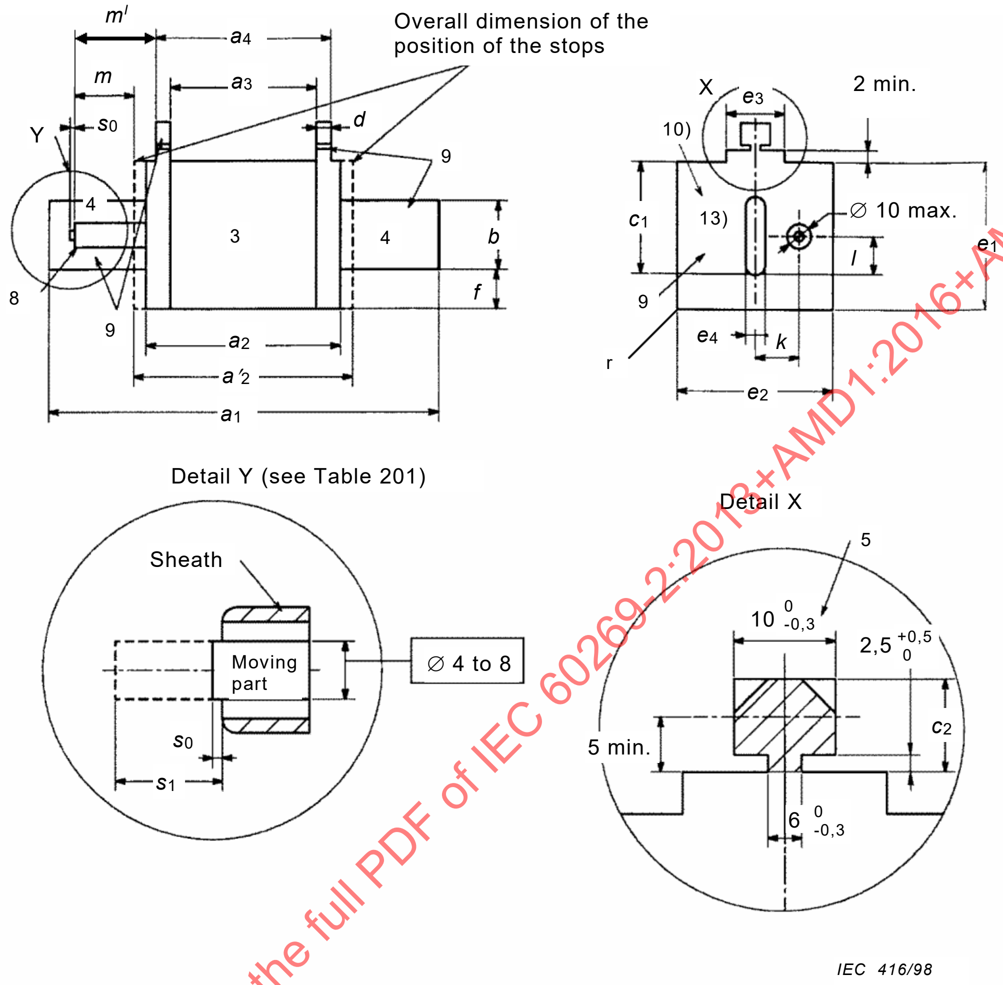
See 8.11.1.8 of fuse system A.

8.11.2.4.1 Test method

See 8.11.2.4.1 of fuse system A.

Dimensions in millimetres

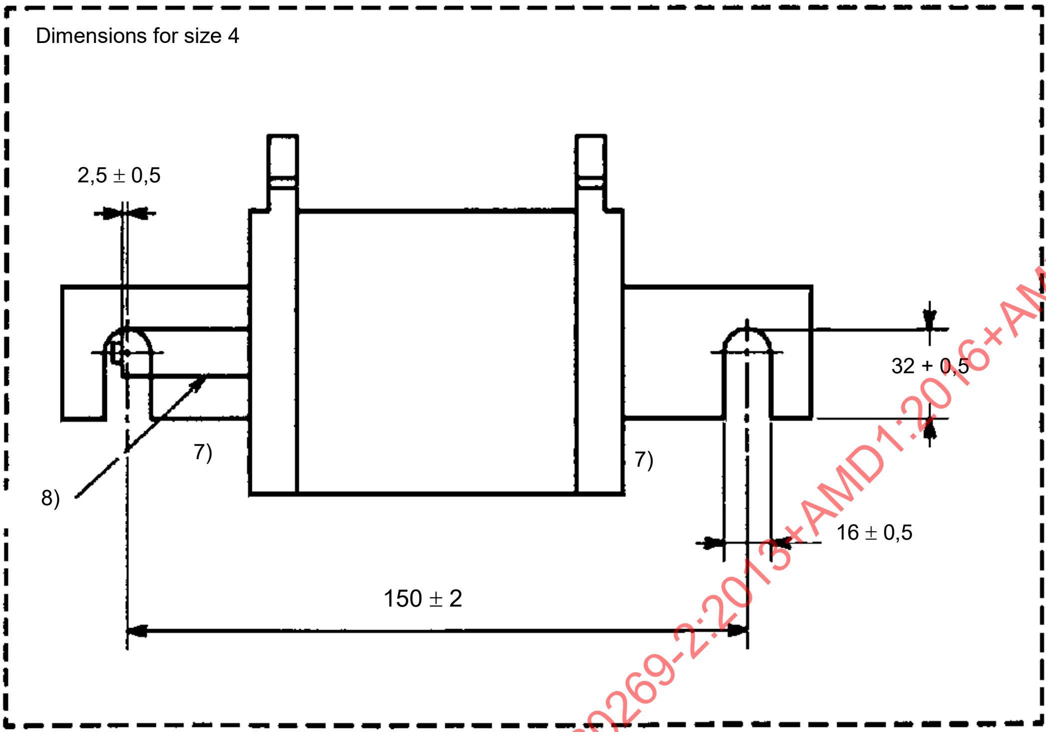
FIGURES



The drawings are not intended to govern the design of fuse-links except as regards the notes and dimensions shown.

Figure 201 – Fuse-links with blade contacts with striker *(1 of 4)*

Dimensions in millimetres



Maximum values of the rated power dissipation P_n

Size	gG				aM			
	500 V a.c.		690 V a.c.		500 V a.c.		690 V a.c.	
	I_n A	P_n W	I_n A	P_n W	I_n A	P_n W	I_n A	P_n W
000	100 125	7,5 9	63	12	100	7	80	6,5
00	160	12	100	12	100/160	7/11	160	11
1	250	23	200	32	250	18	250	22
2	400	34	315	45	400	35	400	40
3	630	48	500	60	630	50	630	53
4	1 000	90	800	90	1 000	80	1 000	80
4a	1 250	110	1 000	110	1 250	110	1 250	110

Figure 201 *(2 of 4)*

Reference A:

Size	a_1 1)	a_2 2)	a'_2	a_3 1)	a_4 1)	b min. 12)	c_1 ±0,8	c_2	d 5)	e_1 max. 6)	e_2 max. 6)	e_3	e_4 ±0,2	f max.	k	l	m	r min.
1	135 ± 2,5	75-10	$79^{+0}_{-1,5}$	62 ± 2,5	68 ± 2,5	20	40	11-2	$2,5^{+1,5}_{-0,5}$	53	52	20^{+5}_{-2}	6	15	16	14,5	25,5 ± 0,5	4
2	150 ± 2,5	75-10	$79^{+0}_{-1,5}$	62 ± 2,5	68 ± 2,5	25	48	11-2	$2,5^{+1,5}_{-0,5}$	61	60	20^{+5}_{-2}	6	15	19	14,5	25,5 ± 0,5	5
3	150 ± 2,5	75-10	$79^{+0}_{-1,5}$	62 ± 2,5	68 ± 2,5	32	60	11-2	$2,5^{+1,5}_{-0,5}$	76	75	20^{+5}_{-2}	6	18	24	14,5	25,5 ± 0,5	7
4	200 ± 3	90 max.		62 ± 2,5	68 ± 2,5	49	87	11-2	$2,5^{+1,5}_{-0,5}$	110	105	20^{+5}_{-2}	8	25	27,5	14,5		10

Reference B:

Size	a_1 1)	a_2 2)	a_3 1)	a_4 1)	b min. 12)	c_1 ±0,8	c_2	d 5)	e_1 max. 6)	e_2 max. 6)	e_3	e_4 ±0,2	f max.	k	l	m'	r min.
000	78,5 ± 1,5	54-6	45 ± 1,5	49 ± 1,5	15	35	10-1	$2^{+1,5}_{-0,5}$	48	21	20 ± 5	6	8	0	21,5	16,6 ± 0,5	1
00	78,5 ± 1,5	54-6	45 ± 1,5	49 ± 1,5	15	35	10-1	$2^{+1,5}_{-0,5}$	48	30	20 ± 5	6	15	0	21,5	16,6 ± 0,5	2
1	135 ± 2,5	75-10	62 ± 2,5	68 ± 2,5	20	40	11-2	$2,5^{+1,5}_{-0,5}$	53	52	20^{+5}_{-2}	6	15	13,7	20,5	23,5 ± 0,5	4
2	150 ± 2,5	75-10	62 ± 2,5	68 ± 2,5	25	48	11-2	$2,5^{+1,5}_{-0,5}$	61	60	20^{+5}_{-2}	6	15	16,2	27,3	23,5 ± 05	5
3	150 ± 2,5	75-10	62 ± 2,5	68 ± 2,5	32	60	11-2	$2,5^{+1,5}_{-0,5}$	76	75	20^{+5}_{-2}	6	18	17,0	35,6	23,5 ± 0,5	7
4a[11)]	200 ± 3	100 max.	84 ± 3	90 ± 3	49	85 ± 2	11-2	$2,5^{+1,5}_{-0,5}$	110	102	30 ± 10	6	30	24,0	49,0	23,5 ± 0,5	10

Dimensions in millimetres

Figure 201 *(3 of 4)*

1) The centres of the dimensions a_1, a_3 and a_4 shall not deviate from the centre of a_2 by more than 1,5 mm.

2) The dimension a_2 shall be observed within the total area $b_{min}/2$ measured from the lower edge of the blade over a width of at least 4 mm on both sides of the blade. Outside this area, the dimension may be less than the values indicated for a_2.

3) Insulating material.

4) The contact surfaces may be plane or provided with ribs.

5) Attachment for replacement handle (detail X).

6) Maximum dimensions of the enclosure of the fuse-link with the radiuses r. Within these limits, the fuse-links may be of any form, for example, square, rectangular, circular, oval polygonal, etc.

7) The slots are mandatory for size 4 fuse-links.

8) Striker.

9) Live parts, gripping-lugs can be insulated.

10) With the exception of the attachment for the replacement handle (detail X), the endplates shall not protrude radially from the insulation body.

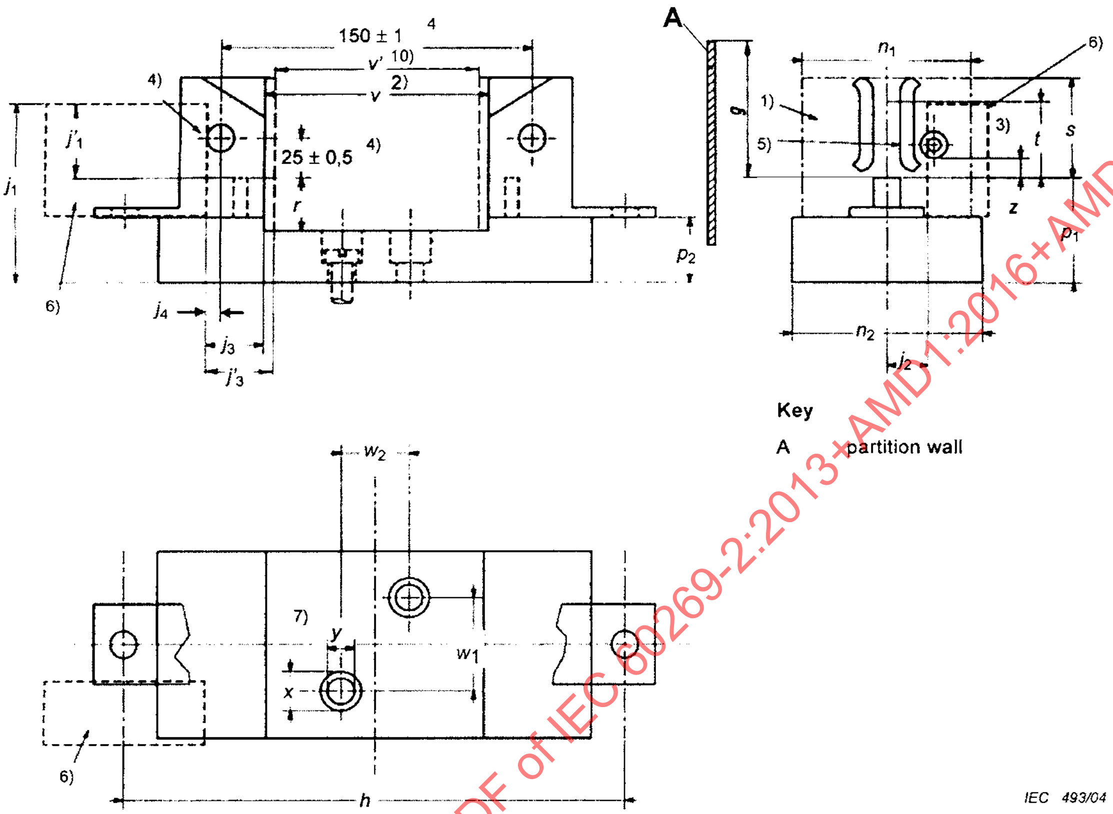
11) Only to be used with a swivel unit that has an interlocking device.

12) As far as overlapping of rated currents exists within the sizes 0, 1, 2 and 3 the dimension of the smaller size is permitted.

13) The edge of blade contacts can be round or of any appropriate shape.

Figure 201 *(4 of 4)*

Dimensions in millimetres



The drawings are not intended to govern the design of fuse-bases except as regards the notes and dimensions shown.

Figure 202 – Fuse-bases for fuse-links with blade contacts with striker *(1 of 3)*

Reference A:

Size	h ±1,5 7)	n_1 max.	n_2 max.	p_1 max.	p_2 ±1,5	r min.	s max.	t min.	v	w_1 7)	w_2 7)	x min. 7)	y ±0,5 7)	z max.
1	175	52	60	55	35	17	38	21	80+3	30±0,7	25±0,7	20	10,5	5
2	200	60	68	60	35	17	46	27	80+3	30±0,7	25±0,7	20	10,5	5
3	210	75	83	68	35	20	58	33	80+3	30±0,7	25±0,7	20	10,5	5
4	-	-	-	-	-	27	84	50	97 min.	-	-	-	-	5

Dimensions in millimetres

Reference B:

Size	g ±1 8)	h ±1,5 7)	n_1 max.	n_2 max.	p_1 max.	p_2 ±1,5	r min.	s max.	t min.	v	v'	w_1 w_2 7)	w_1 w_2 7)	x min. 7)	y ±0,5 7)	z max.
00 11)	47	100	30	38	40	-	17	21	15	56,5+1,5	55-1	0±0,7	25±0,7	14	7,5	3
1	53	175	52	60	55	35	17	38	21	80+3	76-1	30±0,7	25±0,7	20	10,5	5
2	61	200	60	68	60	35	17	46	27	80+3	76-1	30±0,7	25±0,7	20	10,5	5
3	73	210	75	83	68	35	20	58	33	80+3	76-1	30±0,7	25±0,7	20	10,5	5
4a 9)	100	270	102	115	-	40	32	84	50	110±15	-	45±0,7	30±0,7	36	14	6

Dimensions in millimetres

Size	**Rated current** **A**	**Rated acceptable power dissipation** **W**
00 11)	160	12
1	250	32
2	400	45
3	630	60
4	1 000	90
4a	1 250	110

Figure 202 *(2 of 3)*

Reference A:

Size	j_1	j_2	j_3		j_4	
	min.	max.	min.	max.	min.	max.
1	75,5	12	27	30		
2	79,5	15	27	30		
3	87,5	20	27	30		
4		23,5			6,5	9

Reference B:

Size	j_1'	j_2	j_3'	
	min.	max.	min.	max.
00 [11)]	21,5	0	17,5	19,5
1	20,5	13,7	24,5	26,5
2	27,3	16,2	24,5	26,5
3	35,3	17,0	24,5	26,5
4a	49	24,0	24,5	26,5

1) This area is considered to be live.

2) The maximum value of dimension v is intended to define a point of contact. It shall be observed at least at one point of contact within the range of $b_{min}/2$ measured from the lower edge of the blade contact of the fuse-link. At the upper edge of the blade contact, the value v need not be observed.

3) Height of contact surface. It shall also be possible to insert fuse-links with blade contacts according to Figure 201, even if the contact surface is not smooth but grooved or divided.

4) Dimensions for size 4. Fixing bolts are mandatory for size 4; M12 when threaded.

5) Resilient contact surface, except for size 4. Contact force by auxiliary means.

6) Space for the device acted by the striker. The fuse-base provided with the device intended to receive the striker may have a dimension higher than n_2.

7) These values are only mandatory if interchangeability of fuse-bases is required.

8) When constructing multipole or assemblies of single-pole fuse-bases, it is necessary, for reasons of safety, to fit insulating barriers (for example, partition walls) compatible with the maximum dimension prescribed for n_1.

9) Only to be used with a swivel unit that has an interlocking device.

10) v' is the dimension measured between the longitudinal stops.

11) Fuse-bases of size 00 shall be used for fuse-links of size 000 and size 00.

Figure 202 *(3 of 3)*

Fuse system C – Fuse-rails (NH fuse system)

1 General

IEC 60269-1 applies with the following supplementary requirements.

1.1 Scope

The following additional requirements apply to fuse-bases, sizes 00 to 3 in rail design for mounting on 100 mm and 185 mm busbar systems insofar as they are not adequately covered by fuse system A.

2 Terms and definitions

IEC 60269-1 applies with the following supplementary definition.

2.1.301
fuse-rails
fuse-rails combine three single-pole fuse-bases longitudinally arranged in one unit

Note 1 to entry: One terminal of each pole (generally called "busbar terminal") is connected with or without special clamps direct to one phase of a three-phase busbar system. The other terminals ("cable terminals") are prepared to receive outgoing or incoming conductors.

3 Conditions for operation in service

IEC 60269-1 applies.

4 Classification

IEC 60269-1 applies.

5 Characteristics of fuses

IEC 60269-1 applies with the following supplementary requirements.

5.2 Rated voltage

Subclause 5.2 of fuse system A applies.

5.3.2 Rated current

The rated current of the different sizes of the fuse-rails is given in Figure 301.

5.5.1 Rated acceptable power dissipation

The rated acceptable power dissipation of a fuse-rail is given in Figure 301.

6 Markings

IEC 60269-1 applies with the following supplementary requirements.

Clause 6 of fuse system A applies.

7 Standard conditions for construction

IEC 60269-1 applies with the following supplementary requirements.

7.1 Mechanical design

The dimensions of fuse-rails are given in Figure 301.

7.1.2 Connections, including terminals

Subclause 7.1.2 of fuse system A applies.

Fuse-rails with direct terminal clamps shall be capable of accepting conductors within the range of Table 301.

Table 301 – Minimum cross-sectional ranges of unprepared conductors for fuse-rails

Size	Rated current of the fuse-rail A	Cross-sectional area ranges mm^2	
		Cu	Al
00	160	6 to 70	25 to 95
1	250	25 to 120	35 to 150
2	400	50 to 2 × 120	70 to 2 × 150
3	630	50 to 2 × 185	--------------

7.2 Insulating properties

The creepage distances and clearances of fuse-rails shall meet the requirements of IEC 60664-1 for overvoltage category III and pollution degree 3. The minimum clearances are also applicable to metal parts which are not permanently under voltage but may be touched. They shall not be impaired during replacement of the fuse-link.

8 Tests

IEC 60269-1 applies with the following supplementary requirements.

8.1.6 Testing of fuse-holders

Fuse-rails shall be subjected to the tests according to Table 302. This table replaces Table 109 in fuse system A and Table 14 in IEC 60269-1.

Table 302 – Survey of complete tests on fuse-rails and number of fuse-rails to be tested [1]

Test according to subclause		Number of fuse-rails			
		1	1	1	2
8.1.4	Arrangement of the fuse and dimensions	X			
8.2	Verification of the insulating properties and of the suitability for isolation	X			
8.11.2.2	Verification of resistance to abnormal heat and fire	X			
8.11.1.2	Mechanical strength of the fuse-base		X		
8.3	Verification of temperature-rise and power dissipation			X	
8.11.1.1	Mechanical strength of fuse-holders			X	
8.3	Verification of temperature rise and power dissipation			X	
8.10.1.1	Contacts		X		
8.11.1.2	Mechanical strength of the fuse-base		X		
8.5.5.1	Verification of peak withstand current of a fuse-base [a]		X		
8.9	Verification of resistance to heat [b]			X	
8.11.2.4	Non-deterioration of insulating parts of fuse-link and fuse-base			X	
8.11.1.2	Mechanical strength of the fuse-base			X	
8.10.1.2	Direct terminal clamps (if applicable)	X			X
8.11.2.3	Verification of resistance to rusting		X		

[a] Not necessary if the withdrawal forces according to 8.11.1.2 are met.
[b] The dummy in phase L1 (top phase) is secured.

8.3 Verification of temperature rise and power dissipation

Subclause 8.3 of fuse system A applies with the following addition.

8.3.1 Arrangement of the fuse

Subclause 8.3.1 of fuse system A applies with the following addition:

The test arrangement for fuse-rails is given in Figure 302.

8.5.5.1 Verification of peak withstand current of a fuse-base

On fuse-rails, the verification of peak withstand current is covered by the verification of non-deterioration of contacts according to 8.10. Subclause 8.10.3.1 of fuse system A applies for the acceptability of test results.

If, after the verification of non-deterioration of contacts and direct terminal clamps, the measured values of withdrawal forces according to 8.10.2.1 are below the values shown in Table 118, the verification of peak withstand current according to 8.5.5.1.1 of fuse system C has to be performed.

1 The tests are listed in the order of useful test sequences.

8.5.5.1.1 Arrangement of the fuse

Fuse-rails are tested in a three-phase arrangement (single-phase testing with the three phases connected in series is possible with the consent of the manufacturer of a fuse-rail).

For fuse-rails, the test current is 50 kA and limited by gG fuse-links of the highest rating for the particular size. The cut-off currents may be below the values given in Table 112 of fuse system A.

The test set-up for fuse-rails is given in Figure 302.

The cross-sections of the busbars are taken from Figure 302 or corresponding to the manufacturer's instructions.

8.5.5.1.2 Test method

Subclause 8.5.5.1.2 of fuse system A applies with the following clarification: the test is performed on the three phases of one fuse-rail.

8.9 Verification of resistance to heat

See 8.9 of fuse system A.

8.9.1 Fuse-base

See 8.9.1 of fuse system A.

8.9.1.1 Test arrangement

See 8.9.1.1 of fuse system A.

8.9.1.2 Test method

See 8.9.1.2 of fuse system A.

8.9.1.3 Acceptability of test results

After this test, the contact pieces of the fuse-rail shall not have moved to such an extent as to affect the further use of the fuse-rail. After extracting the dummy, the dimensions of Figure 301 shall be considered. The insulating mounting part of the fuse-rail shall neither be broken nor shall it show any signs of cracks.

8.10 Verification of non-deterioration of contacts

Subclause 8.10 of fuse system A applies unless otherwise stated below.

8.10.1 Arrangement of the fuse

Subclause 8.10.1 of fuse system A applies with the following additions:

The three phases of one fuse-base rail according to Figure 301 are connected in series for the test. The test arrangement is given in Figure 302.

8.10.1.2 Direct terminal clamps

Subclause 8.10.1.2 of fuse system A applies with the following addition:

The test is performed on nine terminal clamps of three fuse-rails.

8.11.1.2 Mechanical strength of the fuse-base

Subclause 8.11.1.2 of fuse system A applies with the following addition:

The contact force is tested on all three phases of a new fuse-rail.

If the measured values are too low, the dynamic test in accordance with 8.5.5.1 (fuse system C) shall be performed.

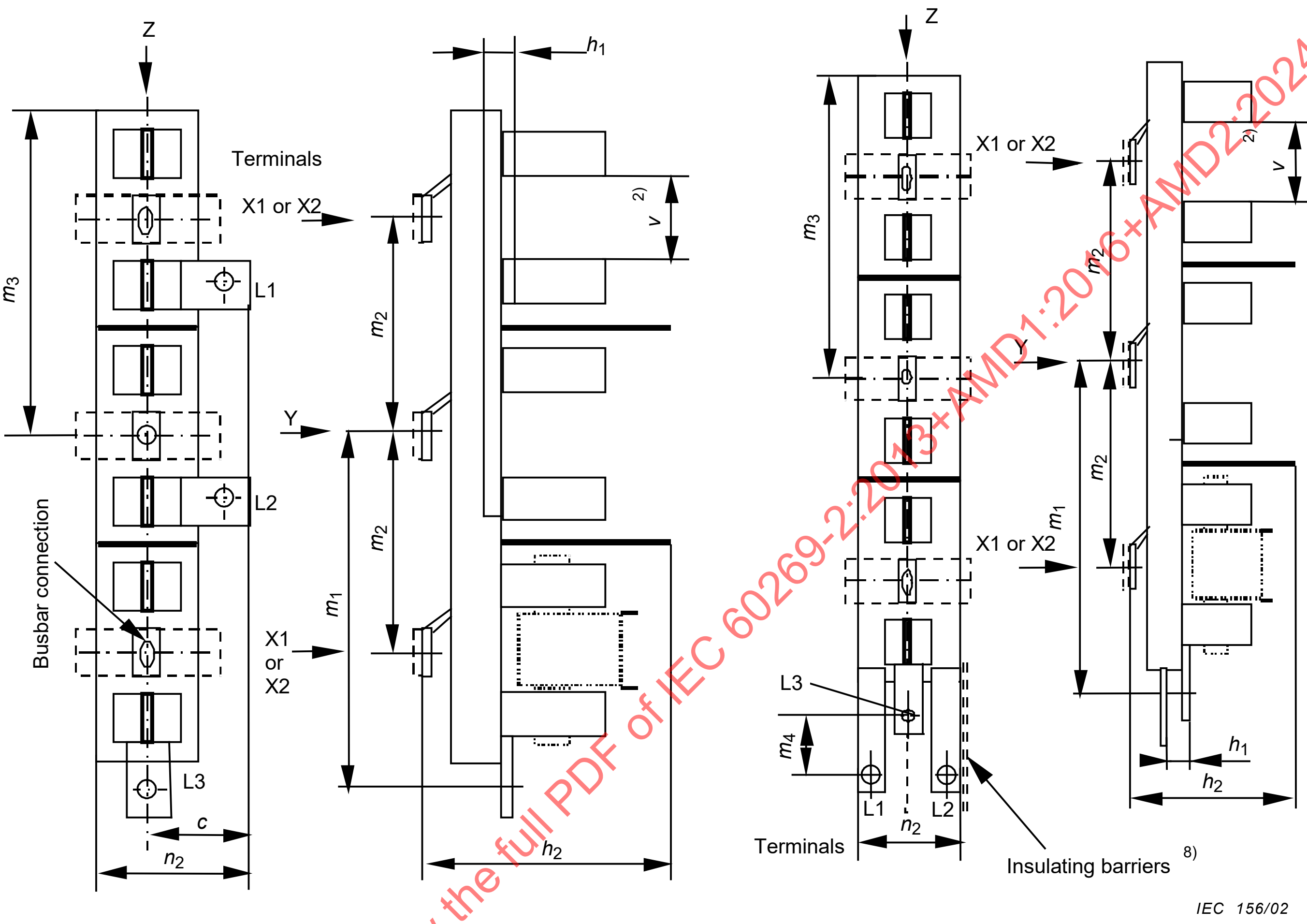
8.11.2.4.1 Test method

Subclause 8.11.2.4.1 of fuse system A applies with the following clarification:

One fuse-rail is tested.

FIGURES

Dimensions in millimetres



Reference C fuse-rail, terminals only, remaining parts as reference B

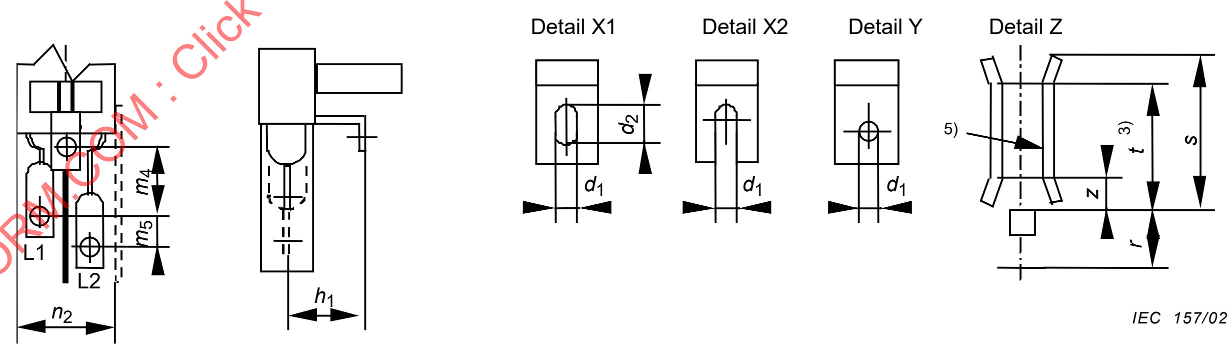
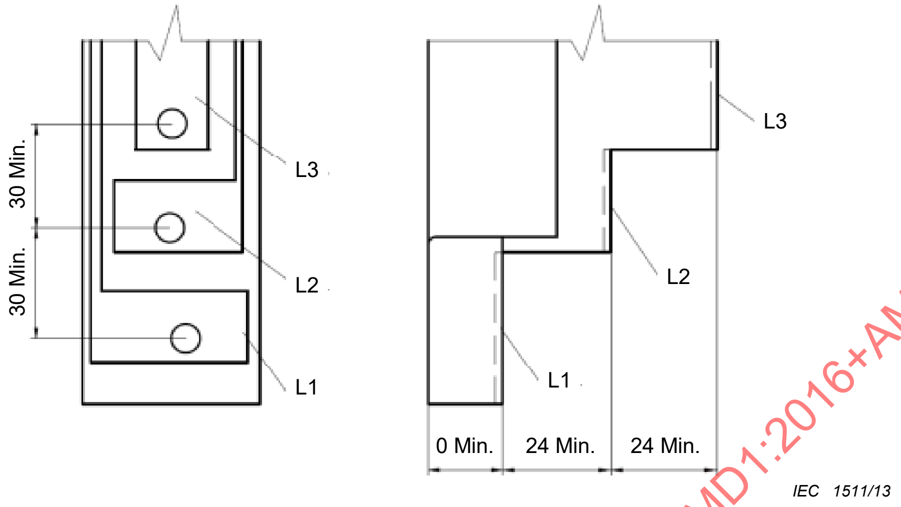


Figure 301 – Fuse-rails for fuse-links with blade contacts *(1 of 3)*

Reference D fuse-rail, size 00, terminals only, remaining parts as reference B



The drawings are not intended to govern the design of fuse-rails except as regards the notes and dimensions shown.

Figure 301 *(2 of 3)*

Dimensions in millimetres

Design	***Size***	***Busbar system*** Centre distance	*c* max.	d_1 ±0,5	d_2 min.	h_1 min.	h_2[b] max.	m_1[a] +20 −5	m_2 ±2,5	m_3 max.	m_4 ±10	m_5 +15	n_2 max.	*r* min.	*s* max.	*t* min.	*v*	*z* max.
Reference A	00 [c]	100	40	9	16		90	155	100	165			70	17	21	15	56,5 ±1,5	3
	00 [c]	185					175	285	185	280								
	1	185	60	14	22	35	175	285	185	280			100	17	38	21	80 ±3	5
	2														46	27		
	3		65										110	20	58	33		
Reference B	00 [c]	100		9	16	10	90	155	100	165	30		60	17	21	15	56,5 ±1,5	3
	00 [c]	185					175	285	185	280								
	1	185		14	22	40	175	285	185	280	50		100	17	38	21	80 ±3	5
	2														46	27		
	3													20	58	33		
Reference C	00 [c]	100		9	16	25	90	155	100	165	30	25	60	17	21	15	56,5 ±1,5	3
	00 [c]	185					175	285	185	280								
	1	185		14	22	40	175	285	185	280	40	55	80	17	38	21	80 ±3	5
	2														46	27		
	3													20	58	33		

[a] Other dimensions are permitted and shall be mentioned in the type test report and in the manufacturer's literature.

[b] Maximum overall dimensions.

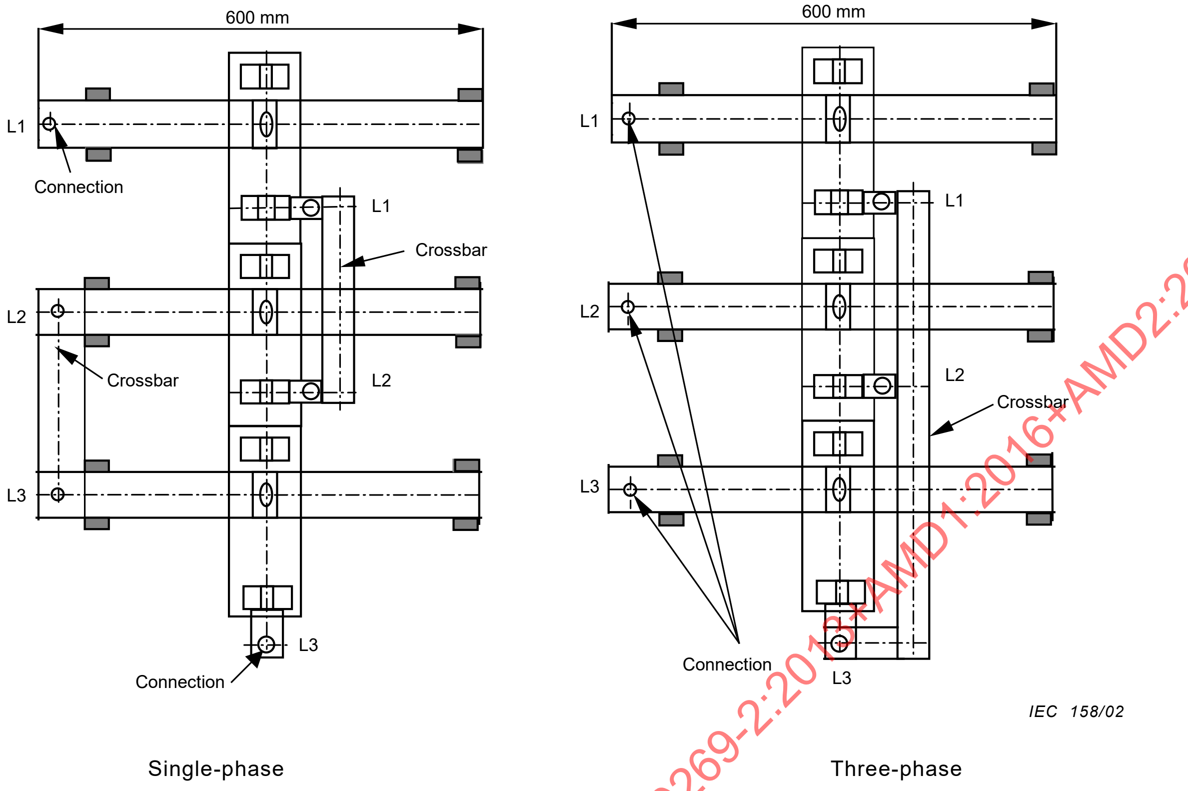
[c] Fuse-bases of size 00 are applicable for fuse-links of size 000 and size 00.

Size	**Rated current per phase** A	**Rated acceptable power dissipation** W
00	160	12
1	250	32
2	400	45
3	630	60

NOTE Footnotes 2), 3), 5) and 8) of Figure 102 apply.

Addition to footnote [b] – Dimension *v* may also be met between insulating contact covers.

Figure 301 *(3 of 3)*

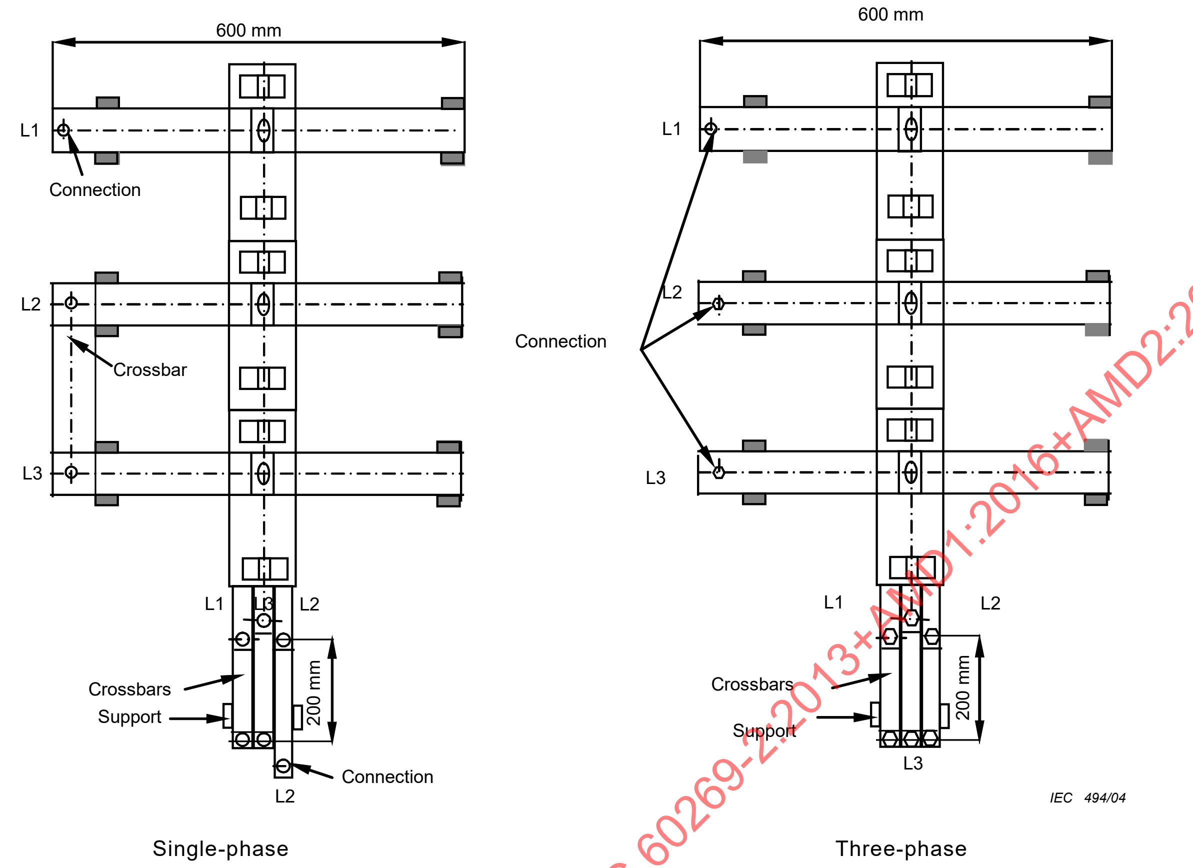


Design reference A

Cross-section of copper busbars:	30 mm or 32 mm × 5 mm for sizes 00 and 1 30 mm or 32 mm × 10 mm for size 2 40 mm × 10 mm for size 3
For tests according to 8.3.4.1 and 8.10:	connections according to 8.3.1 of IEC 60269-1
For test according to 8.5.5.1:	suitable crossbars and connections

The drawings are not intended to govern the design of fuse-rails except as regards the notes and dimensions shown.

Figure 302 – Test arrangement for fuse-rails *(1 of 2)*



Design reference B and C

Cross-section of copper busbars:	30 mm or 32 mm × 5 mm for sizes 00 and 1 30 mm or 32 mm × 10 mm for size 2 40 mm × 10 mm for size 3
For tests according to 8.3.4.1 and 8.10:	cross-bars are replaced by connections according to 8.3.1 of IEC 60269-1
For test according to 8.5.5.1:	suitable crossbars and connections

Figure 302 *(2 of 2)*

Fuse system D –
Fuse-bases for busbar mounting (40 mm system)
(NH fuse system)

1 General

IEC 60269-1 applies with the following supplementary requirements.

1.1 Scope

The following additional requirements apply to combined single pole fuse-bases sizes 00 for busbar systems having a centre distance of 40 mm, insofar as they are not adequately covered by fuse system A. Single pole fuse-bases sizes 00 up to 4a for mounting on other busbar systems are treated like fuse-bases according to Figure 102.

The following characteristics of the fuses are specified in addition to IEC 60269-1:

- standard conditions of construction;
- acceptable power dissipation.

2 Terms and definitions

IEC 60269-1 applies with the following supplementary definition.

2.1.401
fuse-base for 40 mm busbar systems
combined single pole fuse-bases (Figure 401) that are fixed on a 40 mm busbar system by the use of special clamping means

Note 1 to entry: Such fuse-bases may be fitted together for a three-pole version (Figure 402) or a three-pole version with two outlets per pole, the latter named "tandem fuse-base" (Figure 403).

3 Conditions for operation in service

IEC 60269-1 applies.

4 Classification

IEC 60269-1 applies.

5 Characteristics of fuses

IEC 60269-1 applies with the following supplementary requirements.

5.2 Rated voltage

Subclause 5.2 of fuse system A applies.

5.3.2 Rated current

The rated current of tandem fuse-bases size 00 is 63 A for each outlet.

63 A is the preferred value for tandem fuse-bases as used in the incoming cable compartment of meter panels. Higher current ratings up to 2 × 160 A are permissible for other applications. They have to be marked accordingly and should be tested according to this standard.

5.5.2 Rated acceptable power dissipation of tandem fuse-bases

The rated acceptable power dissipation of tandem fuse-bases having a rated current of 63 A per outlet is 7,5 W per outlet.

6 Markings

IEC 60269-1 applies with the following supplementary requirements.

Clause 6 of fuse system A applies.

7 Standard conditions for construction

IEC 60269-1 applies with the following supplementary requirements.

7.1 Mechanical design

Dimensions of fuse-bases for the 40 mm busbar system are given in Figures 401, 402 and 403.

7.1.2 Connections, including terminals

Subclause 7.1.2 of fuse system A applies.

Terminals of 63 A tandem fuse-bases size 00 shall be capable of accepting conductors within the range of Table 401.

The manufacturer shall state in his documentation the dimensions and centre distances of the busbars for which the tandem fuse-bases can be used.

When the busbar contact is effected by clamping means, for example, by hook-shaped fasteners with a screw, it shall be assured by constructional means that the function of the contact-making element is not impaired.

NOTE Impairing of the function can be avoided when, for example, slotted socket-head cap screws according to ISO 1207 are used.

Table 401 – Minimum cross-sectional ranges of unprepared conductors for fuse-bases for busbar mounting

Size	Rated current of the fuse-bases A	Cross-sectional area range mm²	
		Cu	Al
00	63	2,5 to 25	–

7.1.5 Construction of a fuse-base for busbar mounting

Busbar mounted fuse-bases according to Figures 401, 402 and 403 shall have partition walls between adjacent live parts. Fuse-bases should be designed in such a way that partition walls can subsequently be fixed. Measures shall be taken to fix outer walls if necessary.

It shall be possible to insert fuse-links into the fuse-bases and to pull them out by means of a replacement handle according to Figure 103.

It shall be possible to fix fuse-bases for busbar mounting by means of special clamps on 40 mm busbars systems with busbar dimensions 12 mm × 5 mm and/or 12 mm × 10 mm.

Constructional means shall be provided to ensure that the fuse-bases are retained on the busbars without the fastening and contacting screws being tightened.

The clamping screws of the clamping means as well as the terminal screws shall be accessible from the front.

The contact pieces shall be capable of accepting the blade contacts of fuse-links according to Figure 101. The contact pressure has to be guaranteed by spring loaded contact pieces or other adequate means.

Dimensions not given in Figures 401, 402 and 403 can be found in Figure 102.

7.2 Insulating properties and suitability for insulation

See 7.2 of fuse system A.

8 Tests

IEC 60269-1 applies with the following supplementary requirements.

8.3 Verification of temperature rise and power dissipation

Subclause 8.3 of fuse system A applies with the following additions.

8.3.1 Arrangement of the fuse

Subclause 8.3.1 of fuse system A applies with the following additions:

The test arrangements including the conductors are given in Figure 404 and 405. The cross-section of the busbar fitting with the contact system of the sample shall not be smaller than 12 mm × 5 mm. If the contact-making fastening of the fuse-base is achieved by screws, the torques given in Table 402 shall be applied.

Table 402 – Torques to be applied to contact making screws

I_n A	Size	Torque Nm
2 × 63	00	6

8.3.4.1 Temperature rise of the fuse-holder

Subclause 8.3.4.1 of fuse system A applies except that the dummy fuse-link size 00 63 A is described in Figure 407.

8.5.5.1.1 Arrangement of the fuse

The test arrangement in Figure 406 applies for fuse-bases for 40 mm busbar systems. These fuse-bases are always tested in a single-pole arrangement.

The cross-sections of the busbars are taken from Figure 406 or corresponding to the manufacturer's instructions.

For tandem fuse-bases the ranges of cut-off currents given in Table 403 apply.

Table 403 – Test currents

Size	Cut-off current kA
00	4 ... 5 [a]

[a] Preferred values for tandem performances 2 × 63 A in the lower connecting field of meter boards. For other performances with rated current 2 × 100 A a cut-off current between 9 kA and 11 kA is recommended.

8.9.1 Fuse-base

Subclause 8.9.1 of fuse system A applies as far as not otherwise stated below.

8.9.1.1 Test arrangement

The test arrangement for tandem fuse-bases is given in Figure 405. The dummy fuse-link is described in Figure 407. When tandem fuse-bases are tested, the measuring equipment is suspended in the middle upper current path. The tests are generally performed on busbars. The support insulators of the busbars are aligned with the width of the samples in such a way that bending of the busbars is avoided. The cross-section of the busbar shall correspond to the fastening means of the test sample, and the cross-section shall not be smaller than 12 mm × 5 mm. If the contact-making fastening is achieved by a screw, Table 402 applies.

8.9.1.3 Acceptability of test results

Subclause 8.9.1.3 of fuse system A applies with references to Figures 401 and 403.

8.10 Verification of non-deterioration of contacts

Subclause 8.10 of fuse system A applies as far as not otherwise stated below.

8.10.1 Arrangement of the fuse

Subclause 8.10.1 of fuse system A applies with the following additions:

The dummy fuse-link for size 00 63 A is described in Figure 407.

The torque of the contact-making fastening for fuse-bases on 40 mm busbar systems is taken from Table 402.

8.10.2 Test method

Subclause 8.10.2 of fuse system A applies with the following addition:

As far as single contact pieces of fuse-bases for 40 mm busbar systems are concerned, the tap points for resistance measurement shall lie as close as possible to the contact area.

8.11 Mechanical and miscellaneous tests

Subclause 8.11 of fuse system A applies.

8.11.1.2 Mechanical strength of the fuse-base

Subclause 8.11.1.2 of fuse system A applies with the following additions:

The contact force is tested on all outlets of one unused fuse-base. The withdrawal force shall be between the limits as given in Table 404.

Table 404 – Force to withdraw the fuse-link from the fuse-base contacts

Size	Rated current A	Withdrawal force F_{min} N	 F_{max} N
00	63	80	200 [a]

[a] Preferred values for tandem fuse-bases 2 × 63 A in the lower connecting field of meter boards. For other versions with rated current 2 × 100 A, F_{max} = 250 N per pole is recommended.

8.11.2.4.1 Test method

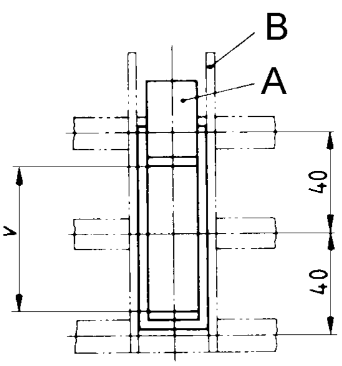
8.11.2.4.1 of fuse system A applies with the following clarification:

Three fuse-bases or one tandem fuse-base shall be tested.

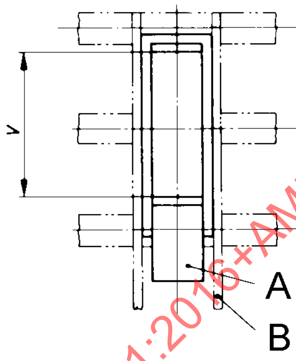
FIGURES

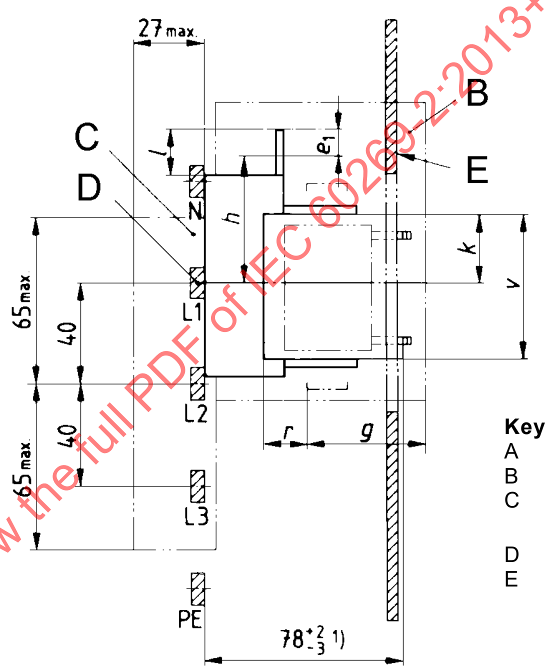
Dimensions in millimetres

Version O for top connection



Version U for bottom connection





Key

A connection strip
B partition wall
C area of live metal parts and other components
D contact area, see footnote 2)
E protection shield

IEC 1816/06

Size	*a* ±1	*v*	*r* min.	*g* ±1	*h* [3] +2 −4	*k* ±2,5	e_1 [4]	*l* [4]
00 [5]	33	56,5 ± 1,5	17	47	50	26,5	10	18

[1] Dimension 78^{+2}_{-3} between the top edge of the busbar and bearing shoulder of the inserted fuse-link (see dimensions c_1 and e_3 according to Figure 101).

[2] The busbar mounting base may rest on the busbars.

[3] Preferred dimension for use in meter boards.

[4] Only for flat connections.

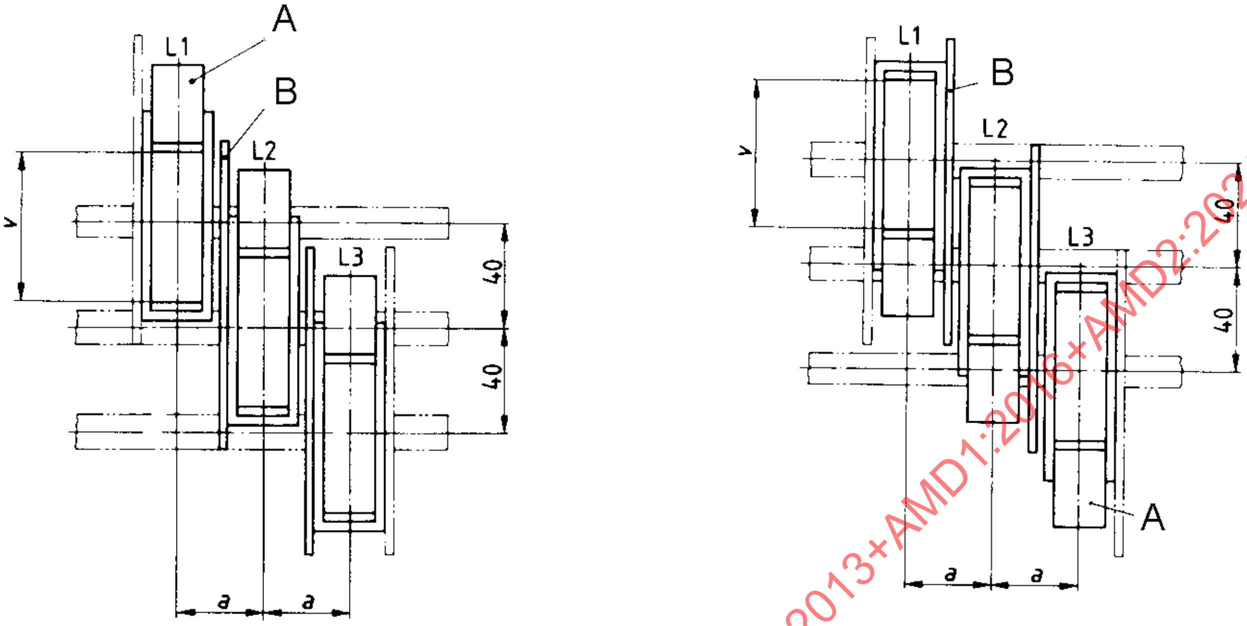
[5] Fuse-bases of size 00 are applicable for fuse-links of size 000 and size 00.

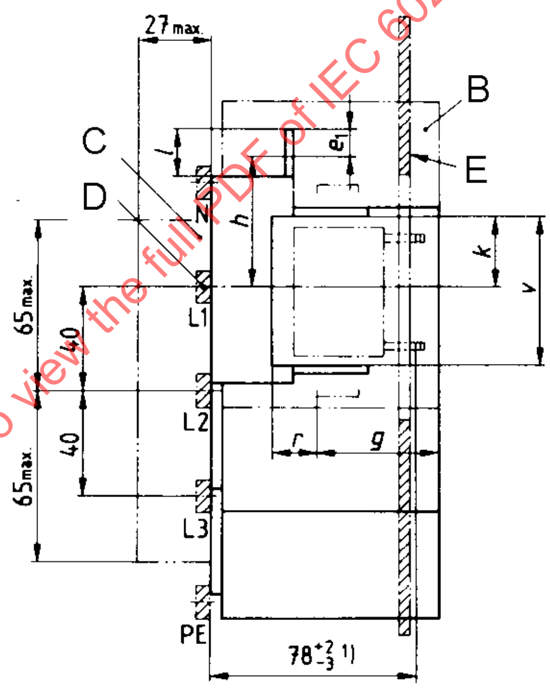
Figure 401 – Busbar mounting bases, 1 pole

Dimensions in millimetres

Version O for top connection

Version U for bottom connection





Key

A connection strip
B partition wall
C area of live metal parts and other components
D contact area, see footnote 2)
E protection shield

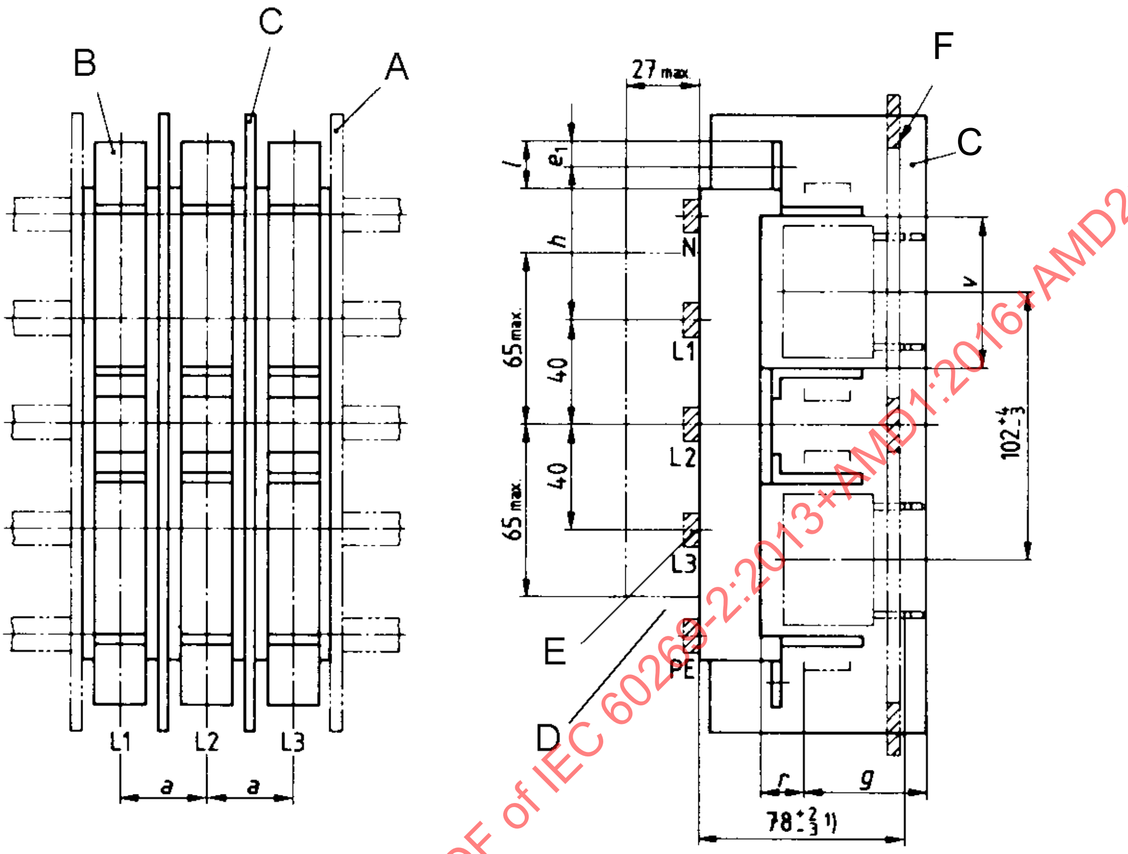
IEC 1817/06

Size	a ±1	v	r min.	g ±1	h 3) +2 −4	k ±2,5	e_1 4)	l 4)
00 5)	33	56,5 ± 1,5	17	47	50	26,5	10	18
NOTE For footnotes 1) to 5) see Figure 401.								

Figure 402 – Busbar mounting bases, 3 pole

Dimensions in millimetres

Versions O and U for top and bottom connection



Key

A outer partition wall

B connection strip

C partition wall

D area of live metal parts and other components

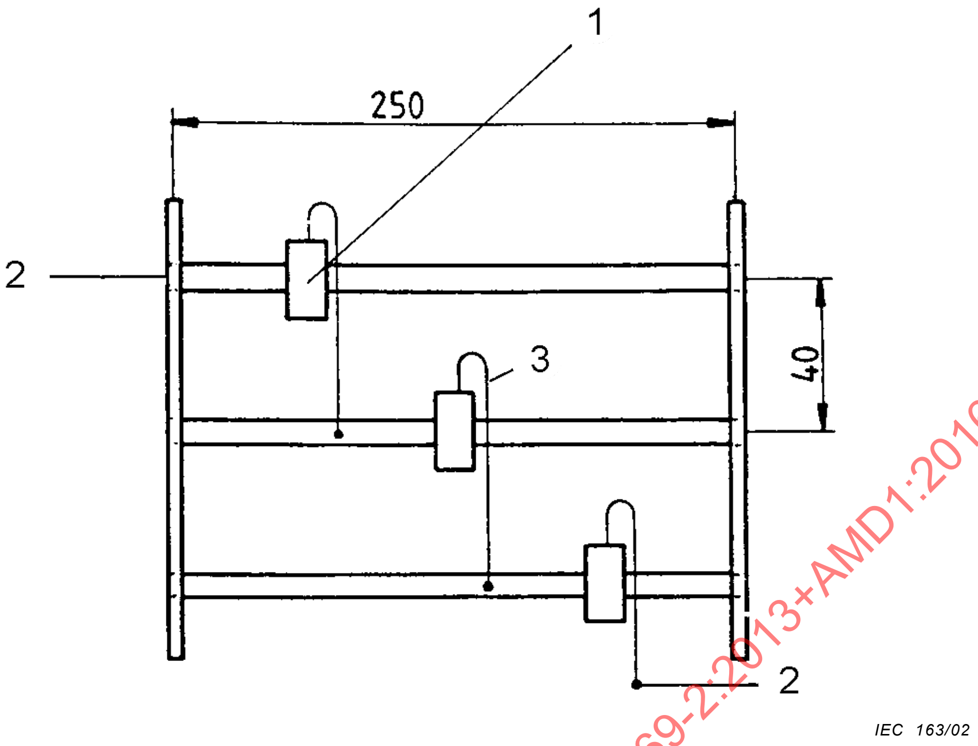
E contact area, see footnote 2)

F protection cover

Size	*a* ±1	*v* ±1,5	*r* min.	*g* ±1	*h* [3)] +2 −4	e_1 [4)]	*l* [4)]
00 [5)]	33	56,5 ± 1,5	17	47	50	10	18
NOTE For footnotes 1) to 5), see Figure 401.							

Figure 403 – Busbar mounting base, size 00, 2 × 3 pole (tandem fuse-base)

Dimensions in millimetres



Key

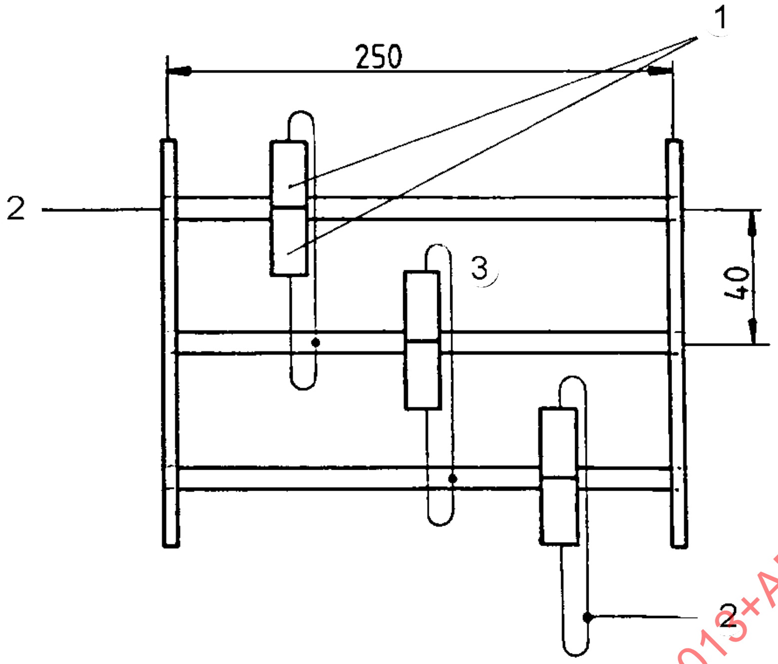
1 single pole (the three poles may be a unit)

2 connection

3 cable, length of each cable 1 m

Figure 404 – Test arrangement for single-pole and triple-pole fuse-bases for busbar-mounting according to 8.3.1

Dimensions in millimetres



Key

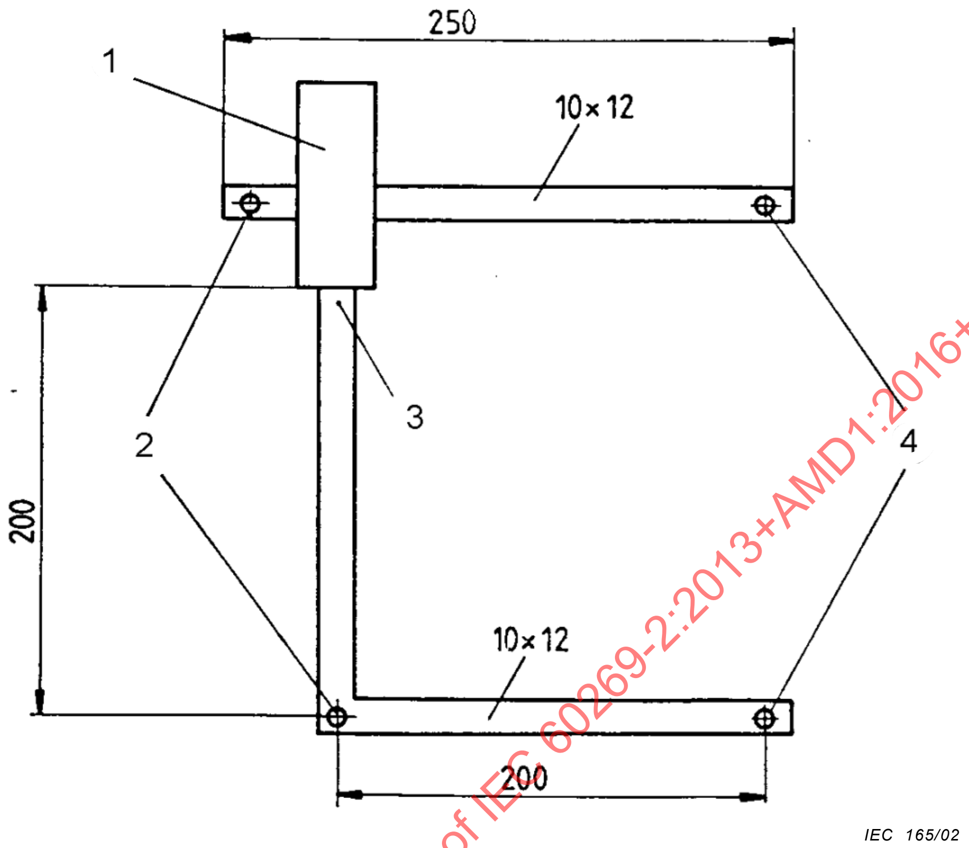
1 two single pole fuse-bases in tandem arrangement
(6 single-poles = 2 × 3 poles may be a unit)

2 connection

3 cable, length of each cable 1 m

Figure 405 – Test arrangement for two single-pole and six single-pole fuse-bases in tandem arrangement for busbar-mounting according to 8.3.1

Dimensions in millimetres



Key

1 single pole sample (or one pole of a multi-pole sample)

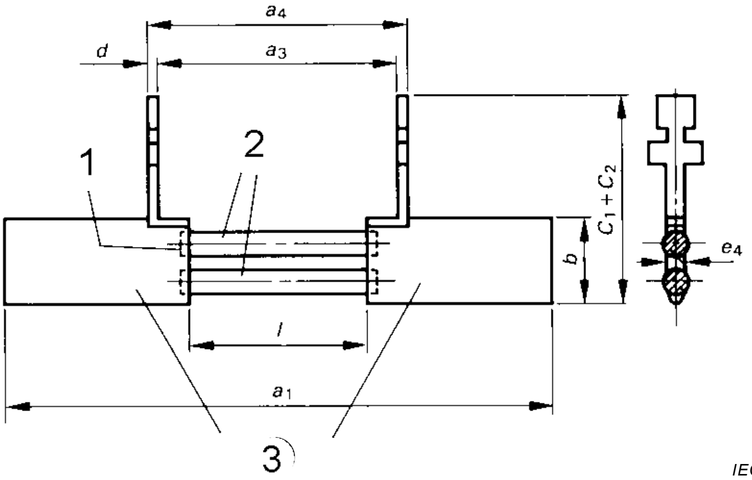
2 support

3 for clamp terminal an adaptor is demanded

4 source

Figure 406 – Test arrangement for the verification of the peak withstand current

Dimensions in millimetres



Key

1 soldered

2 CuMn12Ni

3 copper alloy, silver plated

For the dimensions of the gripping-lugs and other dimensions see Figure 101, in fuse system A.

Size	I_n A	l mm	P [a] W	R [b] mΩ	Bars	
					Number	Diameter mm
00	63	30,5 $^{+0}_{-3}$	7,5	1,88	1	3,5

[a] At I_n shown in the second column.
[b] Measured at the gripping-lugs; equalized with a tolerance of ±2 %.

Figure 407 – Dummy fuse-link

Fuse system E –
Fuses with fuse-links for bolted connections
(BS bolted fuse system)

1 General

IEC 60269-1 applies with the following supplementary requirements.

1.1 Scope

The following additional requirements apply to fuses with fuse-links having bolted connections. Such fuses have rated currents up to and including 1 250 A and rated voltages up to and including 690 V a.c. and up to and including 500 V d.c.

The following characteristics of the fuses are specified in addition to IEC 60269-1:

- minimum rated breaking capacities;
- time-current characteristics;
- I^2t characteristics;
- standard conditions of construction;
- power dissipation and acceptable power dissipation.

2 Terms and definitions

IEC 60269-1 applies.

3 Conditions for operation in service

IEC 60269-1 applies.

4 Classification

IEC 60269-1 applies.

5 Characteristics of fuses

IEC 60269-1 applies with the following supplementary requirements.

5.3.1 Rated current of the fuse-link

The maximum preferred rated currents are given in Figure 501.

5.3.2 Rated current of the fuse-holder

The maximum preferred rated currents for the fuse-holder are given in Figure 502.

5.5 Rated power dissipation of a fuse-link and rated acceptable power dissipation of a fuse-holder

The maximum values of power dissipation of fuse-links are given in Figure 501.

The values of rated acceptable power dissipation of fuse-holders at rated current when tested in accordance with 8.3.1 are given in Figure 502.

5.6 Limits of time-current characteristics

5.6.1 Time-current characteristics, time-current zones and overload curves

In addition to the limits of pre-arcing time given by the gates and the conventional times and currents, the time-current zones, excluding manufacturing tolerances, are given in Figures 503 and 504. The tolerance on time-current characteristics shall not deviate by more than ±10 % in terms of current.

5.6.2 Conventional times and currents

The conventional times and currents, in addition to the values of IEC 60269-1, are given in Table 501.

Table 501 – Conventional time and current for "gG" fuse-links

Rated current I_n A	Conventional time h	Conventional current	
		I_{nf}	I_f
$I_n < 16$	1	1,25 I_n	1,6 I_n

5.6.3 Gates

For "gG" fuse-links the gates given in Table 502 and in IEC 60269-1 apply.

Table 502 – Gates for specified pre-arcing times of "gG" fuse-links

I_n A	I_{min} (10 s) A	I_{max} (5 s) A	I_{min} (0,1 s) A	I_{max} (0,1 s) A
2	3,4	5,0	4,6	7,5
4	6,5	10,5	10,0	18,5
6	10,0	18,0	17,0	35,0
10	18,0	36,0	35,0	60,0

5.7.2 Rated breaking capacity

The rated breaking capacity shall be a minimum of 80 kA a.c. and 40 kA d.c.

6 Markings

IEC 60269-1 applies with the following supplementary requirements.

6.1 Markings of fuse-holders

In addition to IEC 60269-1, the following marking applies:

– size.

The marking of the rated current and the rated voltage shall be discernible from the front when a fuse-link has not been fitted.

6.2 Markings of fuse-links

In addition to IEC 60269-1, the following marking applies:

– size or reference;
– rated breaking capacity.

7 Standard conditions for construction

IEC 60269-1 applies with the following supplementary requirements.

7.1 Mechanical design

The dimensions of fuse-links and fuse-bases are given in Figures 501 and 502.

7.1.2 Connections including terminals

Under consideration.

7.2 Insulating properties and suitability for insulation

The creepage distances and clearances of fuse parts shall meet the requirements of IEC 60664-1 for overvoltage category III and degree of pollution 3.

7.9 Protection against electric shock

Where standardized fuse-holders according to Figure 502 are used, the degree of protection against electric shock shall be at least IP2X for all three stages.

8 Tests

IEC 60269-1 applies with the following supplementary requirements.

8.3 Verification of temperature rise and power dissipation

8.3.1 Arrangement of the fuse

The test arrangement for fuse-links is given in Figure 505. The test arrangement shall be mounted vertically.

8.3.3 Measurement of the power dissipation of the fuse-link

The points of measurement of power dissipation are given in Figure 505.

8.4 Verification of operation

8.4.1 Arrangement of the fuse

The test arrangement of the fuse-link is given in Figure 505. The test arrangement shall be mounted vertically.

8.5 Verification of breaking capacity

8.5.1 Arrangement of the fuse

The test arrangement of the fuse-link is given in Figure 506.

8.5.8 Acceptability of test results

The requirements of IEC 60269-1 apply and in addition fuse-links shall operate without the melting of the fine fuse wire and without mechanical damage to the rig.

8.9 Verification of resistance to heat

Fuse-holders fitted with fuse-links having the maximum power dissipation corresponding to the acceptable power dissipation of the fuse-holder shall be cyclically loaded as pre-treatment. The pre-treatment is specified in 8.4.3.2 of IEC 60269-1. After cooling to normal temperature, the breaking capacity shall be tested at I_1 in accordance with 8.5.

Fuse-links containing organic material in the body or filler shall be subjected to the same test as described above. These fuse-links shall interrupt the test currents I_1 and I_5.

8.10 Verification of non-deterioration of contacts

Subclause 8.10 of IEC 60269-1 applies.

8.10.1 Arrangement of the fuse

Subclause 8.10.1 of IEC 60269-1 applies with the following addition.

The dummy fuse-links shall have dimensions that comply with Figure 501 for those references that are accommodated in the standardized fuse-holders in Figure 502.

The power dissipation of the dummy fuse-links shall be the rated acceptable power dissipation of the fuse-holders given in Figure 502 when tested in the standardized power dissipation test rig given in Figure 505.

The dummy fuse-links shall be so constructed that they do not operate during the passage of the overload current I_{nf}.

8.10.2 Test method

Subclause 8.10.2 of IEC 60269-1 applies with the following addition:

The following wording is added after the first paragraph of 8.10.2 in IEC 60269-1.

The following test values have to be applied:

Test current: conventional non-fusing current I_{nf}

Load period: 25 % of the conventional time

No-load period: 10 % of the conventional time

A test voltage lower than the rated voltage may be used.

8.10.3 Acceptability of the results

After 250 cycles, the measured temperature-rise values shall not exceed the temperature rise measured at the beginning of the tests by more than 15 K.

After 750 cycles, if necessary, the temperature shall not exceed the values measured before the beginning of the tests by more than 20 K.

8.11 Mechanical and miscellaneous tests

8.11.1.1 Mechanical strength of fuse-holders

The fuse-holder, fitted with a fuse-link of the largest rated current and power dissipation that can be accommodated by the fuse-holder, shall be subjected to a temperature rise test at rated current.

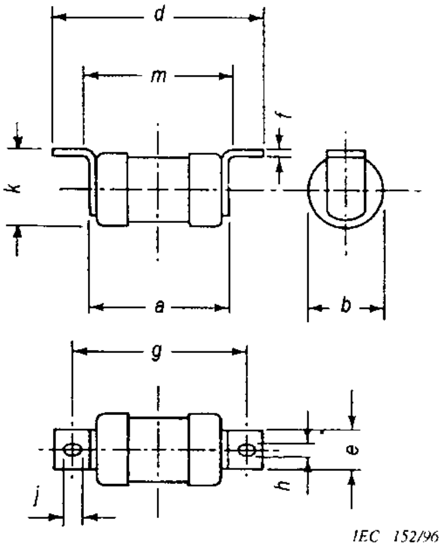
At the conclusion of the temperature rise test, the fuse-link or the fuse-carrier as appropriate, shall be withdrawn and inserted into the fuse-base 100 times.

At the conclusion of these tests, all parts shall be intact and shall function normally.

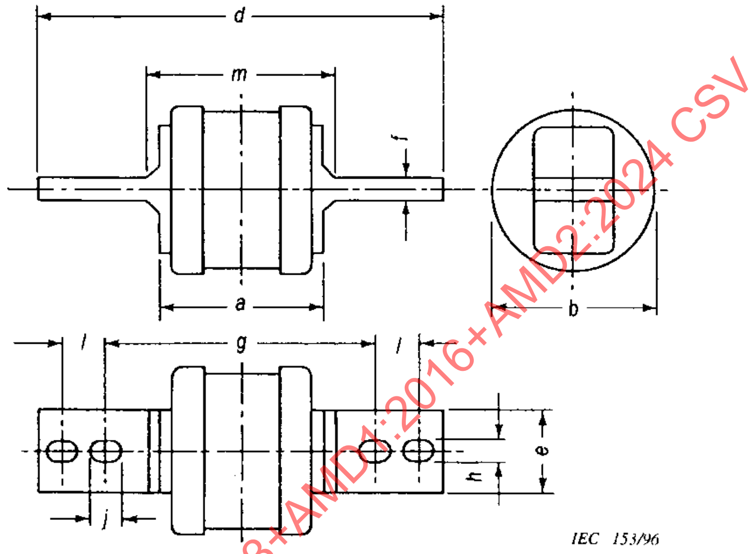
Compliance shall be verified by a further temperature rise test at rated current at the conclusion of which the values obtained shall be not more than 5 K or 15 % (whichever is greater) above the values obtained from the temperature-rise test prior to the commencement of the mechanical test.

Dimensions in millimetres

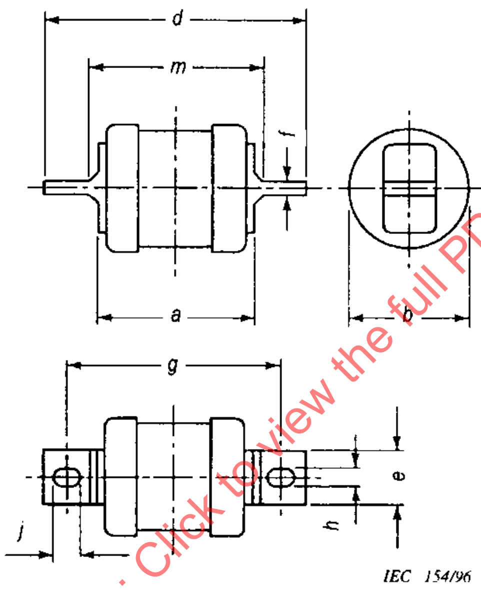
FIGURES



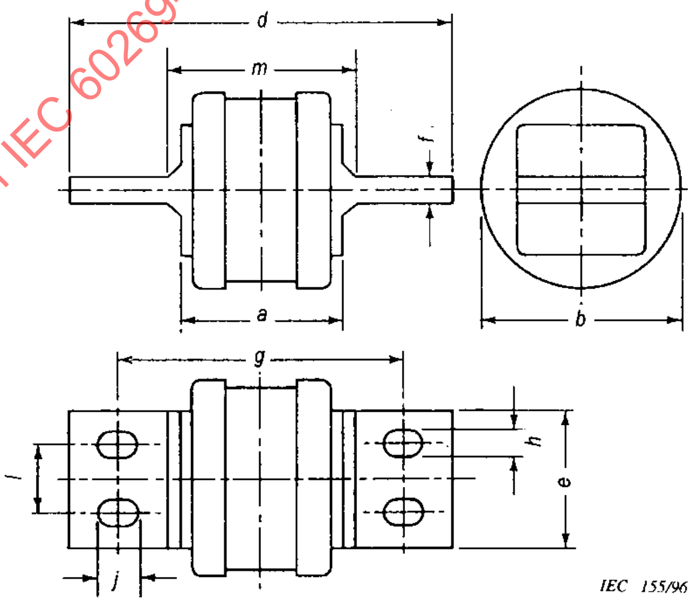
Size A fuse-link



Size C fuse-link



Size B fuse-link



Size D fuse-link

The drawings are not intended to govern the design of fuse-links except as regards the notes and dimensions shown.

Figure 501 – Fuse-links for bolted connection – Sizes A, B, C and D *(1 of 2)*

Size	Maximum rated current A	Maximum power dissipation W	*a* (max.) a,b	*b* (max.)	*d* (max.)	*e* (max.) c	*f* (max.) c		*g* (nom.)	*h* (nom.)	*j* (min.) b,d	*k* (max.)	*l* (nom.) a	*m* (max.)
A1	20	2,7	36,5	14,5	56	11,2	0,8	1,5	44,5	4,2	5,5	14,5	–	36,5
A2	32	4,4	57	24	86	9,2	0,8	1,5	73	5,5	7	25,5	–	60
A3	63	6,9	58	27	91	13	1,2	1,6	73	5,5	7	28	–	61
A4	100	9,1	70	37	111	20	2,4	3,2	94	8,7	9,5	38,5	–	74
B1	100	9,1	70	37	138	20	3,2	4	111	8,7	11	–	–	82
B2	200	17	77	42	138	20	3,2	4	111	8,7	11	–	–	82
B3	315	32	77	61	138	26	3,2	4,8	111	8,7	11	–	–	82
B4	400	40	83	66	138	26	4,8	6,6	111	8,7	11	–	–	89
C1	400	40	83	66	212	26	4,8	6,6	133	10,3	11	–	25,4	95
C2	630	55	85	77	212	26	6,3	7,8	133	10,3	11	–	25,4	95
C3	800	70	89	84	212	39	9,5	11,1	133	10,3	12,5	–	25,4	101
D1	1 250	100	89	102	200	64	9,5	12,7	149	14,3	16,5	–	31,8	95

[a] In all sizes, dimension *a* includes any projections such as rivet heads, but the design of the tags between dimensions *a* and *m* is limited by a line drawn at 45° to the contact surface.

[b] All fixing holes are elongated as indicated by *j*, to allow for manufacturing tolerances on dimension *a*.

[c] Dimensions *e* and *f*, are nominal material sizes and subject to manufacturing tolerances as specified in the relevant standards for the raw materials.

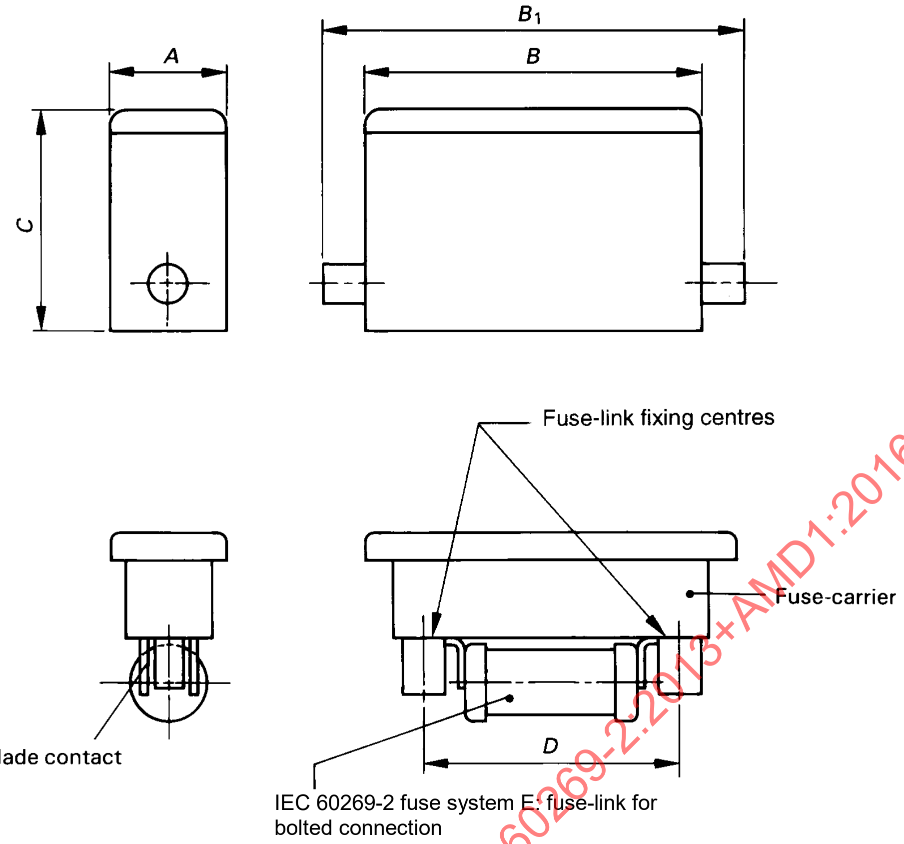
[d] For A1 to A4 size fuse-links, the fixing slots may be extended either axially or laterally to form open-ended slots.

Standardized "gM" fuse-links

Size	Standardized ratings	Current rating A	Characteristic rating A
A1	20M25	20	25
A1	20M32	20	32
A2	32M40	32	40
A2	32M50	32	50
A2	32M63	32	63
A3	63M80	63	80
A3	63M100	63	100
A4 and B1	100M125	100	125
A4 and B1	100M160	100	160
A4 and B1	100M200	100	200
B2	200M250	200	250
B2	200M315	200	315

NOTE The power dissipation of "gM" fuse-links is lower than the values given for "gG" fuse-links in the same dimensional references.

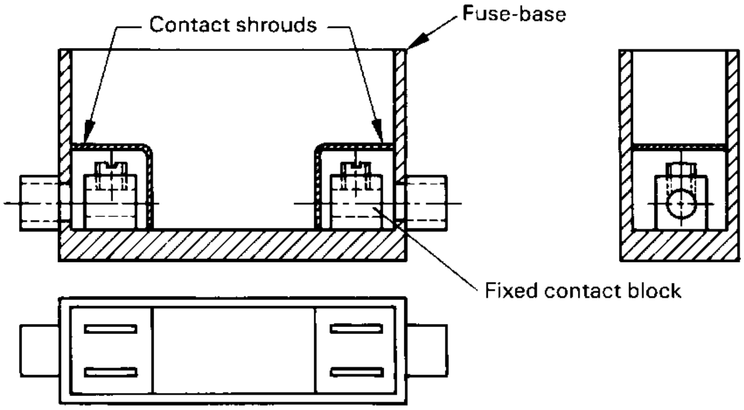
Figure 501 *(2 of 2)*



Dimensions in millimetres

NOTE The fuse-carrier can accommodate centre tag or offset tag fuse-links.

Figure 502 – Typical fuse-holder *(1 of 2)*



Dimensions in millimetres

NOTE Apertures in shrouds to give a degree of protection of IP2X (IEC 60529).

Maximum rated current A	**Rated acceptable power dissipation** W	***A*** max.	***B*** max.	***B***$_1$ max.	***C*** max.	***D***	**Fuse-link accommodated, size**
20	2,7	30	91	110	62	44,5	A1
32	4,4	35	114	134	75	73	A2
63	6,9	47	140	140	91	73	A3
100	9,1	61	175	175	121	94	A4
200	17,0	86	233	310	159	111	B1 + B2

This drawing is included by way of illustration only and does not prejudice the use of other shapes or forms provided they fall within the dimensions listed above.

Figure 502 *(2 of 2)*

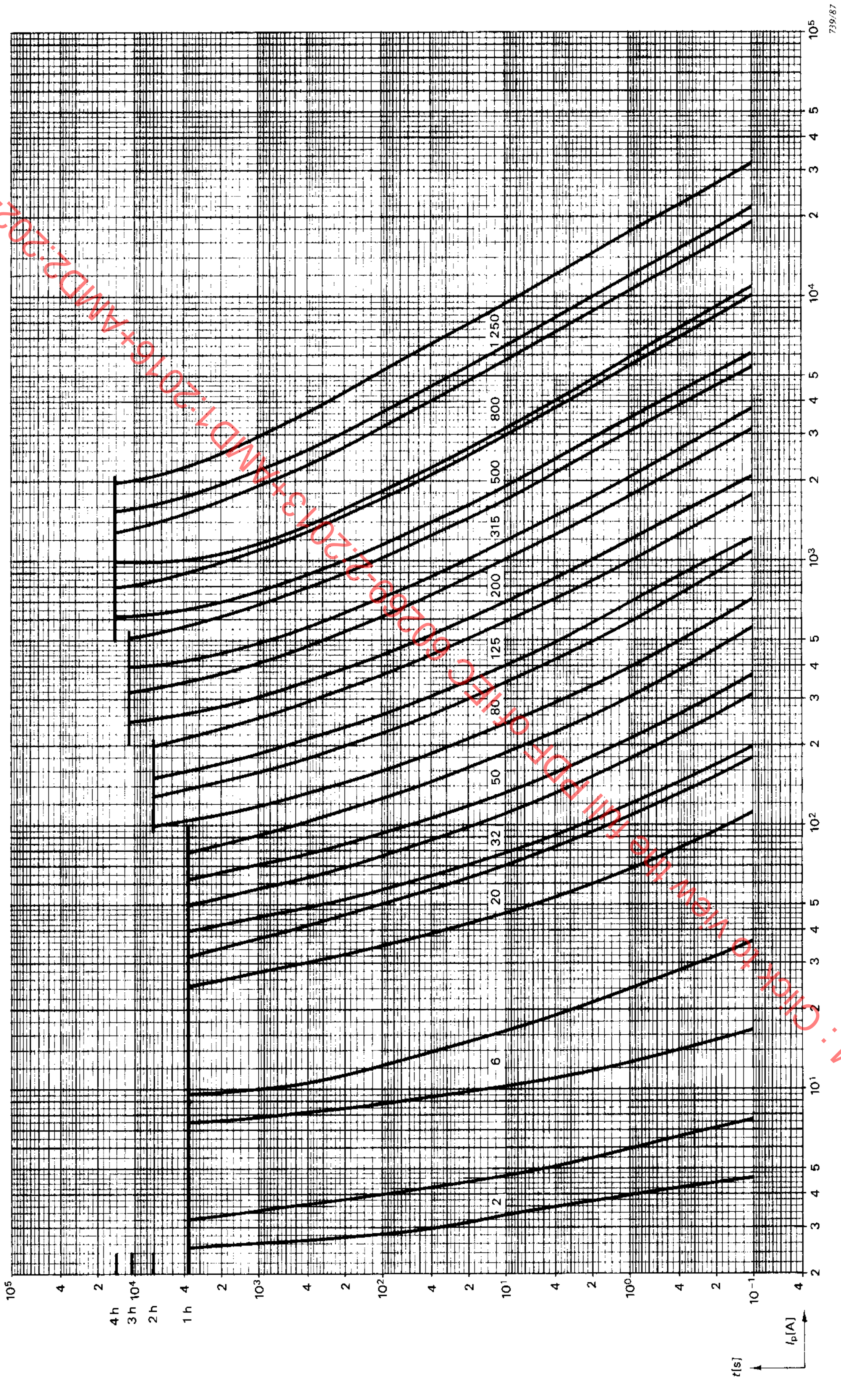


Figure 503 – Time-current zones for "gG" fuse-link

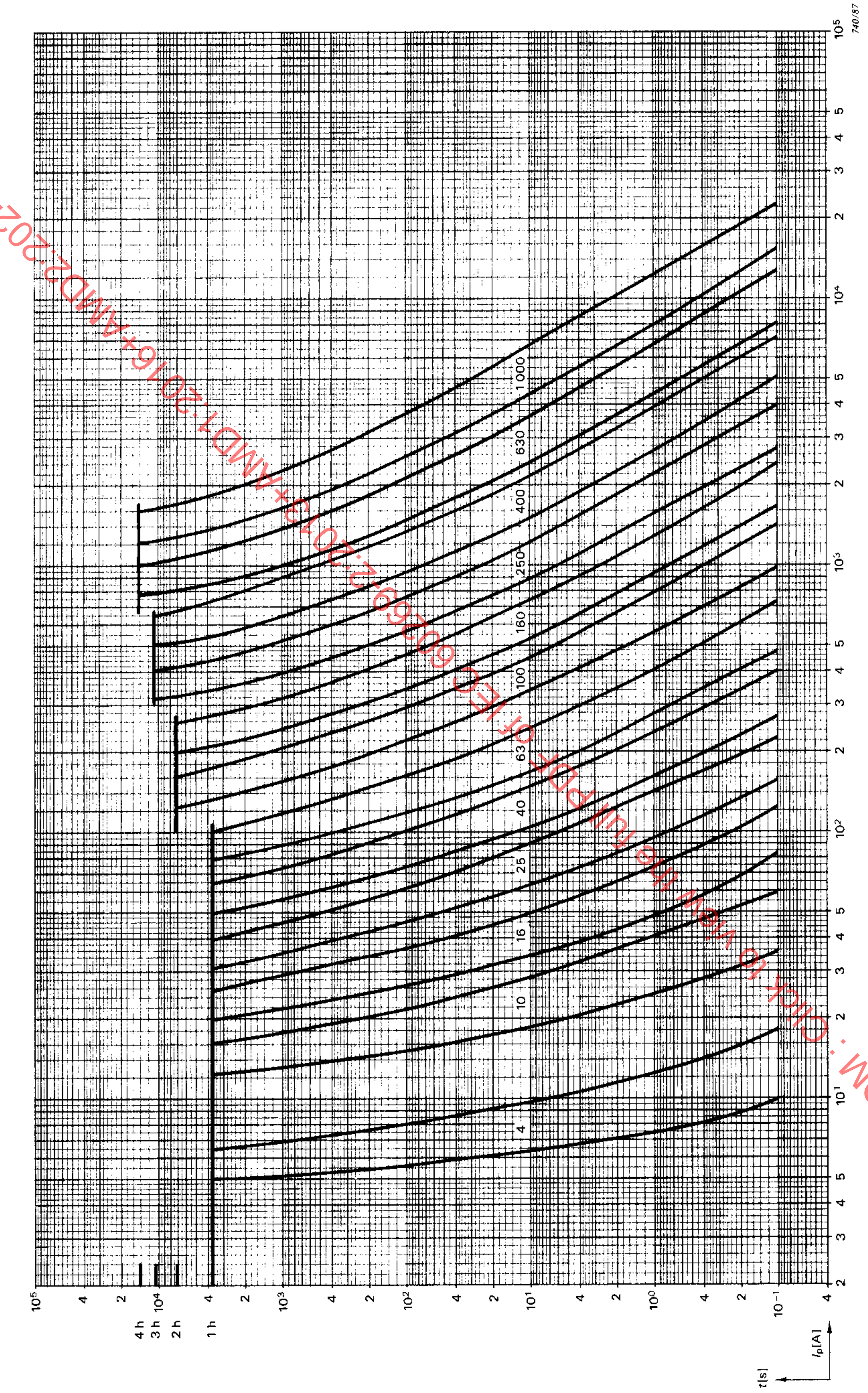
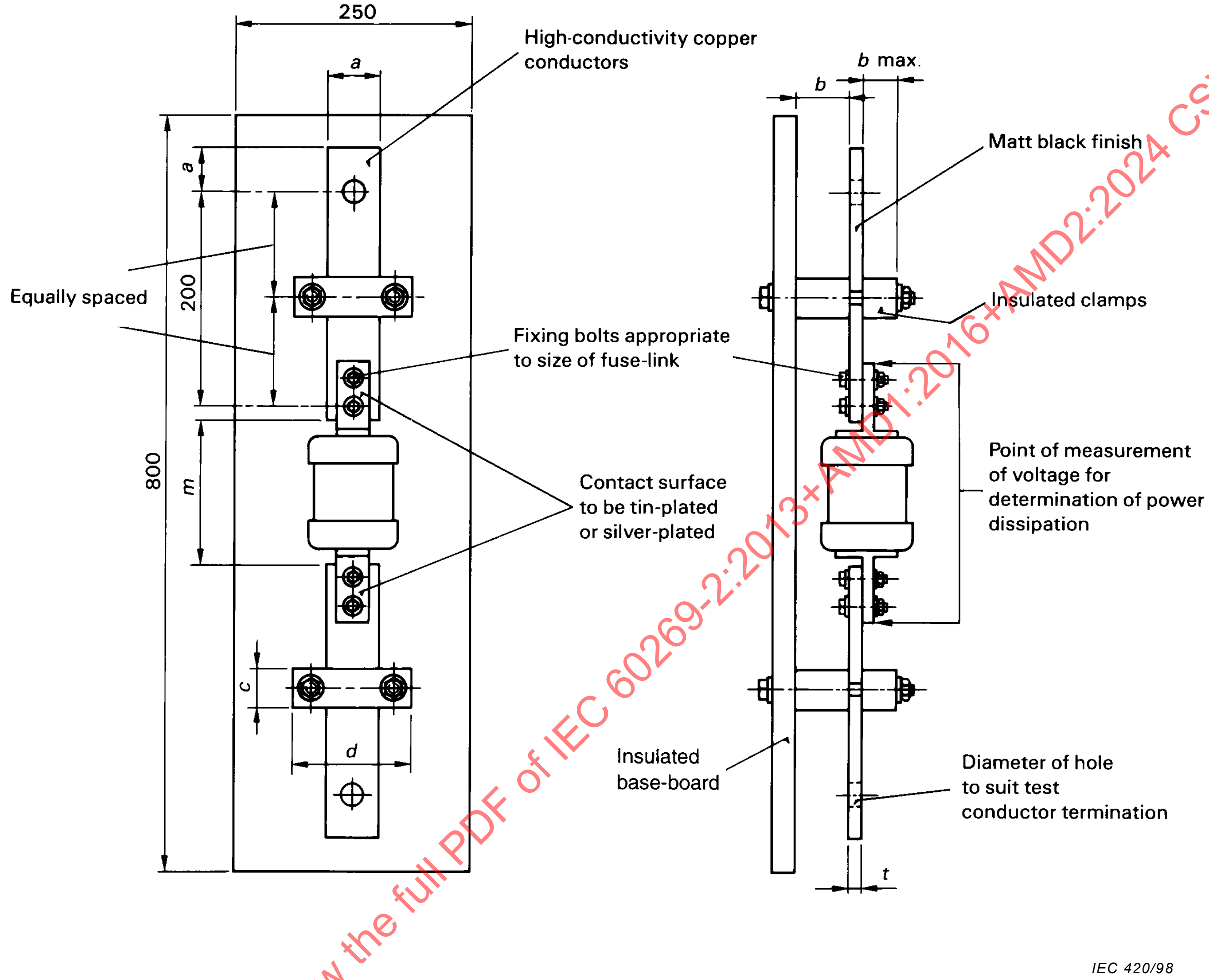


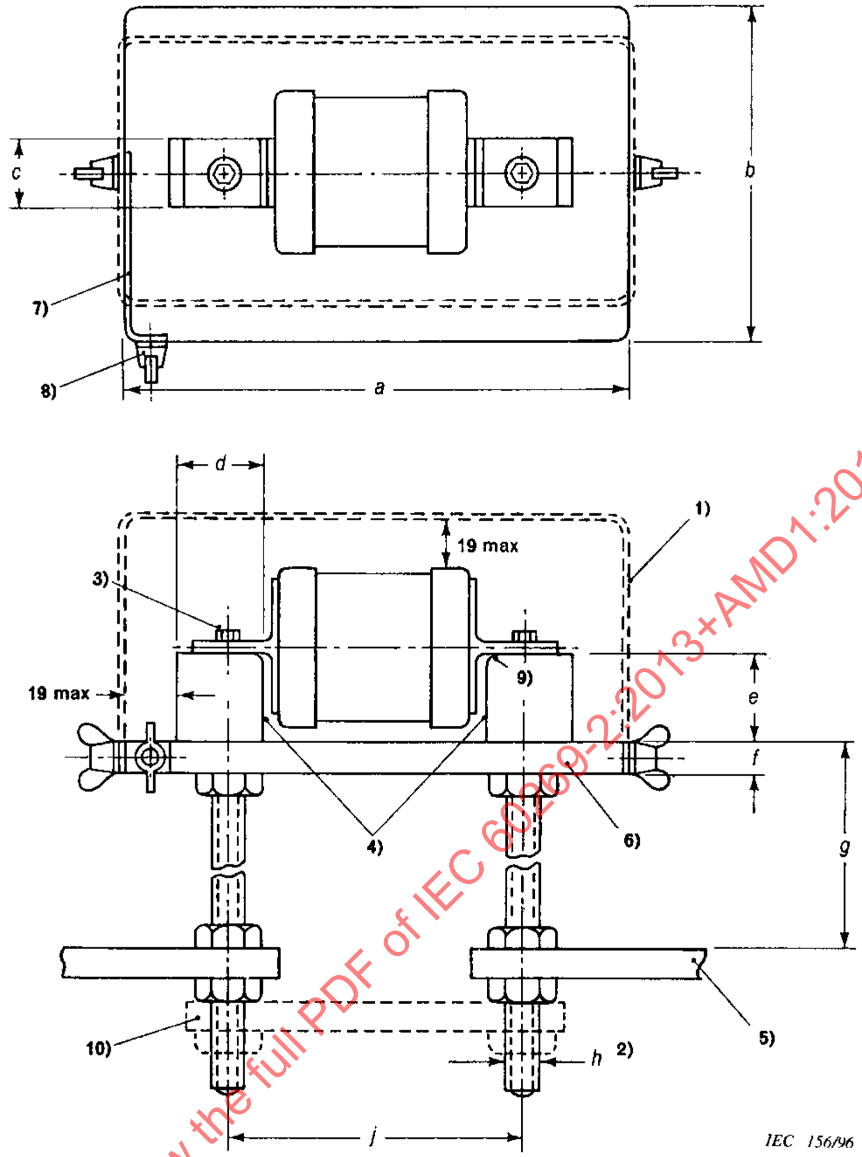
Figure 504 – Time-current zones for "gG" fuse-link

Dimensions in millimetres



Fuse-link Size	Dimensions						Current rating in A up to
	a	*b*	*c*	*d*	*m*	*t*	
A1	10	12,5	16	50	38	0,5	20
A2	10	12,5	16	50	61	0,5	32
A3	16	12,5	16	50	62	1,0	63
A4	20	25	25	70	75	1,6	100
B1	20	25	25	70	83	1,6	100
B2	20	25	25	70	83	5	200
B3	25	38	25	80	83	8	315
B4	25	38	25	80	90	10	400
C1	25	38	25	80	96	10	400
C2	32	38	25	80	96	12	630
C3	40	45	32	100	101	12	800
D1	80	60	45	160	96	10	1 250
NOTE Approximate dimensions are acceptable.							

Figure 505 – Power dissipation test rig



Dimensions in millimetres

Fuse-link, size	Current rating up to A	Dimensions								
		a	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*j*
A1 to A4 B1 to B4	400	187	127	25	36,5	38	12	114	M12	111
C1 to C3	800	248	140	38	51	50	20	114	M20	159
D1	1 250	305	152	63	83	57	20	114	M24	159

Figure 506 – Breaking capacity test rig for fuse-links for bolted connection *(1 of 2)*

1) Detachable cover fabricated from woven wire cloth, mild steel sheet or perforated mild steel sheet of such thickness as to ensure reasonable rigidity. Individual apertures in the wire cloth or perforated steel sheet shall not exceed 8,5 mm^2 in area. The cover may differ in section from that shown on the drawings provided that the clearance of 19 mm between the cover and live metal parts is not exceeded.

2) Connecting studs of high conductivity copper.

3) Fixing centres; for A1 to A3 fuse-links, suitable adapters of minimum section 25 mm × 6,3 mm shall be used.

4) A visible gap at this position is essential to ensure that the end caps are not supported by the contact blocks.

5) The arrangement of the test connections beyond the test rig is not specified (the second paragraph of 8.5.1 of IEC 60269-1 does not apply).

The size of the copper conductors shall be selected according to the rated breaking capacity.

6) The base shall be made from phenolic resin bonded laminated sheet having a cross-breaking strength of not less than 85 MPa.

7) Copper strip.

8) Terminal for fine fuse-wire. Fine copper fuse wire of approximately 0,1 mm diameter, with a free length not less than 50 mm long connected between this terminal and one pole of the test supply.

9) Chamfer.

10) Short-circuiting link required for prospective current test. This may be slotted for easy disconnection.

The size of the copper link shall be selected according to the rated breaking capacity.

Figure 506 *(2 of 2)*

Fuse system F –
Fuses with fuse-links having cylindrical contact caps
(NF cylindrical fuse system)

1 General

IEC 60269-1 applies with the following supplementary requirements.

1.1 Scope

The following additional requirements apply to fuse-links having cylindrical caps with or without striker, complying with the dimensions specified in Figures 601 and 603. Such fuses have rated currents not exceeding 125 A and rated voltages up to and including 1 000 V a.c. or 1 500 V d.c.

The following characteristics of the fuses are specified in addition to IEC 60269-1:

- minimum rated breaking capacities;
- time-current characteristics;
- I^2t characteristics;
- standard conditions of construction;
- power dissipation and acceptable power dissipation.

2 Terms and definitions

IEC 60269-1 applies.

3 Conditions for operation in service

IEC 60269-1 applies.

4 Classification

IEC 60269-1 applies.

5 Characteristics of fuses

IEC 60269-1 applies with the following supplementary requirements.

5.2 Rated voltage

For a.c. the standard values of rated voltage are 400 V, 500 V and 690 V. For d.c. the rated voltages are 250 V, 440 V and 500 V. The standard values of d.c. rated voltage are not related to the standard values of a.c. rated voltage. For example the following standard combinations are possible: 500 V a.c. and 440 V d.c., 690 V a.c. and 440 V d.c., etc.

5.3.1 Rated current of the fuse-link

The maximum rated currents of the fuse-link are given in Table 601. These values depend upon utilization categories and rated voltages.

Table 601 – Maximum rated current of fuse-links with cylindrical caps

Size	400 V a.c		500 V a.c		690 V a.c.	
	gG	aM	gG	aM	gG	aM
	I_n A	I_n A	I_n A	I_n A	I_n A	I_n A
8 × 32	25	12				
10 × 38	32	32	25	20	16	12
14 × 51			50	50	50	40
22 × 58			100	100	80	80
NOTE Fuse-links with higher rated currents can exist.						

5.3.2 Rated current of the fuse-holder

The maximum rated currents of the fuse-holder are given in Table 602.

Table 602 – Maximum rated current of fuse-holders

Size	I_n A
8 × 32	25
10 × 38	32
14 × 51	50
22 × 58	100
The use of fuse-links having higher rated currents should be as agreed by the manufacturer and the user.	

5.5 Rated power dissipation of a fuse-link and rated acceptable power dissipation of a fuse-holder

The maximum values of the rated power dissipation of fuse-links are specified in Table 603.

Table 603 – Maximum values of the rated power dissipation of a fuse-link

Size	gG		gG		gG		aM		aM		aM	
	400 V a.c.		500 V a.c.		690 V a.c.		400 V a.c.		500 V a.c.		690 V a.c.	
	I_n A	P_n W	I_n A	P_n W	I_n A	P_n W	I_n A	P_n W	I_n A	P_n W	I_n A	P_n W
8 × 32	20 25	2,3 2,5					10 12	0,6 0,8				
10 × 38	32	3,0	20 25	2,8 3,0	16	2,2	25 32	1,3 2,0	16 20	1 1,2	12	0,9
14 × 51			50	5,0	40 50	4,6 5,0			40 50	2,9 3,2	32 40	2,3 2,9
22 × 58			100	9,5	63 80	7,3 8,5			100	7,0	63 80	5,3 6,8

NOTE The power dissipation represents the maximum power dissipation of the fuse-link and at the same time the minimum power acceptance to be tolerated by the fuse-base or fuse-holder.

The rated acceptable power dissipation of fuse-bases is given in Table 604.

Table 604 – Rated acceptable power dissipation of a fuse-holder

Size	8 × 32	10 × 38	14 × 51	22 × 58
Rated acceptable power dissipation	2,5 W	3 W	5 W	9,5 W

5.6 Limits of time-current characteristics

5.6.1 Time-current characteristics, time-current zones and overload curves

When applicable, the time-current zones given in Figure 104 of fuse system A of this standard, including manufacturing tolerances shall be met by all pre-arcing and operating times measured during the tests.

5.6.2 Conventional times and currents

The conventional times and currents, in addition to the values of IEC 60269-1, are given in Table 605.

Table 605 – Conventional time and current for "gG" fuse-links with rated current lower than 16 A

Rated current I_n A	Conventional time h	Conventional current	
		I_{nf}	I_f
$I_n \leq 4$ A	1	1,5 I_n	2,1 I_n
$4 < I_n < 16$	1	1,5 I_n	1,9 I_n

5.6.3 Gates

For "gG" fuse-links the gates given in Table 606 apply, in addition to the gates of IEC 60269-1.

Table 606 – Gates for specified pre-arcing and operating times of "gG" fuse-links with rated current lower than 16 A

I_n A	I_{min} (10 s) A	I_{max} (5 s) A	I_{min} (0,1 s) A	I_{max} (0,1 s) A
2	3,7	9,2	6,0	23,0
4	7,8	18,5	14,0	47,0
6	11,0	28,0	26,0	72,0
8	16,0	35,2	41,6	92,0
10	22,0	46,5	58,0	110,0
12	24,0	55,2	69,6	140,4

5.7.2 Rated breaking capacity

The minimum rated breaking capacities are specified in Table 607.

Table 607 – Minimum rated breaking capacities

Rated voltage	Minimum rated breaking capacities
≤ 500 V a.c	100 kA
$500 < U_n \leq 690$ V a.c.	50 kA
≤ 750 V d.c.	25 kA

6 Markings

IEC 60269-1 applies with the following supplementary requirements.

Fuse-links and fuse-holders which meet the requirements and tests of this fuse system may be marked with IEC 60269-2.

6.1 Markings of fuse-holders

In addition to IEC 60269-1, the following marking applies:

– size.

6.2 Markings of fuse-links

In addition to IEC 60269-1, the following marking applies:

– size or reference;
– rated breaking capacity.

The fuse-links shall be marked as described in Table 608.

Table 608 – Marking of fuse-links

Characteristic	gG		aM	
Colour of marking	Black		Green	
Kind of print	Strip with inverse print	Normal print	Strip with inverse print	Normal print
Voltage V				
400	x		x	
500		x		x
690	x		x	

7 Standard conditions for construction

IEC 60269-1 applies with the following supplementary requirements.

7.1 Mechanical design

The dimensions of fuse-links and fuse-bases are given in Figures 601 and 603.

The fuse-links with strikers shall also comply with the dimensions given in Figure 602.

7.1.2 Connections including terminals

The terminals shall be capable of accepting the following cross-sections in Table 609.

Table 609 – Minimum range of cross-sections for rigid copper conductors

Size	8 × 32	10 × 38	14 × 51	22 × 58
Cross-section mm^2	1,5 to 4	1,5 to 6	2,5 to 16	4 to 50

Examples of terminals are given in IEC 60999-1 and IEC 60999-2.

7.2 Insulating properties and suitability for insulation

The creepage distances and clearances of fuse parts shall meet the requirements of IEC 60664-1 for overvoltage category III and degree of pollution 3.

7.7 I^2t characteristics

For the fuse-links covered by this fuse system the maximum pre-arcing I^2t values given in Table 7 of IEC 60269-1 apply for the maximum operating I^2t values. Values of rated currents lower than 16 A are given in Table 610.

Table 610 – Pre-arcing and operating I^2t values at 0,01 s for "gG" fuse-links

I_n A	Pre-arcing I^2t_{min} A^2s	Operating I^2t_{max} A^2s
2	1	23
4	6	90
6	24	225
8	49	420
10	100	576
12	160	750

The maximum operating I^2t values for "aM" fuse-links are specified in Table 611 on the test-voltage of 1,1 × U_n and test no. 2 of the largest rated current of each homogeneous series (Table 20 of IEC 60269-1).

Table 611 – Maximum operating I^2t values for "aM" fuse-links

Rated voltage U_n V	I^2t_{max} A^2s
$U_n \leq 400$	18 I_n^2
$400 < U_n \leq 500$	24 I_n^2
$500 < U_n \leq 690$	35 I_n^2
NOTE For a voltage of 230 V a.c. the maximum I^2t value is 12 I_n^2.	

These values apply for the prospective currents corresponding to pre-arcing times less than 0,01 s.

7.8 Overcurrent discrimination of "gG" fuse-links

Fuse-links in series with rated current ratio of 1:1,6 and rated current 16 A and above have to discriminate up to the values specified in 8.7.4.

7.9 Protection against electric shock

Protection against electric shock can be increased by means of partition walls and covers of the fuse-contacts.

8 Tests

IEC 60269-1 applies with the following supplementary requirements.

8.1.6 Testing of fuse-holders

In addition to the test given in IEC 60269-1, the fuse-holders shall be subjected to the tests according to Table 612.

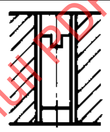
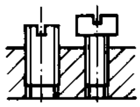
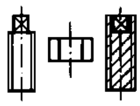
Table 612 – Survey of tests on fuse-holders and number of fuse-holders to be tested

Test according to subclause		Number of fuse-holders				
		3	1	1	1	5
8.5.5.1	Verification of the peak withstand current of a fuse-base		X	X		
8.9	Verification of resistance to heat				X	
8.10	Verification of non-deterioration of contacts					X
8.11.1.1	Mechanical strength of fuse-holders	X				

8.3.1 Arrangement of the fuse

The screws of the terminals are to be fastened by applying a torque which is given in Table 613.

Table 613 – Torque to be applied to the terminal screws

Nominal diameter of thread mm	Torque Nm I	 II	 III	 IV	 V
					
Up to and including 2,8	0,2	–	0,4	0,4	–
Over 2,8 up to and including 3,0	0,25	–	0,5	0,5	–
Over 3,0 up to and including 3,2	0,3	–	0,6	0,6	–
Over 3,2 up to and including 3,6	0,4	–	0,8	0,8	–
Over 3,6 up to and including 4,1	0,7	1,2	1,2	1,2	1,2
Over 4,1 up to and including 4,7	0,8	1,2	1,8	1,8	1,8
Over 4,7 up to and including 5,3	0,8	1,4	2,0	2,0	2,0
Over 5,3 up to and including 6,0	1,2	1,8	2,5	3,0	3,0
Over 6,0 up to and including 8,0	2,5	2,5	3,5	6,0	4,0
Over 8,0 up to and including 10,0	–	3,5	4,0	10,0	6,0
Over 10,0 up to and including 12,0	–	4,0	–	–	8,0
Over 12,0 up to and including 15,0	–	5,0	–	–	10,0

The conductor is moved each time the screw or nut is loosened.

Column I applies to screws without heads if the screw, when tightened, does not protrude from the hole, and to other screws which cannot be tightened by means of a screwdriver with a blade wider than the diameter of the screw.

Column II applies to nuts of mantle terminals which are tightened by means of a screwdriver.

Column III applies to other screws which are tightened by means of a screwdriver.

Column IV applies to screws and nuts other than nuts of mantle terminals, which are tightened by means other than a screwdriver.

Column V applies to nuts of mantle terminals which are tightened by means other than a screwdriver.

8.3.4.1 Temperature-rise of the fuse-holder

The dummy fuse shall have the dimensions indicated in Figure 601 and the rated power dissipation indicated in Table 604.

8.3.4.2 Power dissipation of a fuse-link

The points between which the power dissipation of a fuse-link is preferably measured are marked with S in Figure 601.

8.4.3.6 Operation of indicating devices and strikers, if any

Subclause 8.4.3.6 of IEC 60269-1 applies with the following addition:

The projection of the striker before operation (S_0) shall not exceed 1 mm; after operation, it shall be between 7 mm and 10 mm (S_1). See Figure 602.

The force of the striker on all points between its final limits shall be at least 2,5 N and shall not exceed 20 N at the end of the travel.

After operation, the striker shall remain captive.

The fuse-links with striker may have no indicating device other than a striker.

8.5.5.1 Verification of the peak withstand current of a fuse-base

Verification of the peak withstand current of a fuse-base need not be carried out, if this has already been verified during the breaking capacity test of the fuse-links with the highest rating of the size, providing the cut-off current is within the values given in Table 614.

8.5.5.1.1 Arrangement of the fuse

The test shall be of the single-phase type. The test set-up for the fuse-base shall be in line with 8.5.1 of IEC 60269-1.

8.5.5.1.2 Test method

The current shall be limited by a fuse-link of the highest rating for the particular size. The peak values of the test currents attained must lie in the ranges shown in Table 614.

Table 614 – Test currents

Size	Cut-off current kA
8 × 32	3 ... 4
10 × 38	5 ... 6
14 × 51	13 ... 16
22 × 58	17 ... 21

The maximum values may be exceeded as long as the requirements stated under 8.5.5.1.3 are met.

If the cut-off current range cannot be attained with the highest rating for the size, a correspondingly higher series-connected fuse shall be used. In this case, the test specimen shall be equipped with a dummy fuse-link. Its external dimensions correspond to the dimension given in Figure 601.

8.5.5.1.3 Acceptability of test results

The fuse-links shall not be ejected. There shall be no signs of arcing or welding or other damage likely to prevent further use of the fuse-bases. Pitting marks on the contacts are permissible.

8.7.4 Verification of overcurrent discrimination

The overcurrent discrimination for fuses with rated current up to 12 A and the overcurrent discrimination ratio of 1:1,6 for fuses with rated current higher than 12 A is verified by the I^2t values evaluated from the recorded test results.

The samples are arranged as for the breaking capacity test according to 8.5 and Table 20 of IEC 60269-1 regarding the test circuit and tolerance of current.

Four samples are tested, two samples are tested at the r.m.s. prospective test current I, corresponding to the minimum pre-arcing I^2t values, the other samples at the r.m.s. prospective test current I, corresponding to the operating I^2t values.

The test voltage for all fuses is $\frac{1{,}1 \cdot U_n}{\sqrt{3}}$ with tolerances of –3 % / +2 %.

Table 615 – Test currents and I^2t limits for discrimination test

I_n A	Minimum pre-arcing I^2t		Maximum operating I^2t		Discrimination ratio
	Prospective I r.m.s. kA	I^2t A^2s	Prospective I r.m.s. kA	I^2t A^2s	
2	0,013	0,67	0,064	16	Can be calculated
4	0,035	4	0,130	67	
6	0,064	16	0,220	193	
8	0,100	40	0,310	390	
10	0,130	67	0,400	640	
12	0,180	130	0,450	820	
16	0,270	291	0,550	1 210	1: 1,6
20	0,400	640	0,790	2 500	
25	0,550	1 210	1,000	4 000	
32	0,790	2 500	1,200	5 750	
40	1,000	4 000	1,500	9 000	
50	1,200	5 750	1,850	13 700	
63	1,500	9 000	2,300	21 200	
80	1,850	13 700	3,000	36 000	
100	2,300	21 200	4,000	64 000	
125	3,000	36 000	5,100	104 000	

The evaluated I^2t values shall lie within the corresponding I^2t limits specified in Table 615.

8.9 Verification of resistance to heat

These tests apply to fuse-links and fuse-bases. Fuse-holders fitted with fuse-links having the maximum power dissipation corresponding to the power acceptance of the fuse-holder shall be cyclically loaded as pre-treatment. The pre-treatment is specified in 8.4.3.2 of IEC 60269-1. After cooling to normal temperature the breaking capacity shall be tested at I_1 in accordance with 8.5.

Fuse-links containing organic material in the body or filler shall be subjected to the same test as describe above. These fuse-links shall interrupt the test currents I_1 and I_5.

8.10 Verification of non-deterioration of contacts

Subclause 8.10 of IEC 60269-1 applies.

8.10.1 Arrangement of the fuse

Subclause 8.10.1 of IEC 60269-1 applies with the following addition:

The dummy fuse shall have the dimensions indicated in Figure 601 and have the rated power dissipation equal to the values given for the relevant dimensions in Table 604.

8.10.2 Test method

Subclause 8.10.2 of IEC 60269-1 applies with the following additions:

The following test values shall be applied:

Test current:	conventional non-fusing current I_{nf}
Load period:	25 % of the conventional time
No-load period:	10 % of the conventional time

A test voltage lower than the rated voltage may be used.

8.10.3 Acceptability of test results

After 250 cycles, the measured temperature-rise values shall not exceed the temperature-rise measured before the beginning of the tests by more than 15 K.

After 750 cycles, if necessary, the temperature-rise values shall not exceed the temperature-rise measured before the beginning of the tests by more than 20 K.

8.11.1.1 Mechanical strength of fuse-holders

The fuse-holder, fitted with a fuse-link of the largest rated current and power dissipation that can be accommodated by the fuse-holder, shall be subjected to a temperature-rise test at rated current.

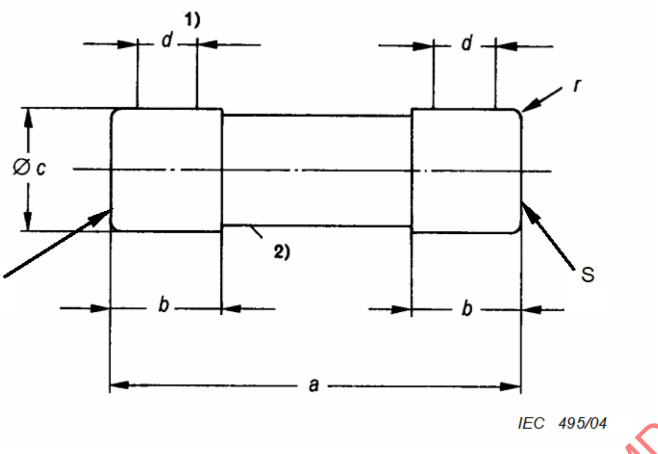
At the conclusion of the temperature-rise test, the fuse-link or the fuse-carrier, as appropriate, shall be withdrawn and inserted into the fuse-base 100 times.

At the conclusion of these tests, all parts shall be intact and shall function normally.

Compliance shall be verified by a further temperature rise test at rated current at the conclusion of which the values obtained shall be not more than 5 K or 15 % (whichever is greater) above the values obtained from the temperature rise test prior to the commencement of the mechanical test.

Dimensions in millimetres

FIGURES



Measuring points S according to 8.3.4.2

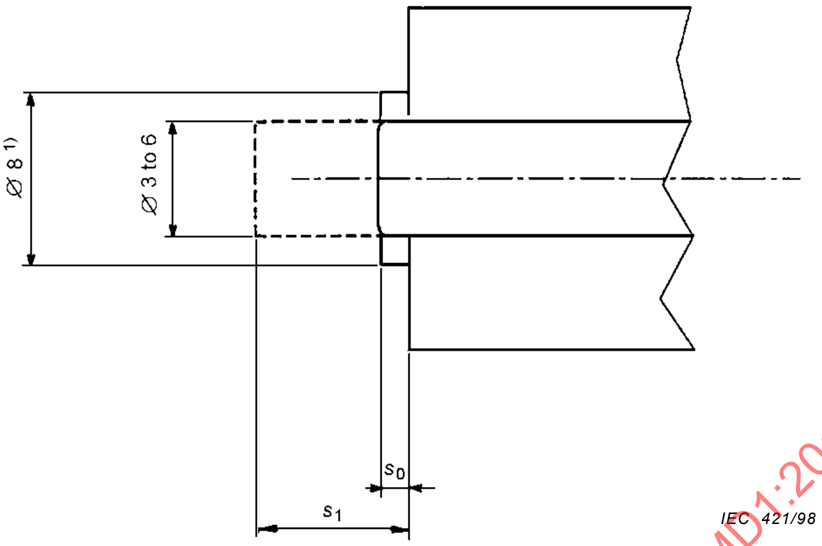
The drawings are not intended to govern the design of fuse-links except as regards the notes and dimensions shown.

1) Cylindrical part within which the specified tolerances shall not be exceeded.

2) The diameter of the fuse-link between the end caps shall not exceed diameter *c*.

Size	***a***	***b*** max.	***c***	***d*** min.	***r***
8 × 32	31,5 ± 0,5	6,7	8,5 ± 0,1	4	1 ± 0,5
10 × 38	+0,9 /−0,6	10,5	10,3 ± 0,1	6	1,5 ± 0,5
14 × 51	$51^{+0,6}_{-1}$	13,8	14,3 ± 0,1	7,5	2 ± 1
22 × 58	$58^{+0,1}_{-2}$	16,2	22,2 ± 0,1	11	2 ± 1

Figure 601 – Fuse-links with cylindrical caps



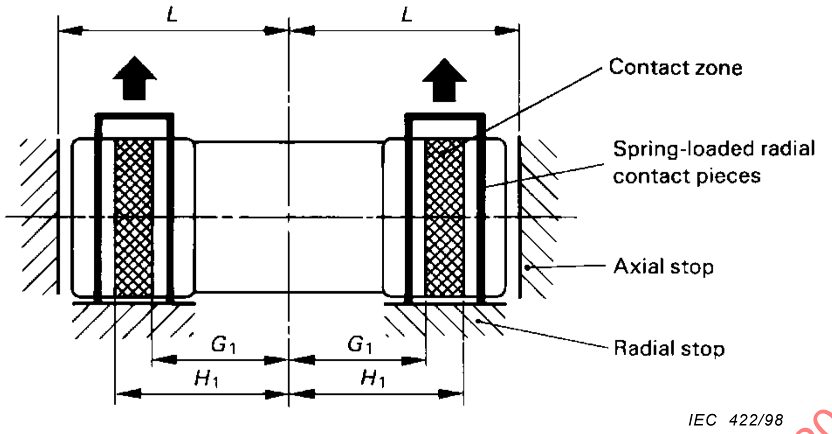
Dimensions in millimetres

NOTE The drawings are not intended to govern the design of fuse-links except as regards the notes and dimensions shown.

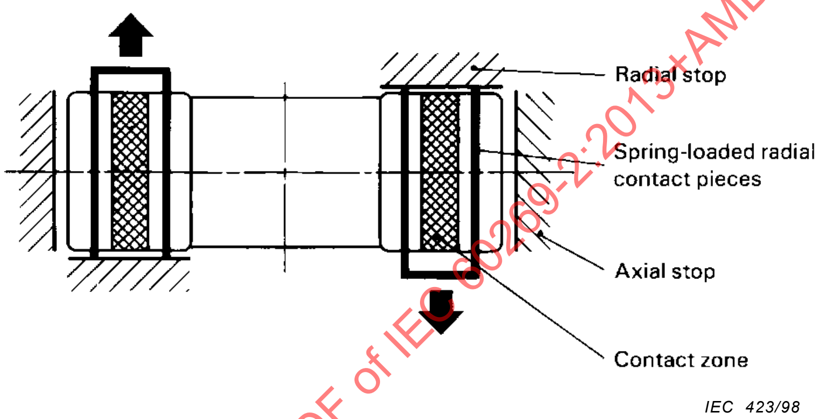
1) Diameter of cylinder in which the striker shall stay.

Figure 602 – Fuse-links with cylindrical contact caps with striker – Additional dimensions for sizes 14 × 51 and 22 × 58 only

Base **A** *Contact on two cylindrical caps*



Base **B** *Contact on two cylindrical caps*



Dimensions in millimetres

Size	I_n A	G_1 max.	H_1 min.	$L\ ^{+0,8}_{0}$
8 × 32	25	11,5	14	16
10 × 38	32	13	15,5	19,3
14 × 51	50	18	20,5	25,8
22 × 58	100	18	25	29

Figure 603 – Base for fuse-links with cylindrical caps *(1 of 2)*