

CONSOLIDATED VERSION

VERSION CONSOLIDÉE



Low-voltage fuses –

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

Fusibles basse tension –

**Partie 3: Exigences supplémentaires pour les fusibles destinés à être utilisés
par des personnes non qualifiées (fusibles pour usages essentiellement
domestiques et analogues) –
Exemples de systèmes de fusibles normalisés A à F**



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

LOW-VOLTAGE FUSES –

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

FOREWORD

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This Consolidated version is not an official IEC Standard and has been prepared for user convenience. Only the current versions of the standard and its amendment(s) are to be considered the official documents.

This Consolidated version of IEC 60269-3 bears the edition number 4.2. It consists of the fourth edition (2010-05) [documents 32B/553/FDIS and 32B/557/RVD], its amendment 1 (2013-01) [documents 32B/594/CDV and 32B/602A/RVC] as well as its corrigenda 1 (2013-03) and 2 (2013-06), and its amendment 2 (2019-06) [documents 32B/650/CDV and 32B/666/RVC]. The technical content is identical to the base edition and its amendments.

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 60269-3 has been prepared by subcommittee 32B: Low-voltage fuses, of IEC technical committee 32: Fuses.

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 3 supplements or modifies the corresponding clauses or subclauses of Part 1.

Where no change is necessary, this Part 3 indicates that the relevant clause or subclause applies.

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

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

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

Part 1: General requirements

NOTE This part includes IEC 60269-1 (third edition, 1998) and parts of IEC 60269-2 (second edition, 1986) and IEC 60269-3 (second edition, 1987).

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

NOTE This part includes parts of IEC 60269-2 (second edition, 1986) and all of IEC 60269-2-1 (fourth edition, 2004).

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

NOTE This edition of IEC 60269-3 is based on edition 3. Edition 3 was a result of a restructuring of the IEC 60269 series of standards in 2006. Edition 3 included parts of IEC 60269-3 (second edition, 1987) and all of IEC 60269-3-1 (second edition, 2004).

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

NOTE This part includes IEC 60269-4 (third edition, 1986) and IEC 60269-4-1 (first edition, 2002).

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

NOTE Currently IEC/TR 61818 (2003).

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

The committee has decided that the contents of the base publication and its amendments will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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 publication using a colour printer.

INTRODUCTION

~~A reorganization of the different parts of the IEC 60269 series has been carried out, in order to simplify its use, especially by the laboratories which test the fuses.~~

~~This fourth edition is based on edition 3 of IEC 60269-3. Edition 3 was a result of a restructuring of the IEC 60269 series of standards in 2006. At this time IEC 60269-1, IEC 60269-2, IEC 60269-2-1, IEC 60269-3 and IEC 60269-3-1 have been integrated into either the new part 1 or the new parts 2 or 3, according to the subjects considered, so that the clauses which deal exclusively with “fuses for authorised persons” are separated from the clauses dealing with “fuses for unskilled persons”.~~

~~As far as IEC 60269-4 and IEC 60269-4-1 are concerned, they have been integrated into the new part 4 which deals with the fuse-links used for semiconductor protection.~~

LOW-VOLTAGE FUSES –**Part 3: Supplementary requirements for fuses
for use by unskilled persons
(fuses mainly for household and similar applications) –
Examples of standardized systems of fuses A to F****1 General scope**

Fuses for use by unskilled persons according to the following fuse systems comply with all subclauses of IEC 60269-1 and with the requirements laid down in the relevant fuse systems.

This standard is divided into ~~six~~ **four** fuse systems, each dealing with a specific example of standardized fuses for use by unskilled persons:

- Fuse system A: D type fuse system
- Fuse system B: Cylindrical fuses (NF cylindrical fuse system)
- Fuse system C: Cylindrical fuses (BS cylindrical fuse system)
- ~~• Fuse system D: Cylindrical fuses (Italian cylindrical fuse system)~~
- ~~• Fuse system E: Pin-type fuses~~
- Fuse system F: Cylindrical fuse-links for use in plugs (BS plugtop fuse system)

NOTE 1 Examples of standardized fuses complying with the requirements of IEC 60269-1 are listed in the present standard. Other examples may be added, provided that they comply with these requirements.

For recommendations for future designs of fuses, see Annex CC.

NOTE 2 The following fuse systems are standardized systems with respect to their safety aspects.

The National Committees may select from the examples of standardized fuses one or more systems for their own standards. Colour codes are not specified for each fuse system. Where colour codes are indicated, they apply only to that particular fuse system.

1.2 Normative references

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

IEC 60068-2-31, *Environmental testing – Part 2-31: Tests – Test Ec: Rough handling shocks, primarily for equipment-type specimens*

IEC 60269-1:2006, *Low-voltage fuses – Part 1: General requirements*
Amendment 1 (2009)

IEC 60664 (all parts), *Insulation coordination for equipment within low-voltage systems*

IEC 60898-1:2002, *Electrical accessories – Circuit-breakers for overcurrent protection for household and similar installations – Part 1: Circuit-breakers for a.c. operation*
Amendment 1 (2002)
Amendment 2 (2003)

IEC 60999:1990, *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units for electrical copper conductors*

Fuse system A – D type fuse system

1 General

IEC 60269-1 applies with the following supplementary requirements.

1.1 Scope

The following additional requirements apply to "gG" fuses for use by unskilled persons for domestic and similar applications with rated currents up to and including 100 A and rated voltages of up to and including 500 V a.c. and 500 V d.c.

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

- rated voltage;
- rated power dissipation of the fuse-link and rated acceptable power dissipation of a fuse-holder;
- time-current characteristic;
- gates, I^2t characteristics and conventional times and currents;
- rated breaking capacity;
- marking on the fuse;
- standard conditions for construction;
- tests.

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 voltages are 400 V for size D01, D02 and D03¹ and 500 V for size DII, DIII and DIV.

For d.c., the rated voltages are 250 V for D01, D02 and D03 and 500 V for DII, DIII and DIV.

¹ These three sizes are also applicable for 415 V networks.

5.3.1 Rated current of the fuse-link

The rated currents of the fuse-links are given in Figures 110 and 111.

5.3.2 Rated current of the fuse-holder

The rated currents of the fuse-carriers are given in Figures 112, 113 and 114. The rated currents of the fuse-bases are given in Figures 118, 119 and 120.

5.3.3 Rated current of the gauge-piece

The rated current of the gauge-piece is identical with the highest rated current of the fuse-link, which the gauge piece can accept.

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 D-type fuse-links are specified in Table 101.

Table 101 – Maximum values of power dissipation

Rated current I_n A	Maximum power dissipation W	
	D01 – D03	DII – DIV
2	2,5	3,3
4	1,8	2,3
6	1,8	2,3
10	2,0	2,6
13	2,2	2,8
16	2,5	3,2
20	3,0	3,5
25	3,5	4,0
32	4,0	5,2
35 ^a	4,0	5,2
40	4,4	5,7
50	5,0	6,5
63	5,5	7,0
80	6,5	8,0
100	7,0	9,0

^a In some countries, the rating of 35 A is replaced by 32 A and 40 A.

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, time-current zones are stated in Figures 101 to 103 and Figure 127. The tolerance on time-current characteristics given by the manufacturer shall not deviate by more than $\pm 10\%$ in terms of current.

The time-current zones given in Figures 101 to 103 and Figure 127, including manufacturing tolerances, shall be met for all pre-arcing and operating 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 102.

Table 102 – Conventional time and current for "gG" fuse-links

Rated current I_n A	Conventional time h	Conventional current	
		I_{nf}	I_f
2 and 4	1	$1,5 I_n$	$2,1 I_n$
6 and 10	1	$1,5 I_n$	$1,9 I_n$
$13 \leq I_n \leq 35$	1	$1,25 I_n$	$1,6 I_n$

5.6.3 Gates

For "gG" fuse-links, in addition to the gates of IEC 60269-1, the gates given in Table 103 apply.

Table 103 – Gates for specified pre-arcing times of "gG" fuse-links with rated currents 2 A, 4 A, 6 A, 10 A, 13 A and 35 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
10	22,0	46,5	58,0	111,0
13	26,0	59,8	75,4	144,3
35	89,0	175,0	255,0	445,0

5.7 Breaking range and breaking capacity

5.7.2 Rated breaking capacity

The rated breaking capacity shall not be less than the following values:

- 50 kA a.c.
- 8 kA d.c.

NOTE D-type fuses are frequently used in a.c. installations with short-circuit currents higher than 20 kA, and also in d.c. installations. Therefore, all fuses ought to comply with the requirements of this subclause.

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 60269-3". For devices according to this standard, national approvals can be awarded by national test-houses. Such national approvals may be marked on the relevant parts of the fuse. The marking shall be durable. This durability shall be proved by appropriate tests.

6.4 Marking of the gauge-pieces

- name of manufacturer or trademark by which he may be readily identified;
- rated current, or colour code.

NOTE For gauge-pieces having very small dimensions, the manufacturer's name may be omitted, provided it is indicated on the packing.

7 Standard conditions for construction

IEC 60269-1 applies with the following supplementary requirements.

7.1 Mechanical design

Deviations from the dimensions specified in the figures may be made, but only if they provide a technical advantage and do not adversely affect the purpose and safety of fuses complying with the standard sheets, especially with regard to interchangeability and to non-interchangeability. Fuses with such deviations shall, however, comply with all other requirements of this specification as far as they reasonably apply.

7.1.2 Connections including terminals

The terminals shall be capable of accepting the cross-sections of conductors indicated in Table 104.

The largest cross-sectional areas specified in Table 104 may be reduced to 6 mm² (size DII); 16 mm² (size DIII) and 35 mm² (size DIV), provided that the fuse-base terminals are connected to internal wiring of switchboards, fuse-boxes, etc. and external conductors are consequently fitted to separate supply terminals of a type-tested or partially type-tested assembly.

In the case of fuse-bases for busbar mounting, the busbar dimensions and centre distances have to be specified by the manufacturer. The busbar cross-section shall correspond to the value Q according to the table in Figure 118.

The connections to the busbars shall meet the requirements described in 8.10.

Table 104 – Cross-sections of rigid (solid or stranded) or flexible copper conductors

Fuse-base		Cross-section mm ²
Size	I_n A	
D01	16	1,5 to 4
D02	63	1,5 to 25
D03	100	10 to 50
DII	25	1,5 to 10
DIII	63	2,5 to 25
DIV	100	10 to 50
NOTE This table is provisional, awaiting the results of IEC SC 17B and/or 23F.		

7.1.3 Fuse-contacts

The fuse-contacts shall be nickel-plated or protected by other materials of at least similar protective properties.

Fuse-link contacts of rated currents 50 A and above and fuse-link contacts of D02 fuse-links of rated currents 32 A up to 40 A shall be silver-plated with a minimum thickness of the silver layer of 3 µm.

7.1.4 Construction of a gauge-piece

The contact pieces, if any, shall be in one piece and made of copper alloy containing at least 50 % copper. Their contact surfaces shall be flat and free from burrs.

The metal portion of gauge-pieces of sizes DII and DIII shall have smooth contact surfaces on both sides without burrs within the prescribed area, and both contact surfaces shall protrude from the adjacent ceramic material.

For DII, DIII and DIV-fuses, the part forming the calibration ring shall be of ceramic material. The colour of the face of the calibration ring shall be in accordance with the colour of the fuse indicator given in the table in Figure 111.

NOTE Gauge-pieces ensure non-interchangeability. Therefore, they are so designed as to be insertable or replaceable only by special hand keys, which are not available to unskilled persons.

Compliance with the requirements of the subclause is to be checked by inspection.

With respect to the two types of fuse-bases of size DII and DIII there are two types of gauge-pieces:

- screw-in gauge-pieces (Figure 122);
- push-in gauge-pieces (Figure 123).

See Figures 121, 122, 123 and 124.

7.1.6 Construction of a fuse-carrier

A fuse-carrier shall be provided with means for retaining the fuse-link in position whether the fuse-carrier is fitted in the fuse-base or not

A fuse-carrier for fuse-links for which an indicating device is required shall be provided with an appropriate opening for observing the indicator. The opening shall be closed with a securely fixed window of suitable transparent material or other suitable means of protection against material, which could be ejected from the indicator.

The screwed shell shall be of solid copper alloy containing at least 50 % copper and those made from rolled sheet at least 62 % copper.

The insulating parts shall be of ceramic or other sufficiently heat-resistant material.

The hole for the voltage tester is optional.

See Figures 112, 113, 114, 115 and 116.

7.1.7 Construction of a fuse-link

A fuse-link shall be so constructed that it is not possible to remove or to replace parts ensuring non-interchangeability.

In case the fuse has an indicating device, the indication shall be visible when the fuse-link is inserted in the fuse-holder or fuse-carrier.

The fuse-link body shall be of ceramic material. Contact pieces shall be of copper or an alloy containing at least 62 % copper. The colour of the fuse-indicator shall be in accordance with Figure 111.

See Figures 110 and 111.

7.1.8 Non-interchangeability

Fuses shall be so designed that a fuse-link cannot be replaced inadvertently by another rated current exceeding a pre-determined value.

For rated currents below 10 A non-interchangeability is not required.

7.1.9 Construction of a fuse-base

A fuse-base shall be so designed that it can be securely fixed in such a way that its unintentional removal is not possible.

A fuse-base intended for use with gauge pieces shall be provided with suitable means for retaining the gauge pieces in positions and allowing their removal only by the aid of a suitable tool.

Covers of fuse-bases providing protection against access of live parts shall withstand the mechanical stresses occurring during fixing and shall be firmly fixed in such a manner that they can be removed only by the aid of a tool or deliberate action when mounted.

The terminals shall be suitable for accepting conductors with the appropriate cross sectional areas

Current-carrying parts of solid copper alloy shall contain at least 50 % copper and those made from rolled material at least 62 % copper.

A fuse-base for rail-mounting shall not detach when inserting and removing the fuse-link (2/3 of the torque designated for fuse-carriers of Table 115 shall be used).

The fuse-base may move back and forth longitudinally on the rail.

A fuse-base for surface-mounting shall not wobble when placed on a flat surface.

For fuse-bases of size DII and size DIII there are two types, which differ with respect to the construction of the gauge-piece:

- fuse-bases for screw-in gauge-pieces (Figure 119);
- fuse-bases for push-in gauge-pieces (Figure 120).

See Figures 115, 117, 118, 119, 120 and 124.

7.2 Insulating properties and suitability for isolation

The minimum creepage distances, clearances and distances through the insulation material or sealing compound shall comply with the values given in Table 105. In the case of fuse-bases for busbar mounting, the specified values shall be observed when busbars with the maximum dimensions and the minimum separation distances are used.

Table 105 – Creepage distances, clearances and distances through sealing compound

Creepage distance mm	DII – DIV	D01 – D03
Between metal parts, including contacts, which are of different polarity when the fuse-link has operated	5	4
Between live parts and accessible metal parts, including fuse-base fixing screws or metallic fixing means for rail mounting, with a fuse-carrier, a fuse-link and a gauge-piece in position	5	3
Between live parts and cover-fixing screws or metallic fixing means for rail mounting which are not earthed and not accessible to the standard test finger	3	2
Clearance mm	DII – DIV	D01 – D03
Between metal parts, including contacts, which are of different polarity when the fuse-link has operated	5	3
Between live parts and accessible metal parts, including fuse-base fixing screws or metallic fixing means for rail mounting, with a fuse-carrier, a fuse-link and a gauge-piece in position	5	3
Between live parts and cover-fixing screws or metallic fixing means for rail mounting which are not earthed and not accessible to the standard test finger	3	2
Distance mm	DII – DIV	D01 – D03
Between live parts and the surface on which a fuse-base for front connection is mounted	10	6
Through sealing compound between live parts covered with at least 2,5 mm of sealing compound and the surface on which a fuse-base for front connection is mounted	5	3
NOTE 1 The standard test finger referred to in the table is that specified in IEC 60529.		
NOTE 2 Pending the result of SC 17B, TC 23 and TC109 of IEC, the table is provisional.		

7.3 Temperature rise, power dissipation of the fuse-link and acceptable power dissipation of the fuse-holder

Instead of Table 5 of IEC 60269-1, following Table 106 applies.

Table 106 – Temperature-rise limits for terminals

For terminals, the temperature-rise limits, when the fuse-base is fitted with conductors having a cross-section as indicated in Table 17, 8.3.4.2 of IEC 60269-1, for the corresponding rated current of the fuse-base shall not exceed	65K
---	-----

7.7 I^2t characteristics

7.7.1 Pre-arcing I^2t values

In addition to Table 7 of IEC 60269-1, the following pre-arcing I^2t values apply.

Table 107 – Pre-arcing I^2t values at 0,01 s for "gG" fuse-links

I_n A	I^2t_{min} A ² s	I^2t_{max} A ² s
2	1,0	23,0
4	6,2	90,2
6	24,0	225,0
10	100,0	676,0
13	170,0	900,0
35	2 250,0	8 000,0

7.7.2 Operating I^2t values

The maximum pre-arcing I^2t values given in Table 107 of this standard and of Table 7 of IEC 60269-1 shall be taken as maximum operating I^2t values and shall be verified by the breaking capacity test specified in 8.7.1 of IEC 60269-1.

7.8 Overcurrent discrimination of "gG" fuse-links

Fuse-links 16 A and above in series, with the rated current ratio of 1:1,6 have to operate selectively in the whole breaking range (see 8.7.4).

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

Table 108 – I^2t values for the discrimination with circuit breakers

I_n A	I^2t_{min} A ² s	I_p A
16	250	500
20	450	670
25	810	900
32	1 400	1 180
35	2 000	1 410
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

7.9 Protection against electric shock

The degree of protection shall be at least IP2X when the fuse is under normal service conditions.

For D-type fuses, the operation of replacing a fuse-link is considered in two stages, which are: "removing the fuse-link and the fuse-carrier" and "fuse-link and fuse-carrier removed". The first stage is considered to represent D-type fuses under normal service conditions. Only when the fuse-link and the fuse-carrier are removed, may the degree of protection temporarily be reduced to IP1X.

NOTE The temporary suspension of the complete protection "IP2X" against electric shock (after many years of sufficiently safe application of the D-type fuse system by unskilled users) need not be regarded as dangerous, as there is enough experience with interchanging of incandescent lamps, where comparable degrees of safety exist.

8 Tests

IEC 60269-1 applies with the following supplementary requirements.

8.1.4 Arrangement of the fuse and dimensions

The thickness of the screwed shell of fuse-bases and fuse-carriers is measured by means of a micrometer with pointed noses. The mean values of two sets of three measurements shall be at least equal to the value specified in Figures 112 to 114 and 118 to 120.

The two sets of measurements are made on one of two different longitudinal lines, which are at least 30°, displaced with respect to each other.

Generally, the three measurements along the longitudinal line are equally distributed over this, if possible, at the most unfavourable points.

For rolled thread, one of the measurements is made at the top, one at the bottom of the thread and the remaining one between these as one likes.

For fuse-carriers the measurements are made at the part of the screwed shell, which protrudes from the insulator.

For fuse-bases no measurement is made in the first course of the thread.

In the case of fuse-bases for busbar mounting, the busbar dimensions and centre distances specified by the manufacturer shall be taken into account. The busbars used for the individual tests shall be selected according to the respective electrical, thermal and mechanical stresses.

The busbars used for the individual tests shall be specified in the test report (materials, dimensions).

8.1.5.1 Complete tests

The following additional tests are required according to Tables 109 and 110.

Table 109 – Survey of tests on fuse-links

Test according to subclause		Number of test samples					
		3	4	1	1	2	1
8.4.3.2	Verification of rated current	x					
8.7.4	Verification discrimination		x				
8.11.1	Mechanical strength			x	x		
8.11.2.4	Resistance to storage at elevated temperature					x	x
8.11.2.6	Dimensions and non-interchangeability	x	x				

Table 110 – Survey of tests on fuse-bases, fuse-carriers and gauge-pieces

Test according to subclause	Number of test samples									
	Fuse-bases				Fuse-carriers				Gauge-pieces	
	1	1	3	1	1	1	1	3	1	1 1
8.9 Verification of resistance to heat	x				x					
8.11.1 Mechanical strength		x				x	x			x x
8.11.2.4 Resistance to storage at elevated temperature			x	x				x	x	
8.11.2.6 Dimensions and non-interchangeability										x x

8.1.5.2 Testing of fuse-links of a homogeneous series

In addition to IEC 60269-1, the following applies.

Fuse-links having different contact parts and different shapes of ceramic bodies only intended to provide non-interchangeability and not affecting the performance may be considered to meet the requirements of a homogeneous series.

8.2 Verification of the insulating properties and of the suitability for isolation**8.2.1 Arrangement of the fuse-holder**

In addition to IEC 60269-1, the following applies.

The metal covering (can be aluminium foil) shall not be pressed on to the inspection window. For fuse-carriers, for example, a distance of 3 mm from the outer lower edge of the insulating part shall be left uncovered by metal covering.

Fuse-bases for busbar mounting shall be used together with busbars with the maximum dimensions and the minimum separation distances.

8.2.2.3 Test method

In addition to IEC 60269-1, the following applies.

8.2.2.3.1 This test shall be performed immediately after the humidity treatment described in 8.2.2.3.2 of IEC 60269-1. The fuse-holder shall be submitted to the test voltage given in Table 15 of IEC 60269-1.

8.2.6 Creepage distances, clearances and distances through sealing compound**8.2.6.1 Test method**

Creepage distances, clearances and distances are measured on the complete fuse, first using conductors with the smallest cross-sectional areas specified in Table 104, and then the largest.

NOTE The contribution to the creepage distance of any groove less than 1 mm wide is limited to its width. Any air gap less than 1 mm wide is ignored in computing the total clearance.

8.2.6.2 Acceptability of test results

Creepage distances, clearances and distances shall not be less than the values in millimetres in Table 105.

8.3 Verification of temperature rise and power dissipation

8.3.1 Arrangement of the fuse

The fuse-carrier shall be inserted with a torque as indicated in Table 111.

Table 111 – Test torque for verification of temperature rise and power dissipation

Size	Torque Nm
D01	1,0
D02	1,0
D03	1,7
DII	2,7
DIII	4,3
DIV	6,7

The torque applied to the screws of the terminals is two-thirds of the values given in Table 116.

In the case of fuse-bases for busbar mounting, busbars with the smallest dimensions as specified by the manufacturer shall be used.

8.3.3 Measurement of the power dissipation of the fuse-link

~~The power dissipation shall be measured between the end caps of the fuse-link (see Figure 109).~~ The points at which the power dissipation is measured are marked with B and C in Figure 109.

8.3.4.1 Temperature rise of the fuse-holder

The test shall be made with a dummy fuse-link as specified in Figure 104 for the rated current of the fuse-holder ~~(see Figure 109)~~. The points at which the temperature rise is measured are marked with A and D in Figure 109.

8.3.5 Acceptability of test results

For terminals, the temperature-rise limits, when the fuse-base is fitted with conductors having a cross-section as indicated in Table 17, 8.3 of IEC 60269-1 for the corresponding rated current of the fuse-base, shall comply with Table 106.

The power dissipation of the fuse-link shall not exceed the values specified in Table ~~114~~ 101.

8.4.3.1 Verification of conventional non-fusing and fusing current

This test shall be performed using a test rig as shown in Figures 105 and 106.

8.4.3.2 Verification of rated current of fuse-links

Three fuse-links are subjected to 100 operating cycles, each cycle comprising a period of 1 h during which the test current flows and a period of 15 min without the current flowing.

The test current of $1,2 I_n \pm 2,5 \%$ applies only for fuse-links with rated current <16 A. For fuse-links with rated current ≥ 16 A these requirements are deemed to be met by test of 8.4.3.2 of IEC 60269-1, with the exception that three samples are tested.

During these cycles, the fuse-links shall not operate. They are allowed to cool down to approximately room temperature and are then loaded with a current equal to 0,9 times I_{nf} shown in Table 2 of IEC 60269-1 and Table 102 of this standard. The fuse-links shall not operate within the conventional time shown in Table 2 of IEC 60269-1 and Table 102 of this standard.

After the fuses have been allowed to cool down to approximately room temperature, they are loaded with I_f . The fuse-links shall operate within the conventional time.

8.4.3.5 Conventional cable overload protection test

The test procedure described under 8.4.3.5 of IEC 60269-1 is not valid for fuses <16A.

NOTE (for gG fuses only) The tests in IEC 60269-1 are deemed to give satisfactory results at $1,45 I_n$ in typical applications at an ambient temperature of 30 °C. A special test may be required by some countries to prove that fuses and MCBs are equivalent protective devices. Details of the special test are given in Annex AA of this standard.

8.4.3.6 Operation of indicating devices and strikers, if any

In addition to IEC 60269-1 concerning indicating devices, the following applies.

If the test is performed at reduced voltages, the test circuit voltage shall be $100 \text{ V} \pm 5 \text{ V}$ and the test current shall be $2 \times I_f + {}^{20}_0 \%$.

8.5.1 Arrangement of the fuse

In case of fuse-bases for busbar mounting, busbars with the biggest dimensions as specified by the manufacturer shall be used.

8.5.2 Characteristics of the test circuit

For the test with d.c. current, Table 21 of IEC 60269-1 applies, with the following exception.

Table 112 – Test according to 8.5.5.1

	No. 1, No. 2	No. 3, No. 4, No. 5
Time constant	$15 + {}^5_0 \text{ ms}^a$	$\leq 3 \text{ ms}$
^a The above-mentioned time-constant is within the limits given in IEC 60269-1.		

8.5.5 Test method

8.5.5.1 In order to verify that the fuse satisfies the conditions of 7.5 of IEC 60269-1, tests in accordance with Table 20 of IEC 60269-1 shall be made. An alternative test to tests Nos. 1 and 2 of Table 20 is given in Annex BB.

8.5.8 Acceptability of test results

In addition to 8.5.8 of IEC 60269-1, the following applies.

After this test, the end caps of the fuse-links may have small holes, blisters, spots and localized bulging as long as the gauge-piece and the fuse-carrier are not damaged. Blackening of the inspection window; if any, is ignored.

8.7.4 Verification of overcurrent discrimination

The samples are arranged as for breaking-capacity test according to 8.5 of IEC 60269-1.

Two samples are tested at the current $I_{\min}$ and two others at the current $I_{\max}$. The current values are given in Table 113.

The a.c. test voltage is: $\frac{1,1 \times U_n}{\sqrt{3}}$

The other characteristics of the test circuit are the same as for the breaking-capacity test No. 2 (see Table 20 of IEC 60269-1).

The evaluated I^2t values shall meet the I^2t limits specified in Table 113.

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

Minimum pre-arcing I^2t value			Operating I^2t value		Selectivity ratio
I_n A	Prospective $I_{\min}$ kA r.m.s.	$I^2t_{\min}$ A ² s	Prospective $I_{\max}$ kA r.m.s.	$I^2t_{\max}$ A ² s	
2	0,013	0,67	0,064	16,4	
4	0,035	4,90	0,130	67,6	
6	0,064	16,40	0,220	193,6	
10	0,130	67,60	0,400	640,0	
13	0,200	160,0	0,480	922,0	
16	0,270	291,00	0,550	1 210,0	
20	0,400	640,00	0,790	2 500,0	
25	0,550	1 210,00	1,000	4 000,0	
32	0,790	2 500,00	1,200	5 750,0	
35	0,870	3 030,00	1,300	6 750,0	
40	1,000	4 000,00	1,500	9 000,0	1:1,6
50	1,200	5 750,00	1,850	13 700,0	
63	1,500	9 000,00	2,300	21 200,0	
80	1,850	13 700,00	3,000	36 000,0	
100	2,300	21 200,00	4,000	64 000,0	

The pre-arcing I^2t values measured at the test current $I_{\min}$ shall be higher than the I^2t value, specified in column 3 of Table 113. The operating I^2t values measured at the test current $I_{\max}$ shall be lower than I^2t values specified in column 5 of Table 113.

8.9 Verification of resistance to heat

8.9.1 Fuse-base

The test is carried out only on fuse-bases of non-ceramic insulating material.

8.9.1.1 Test arrangement

The fuse-base to be tested is fitted with a dummy fuse-link according to Figure 104, whose power dissipation at test current lies within the limits indicated in Table 114.

The torque applied to the fuse-carrier shall be two-thirds of the torque specified in Table 115. The cross-sectional area of the conductors connected depends on the maximum rated current of the largest fuse-link to be inserted in the fuse-base (see IEC 60269-1, Table 17). In case of

fuse-bases for busbar mounting, the busbars with the smallest dimensions as specified by the manufacturer shall be used.

Table 114 – Power dissipation of a dummy fuse-link at rated and conventional fusing currents including tolerances

Size		D01	D02	D03	DII	DIII	DIV
Power dissipation at I_n	W	2,5	5,5	7,0	4,0	7,0	9,0
Power dissipation at test current I_f ^a	W	6,7	14,1	17,9	10,3	17,9	23,0
Force applied to the dummy fuse-link	N	35,0	50,0	75,0	50,0	75,0	110,0

^a For these values a tolerance of ± 3 % applies.

The fuse is placed in a test arrangement according to Figure 107 and placed in a heating chamber, the holes provided for the passage of conductors are sealed. The length of the connected conductors shall be at least 1 m outside the heating chamber. The heating chamber must be such that during the test, the air temperature is kept at $80\text{ °C} \pm 5\text{ °C}$, measured in the plane of the sample at a distance of approximately 15 cm.

8.9.1.2 Test method

The air temperature in the heating chamber is raised to $80\text{ °C} \pm 5\text{ °C}$ and is maintained for 2 h. Immediately afterwards, but while maintaining the temperature of the heating chamber, the sample is loaded with a test current corresponding to approximately I_f . At this test current the power dissipation of the dummy fuse-link shall lie within the limits indicated in Table 114. The current shall be kept constant during the whole test duration of 2 h. At the end of the test, a weight is applied straight and not jerkily at position 4 (see Figure 107), which (taking into account the lever-arm relations) generates along arrow G a force according to Table 114 on the dummy fuse-link. To apply the force, the inspection window has to be removed. The sample may be connected to a reduced voltage source ($\geq 42\text{ V}$).

8.9.1.3 Acceptability of test results

After applying the force, a current shall continue to flow through the sample. The force is maintained for 15 min and the current shall continue to flow unchanged through the sample. Furthermore, after this test, the fuse-base shall not show any damage impairing its further use.

8.9.2 Fuse-carrier

8.9.2.1 Test arrangement

A fuse-base shall be mounted on a 15 mm thick plywood board. The arrangement shall be the same as in normal use. The fuse-base is fitted with a dummy fuse-link according to Figure 104. The cross-sectional area of conductors depends on the rated current of the fuse-base (see IEC 60269-1, Table 17). The length of the conductors shall be at least 1 m outside the heating chamber in which the test arrangement is to be placed.

The torque applied to the fuse-carrier shall correspond to Table 115. For tightening and later loosening of the fuse-carrier, an adapter for the fuse-carrier is used, the interior form of which enables a tight connection to the insulated part of the fuse-carrier. The adapter of the fuse-carrier is tightened with a torque wrench with a square-section shank – as is usual in service – (see Figure 108). The nut and the described test device shall be placed in the above-mentioned heating chamber.

8.9.2.2 Test method

The air temperature in the heating chamber is raised to $80\text{ °C} \pm 5\text{ °C}$ and maintained for 2 h. Immediately afterwards, the fuse is loaded with a test current, corresponding to approximately I_f , for 2 h and the test current must be adjusted in such a way that the power dissipation of the dummy fuse-link lies within the limits indicated in Table 114.

The test current shall be kept constant during the 2 h test. Immediately after the opening of the test chamber, the nut heated up during the test is fitted to the torque wrench, and with this torque wrench, the fuse-carrier is loosened twice and tightened again.

8.9.2.3 Acceptability of test results

After this test, the fuse-carrier shall show no damage impairing its further use; especially, the insulating material shall not show any fissures or inadmissible shrinkage.

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-link is given in Figure 104 of this standard.

Torques to be applied to the fuse-carrier are equal to 40 % of the values given in Table 115.

8.10.2 Test method

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

The test-current is the conventional non-fusing current.

The load period is 75 % of the conventional time.

The no-load period is 25 % of the conventional time.

The conventional time, as well as the non-fusing current, is stated in Table 2 of IEC 60269-1. 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 third paragraph of 8.10.2 in IEC 60269-1 is replaced by the following wording.

Before the beginning of the cycling test, the temperature rise of the contacts shall be measured at rated current when steady-state conditions have been obtained. The measurement shall be repeated after 250 cycles and, if necessary, after 750 cycles.

The voltage drop of the contacts is measured after 50, 250 and 750 cycles at direct current of $I_m = (0,05 \text{ to } 0,30) I_n$. However, the current I_m has to be chosen in such a way as to give a voltage drop of at least $100\text{ }\mu\text{V}$.

The tolerance of I_m during the measurement shall not be greater than $+10\text{ }_0\text{ }\%$. ~~The points between which the voltage drop is measured are marked A, B, C and D in Figure 109.~~ Measuring points are marked in Figure 109.

The resistance of the contact is then determined on the basis of the voltage drop. Before measurement, the sample has to be cooled down to room temperature. If the room temperature during the measurement deviates from 20 °C, the following formula may be applied.

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

where

R_{20} is the resistance at temperature 20 °C;

R_T is the resistance at temperature T ;

α_{20} is the temperature coefficient.

8.10.3 Acceptability of test results

At the end of 250 cycles (Equation 1) and at the end of 750 cycles (Equation 2), the following limits shall not be exceeded.

$$\frac{R_{250} - R_{50}}{R_{50}} \leq 15 \% \quad (1)$$

$$\frac{R_{750} - R_{50}}{R_{50}} \leq 40 \% \quad (2)$$

Alternatively, the temperature measured according to Figure 109 can be used for verification. As measuring points, the terminating lugs of the fuse-base (Figure 109) should be chosen. In this case, the following limits shall not be exceeded:

After 250 cycles, the measured temperature rise values shall not exceed the temperature rise values measured at the beginning of the cycling test by more than 15 K and after 750 cycles, the measured temperature rise values shall not exceed the temperature rise values measured at the beginning of the test by more than 20 K.

8.11 Mechanical and miscellaneous tests

8.11.1 Mechanical strength

8.11.1.1 Mechanical strength of the gauge-piece

8.11.1.1.1 Gauge-piece of size DII and DIII (screw-in gauge-pieces)

Gauge-pieces shall be so constructed that the current-carrying parts are in one piece and that they withstand the mechanical stress occurring in normal use.

Compliance is checked by inspection and by the following tests.

The gauge-piece is screwed into a fuse-base by applying a torque of 1 Nm for 1 min. It is then withdrawn with the aid of the appropriate hand-key. In addition, an axial force of 10 N is applied in both directions between the metal part and the ceramic part of the gauge-piece. The test is made on the gauge-piece as delivered. For gauge-pieces having parts which are cemented or glued together, the test is repeated after the samples have been immersed for 24 h in water at the temperature of 20 °C ± 5 °C, and again after the samples have been conditioned for 1 h at a temperature of 200 °C ± 5 °C.

After these tests, the samples shall show no change impairing their future use; in particular, the thread shall not be damaged and the ceramic parts shall still be securely fixed to each other and shall not be detached from the metal part.

8.11.1.1.2 Gauge-piece of size D01, D02, D03, DIV and D-type push-in gauge-rings

By means of force measurement it is checked whether the resilient grip can hold the gauge-piece with the determined force ≥ 2 N.

8.11.1.2 Mechanical strength of the fuse-carrier

A force of 2,5 N (fuse-carrier D01 and D02) and 5 N (in all other cases) is applied gently to the inspection window from the inside, using a steel rod of 6 mm diameter. The inspection window shall neither break nor be displaced during the test.

A test mandrel, having the maximum diameter of the fuse-link d_3 or d_4 as specified in Figure 110 or Figure 111 is inserted five times in the fuse-carrier. After this test, ~~a fuse-link (smooth ceramic surface) with a minimum outside diameter d_3 or d_4 according to Figure 110 or Figure 111~~ the test-dummy shown in Figure 126 shall be retained in the fuse-carrier when it is turned upside down.

8.11.1.3 Mechanical strength of the fuse-link

The fuse-links shall have adequate mechanical strength and their contacts shall be securely fixed. For compliance they shall be tested as follows.

The fuse-link is placed in the appropriate fuse-carrier complying with Figure 112, 113 or 114, which is screwed into a fuse-base complying with Figure 118, 119 or 120, a gauge-piece complying with Figure 121, 122 or 123 being in position. The gauge-piece has a diameter d_1 equal to the minimum value specified for the relevant rated current.

The torque applied to the fuse-carrier is equal to that specified in Table 115 and the fuse-carrier is then withdrawn. The fuse-carrier is screwed in and withdrawn five times. After this test, the fuse-link shall show no damage within the meaning of this standard. It shall not be possible to remove the fuse-link end caps by hand.

8.11.1.4 Mechanical strength of the fuse

The fuse-carrier fitted with a fuse-link complying with the standards is screwed five times into the fuse-base fitted with the gauge-piece by applying a torque as given in Table 115 and withdrawn five times. In case of fuse-bases for busbar mounting, the busbars with the smallest dimensions as specified by the manufacturer shall be used. After this test, the samples shall show no change impairing their further use.

NOTE The tests specified in 8.11.1.3 and 8.11.1.4 may be performed at the same time.

Table 115 – Test-torque for mechanical strength

Size	Torque Nm
D01	1,5
D02	1,5
D03	2,5
DII	4,0
DIII	6,5
DIV	10,0

Mechanical strength of screw thread:

For screws, which are operated during the installation of the fuse, including screws of terminals and screws for fixing covers – but not screws for fixing the fuse-base to the supporting surface – the following test is performed.

The screws are tightened and loosened five times in the case of metallic thread and ten times in the case of non-metallic thread by means of a suitable test spanner or screwdriver, applying a torque as indicated in Table 116.

For testing terminal screws, a conductor of the largest cross sectional area specified by the manufacturer or in IEC 60269-1 shall be placed in the terminal. The conductor shall be moved after each operation to present a new surface to the terminal screw.

Table 116 – Mechanical strength of screw-thread

Nominal diameter of thread mm	Torque Nm
$\leq 2,6$	0,4
$> 2,6 \leq 3,0$	0,5
$> 3,0 \leq 3,5$	0,8
$> 3,5 \leq 4,0$	1,2
$> 4,0 \leq 5,0$	2,0
$> 5,0 \leq 6,0$	2,5
$> 6,0 \leq 8,0$	5,5
$> 8,0 \leq 10,0$	7,5

During the test, no change impairing the further use of the screwed connection shall occur.

8.11.2.4 Resistance to storage at elevated temperature

8.11.2.4.1 Test arrangement

Three fuse-carriers and three fuse-bases shall be placed in a heating chamber at a temperature of $180\text{ °C} \pm 5\text{ °C}$ for a period of 168 h for the test on insulating parts other than ceramics supporting current-carrying parts.

Covers shall be placed in a heating chamber at the following temperature for a period of 168 h: $100\text{ °C} \pm 5\text{ °C}$.

A complete fuse shall be exposed for 1 h to a temperature of $150\text{ °C} \pm 5\text{ °C}$ to meet the requirements for cemented parts, sealing compound and colour markings.

8.11.2.4.2 Test method

After cooling down to room temperature the following shall be tested.

One fuse-carrier and fuse-base shall be exposed to humid atmospheric conditions as described in 8.2.2.3.2 of IEC 60269-1. Immediately after this treatment, the insulating properties shall be verified at a test voltage of 2,0 kV, according to 8.2.1, 8.2.2.1 and 8.2.2.3.1 of IEC 60269-1, with the exception of Table 15.

The other two fuse-carriers and fuse-bases shall be tested as follows.

The fuse-carriers fitted with a fuse-link complying with the standards are screwed five times into the fuse-bases fitted with gauge-pieces by applying a torque as given in Table 111 and withdrawn five times.

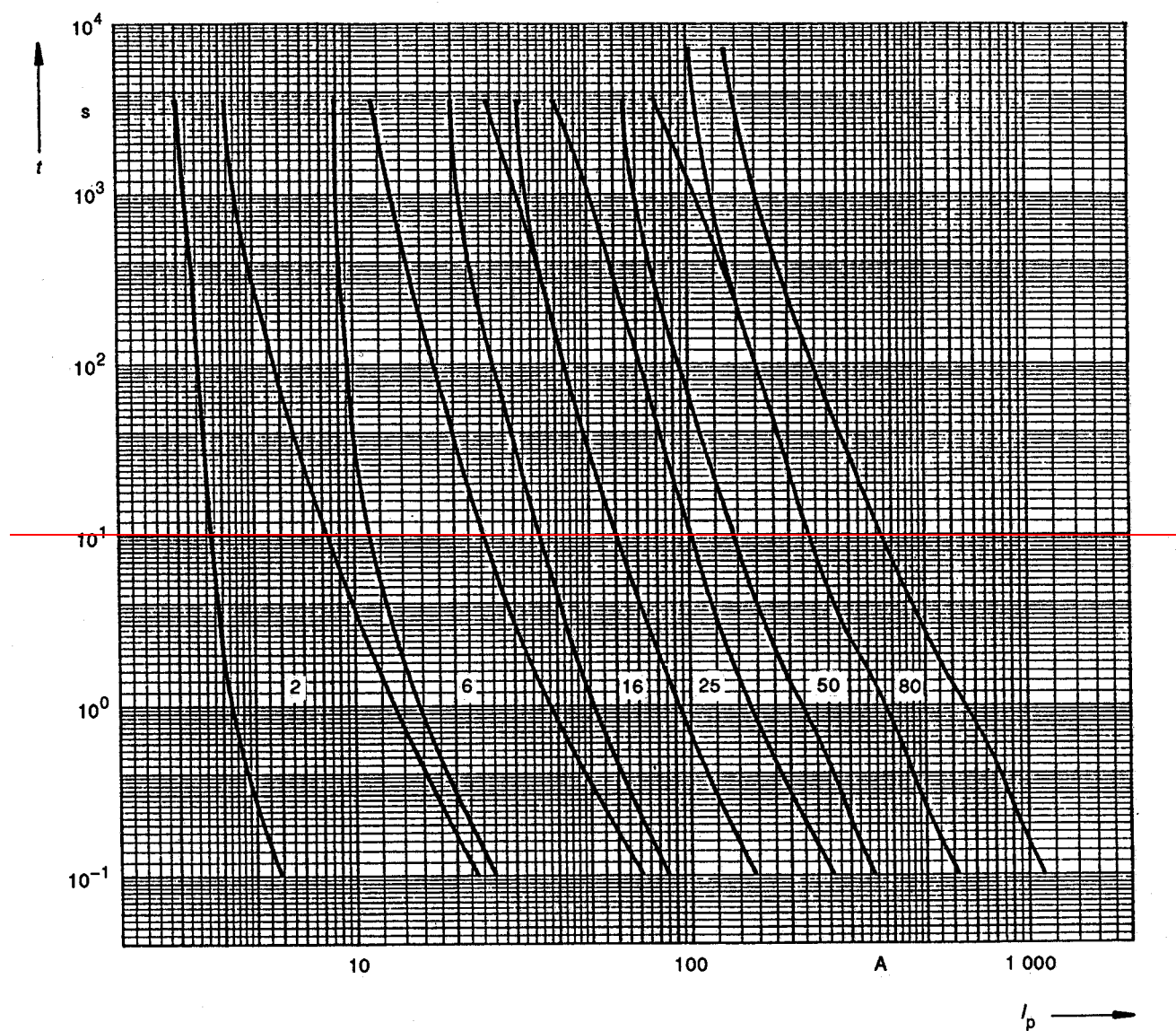
8.11.2.4.3 Acceptability of test results

After this test, the test samples shall show no change impairing their further use. The mechanical strength, especially of the cemented parts, shall be maintained.

The sealing compound shall not have moved to such an extent that live parts are exposed. After this test, the identification colour shall not have changed appreciably.

8.11.2.6 Dimensions and non-interchangeability

Compliance with 8.1.4 of 60269-1 and 7.1.8. of this standard shall be verified by measuring and comparing the dimensions of fuse-links with the related dimensions of the other parts of the fuse.



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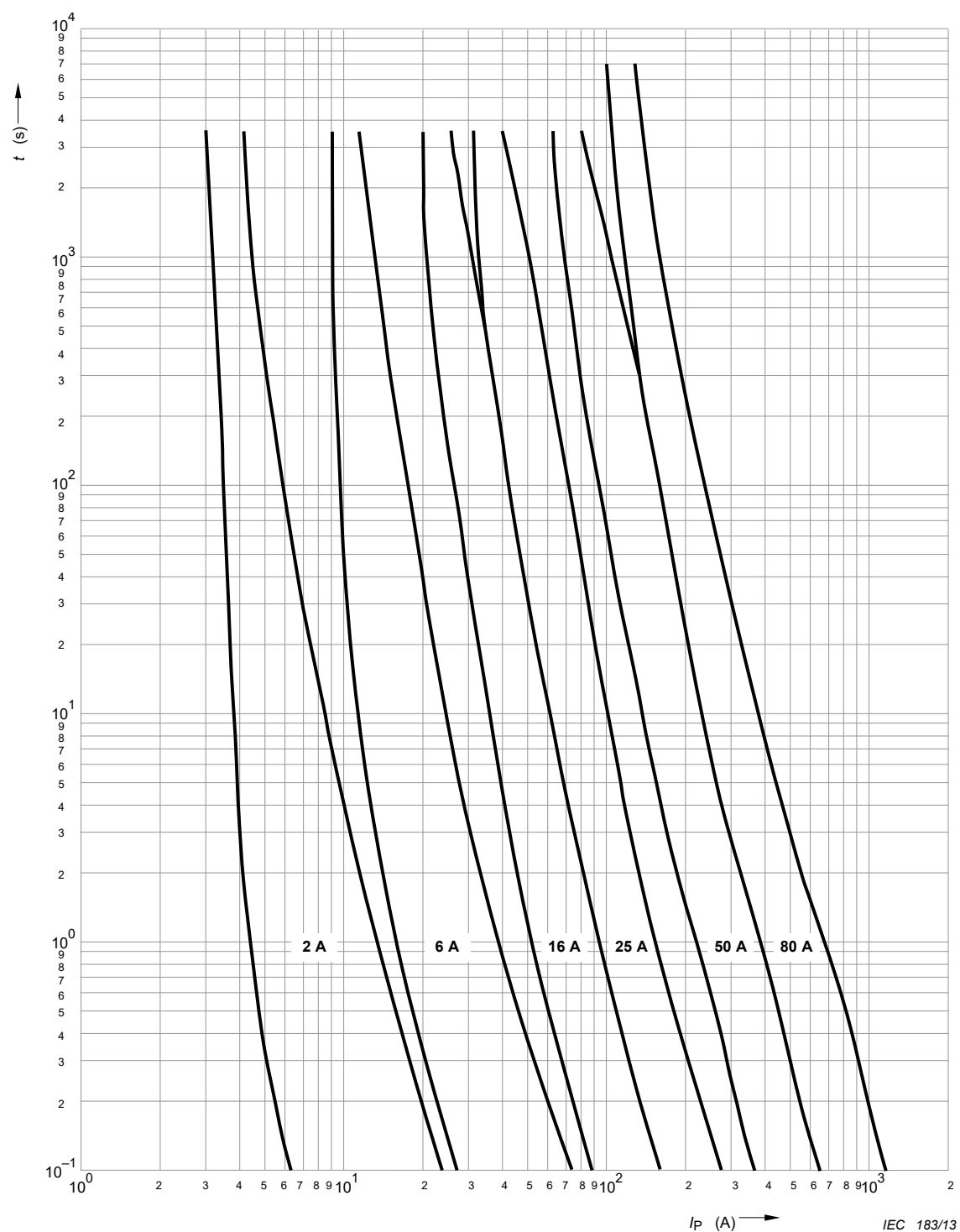
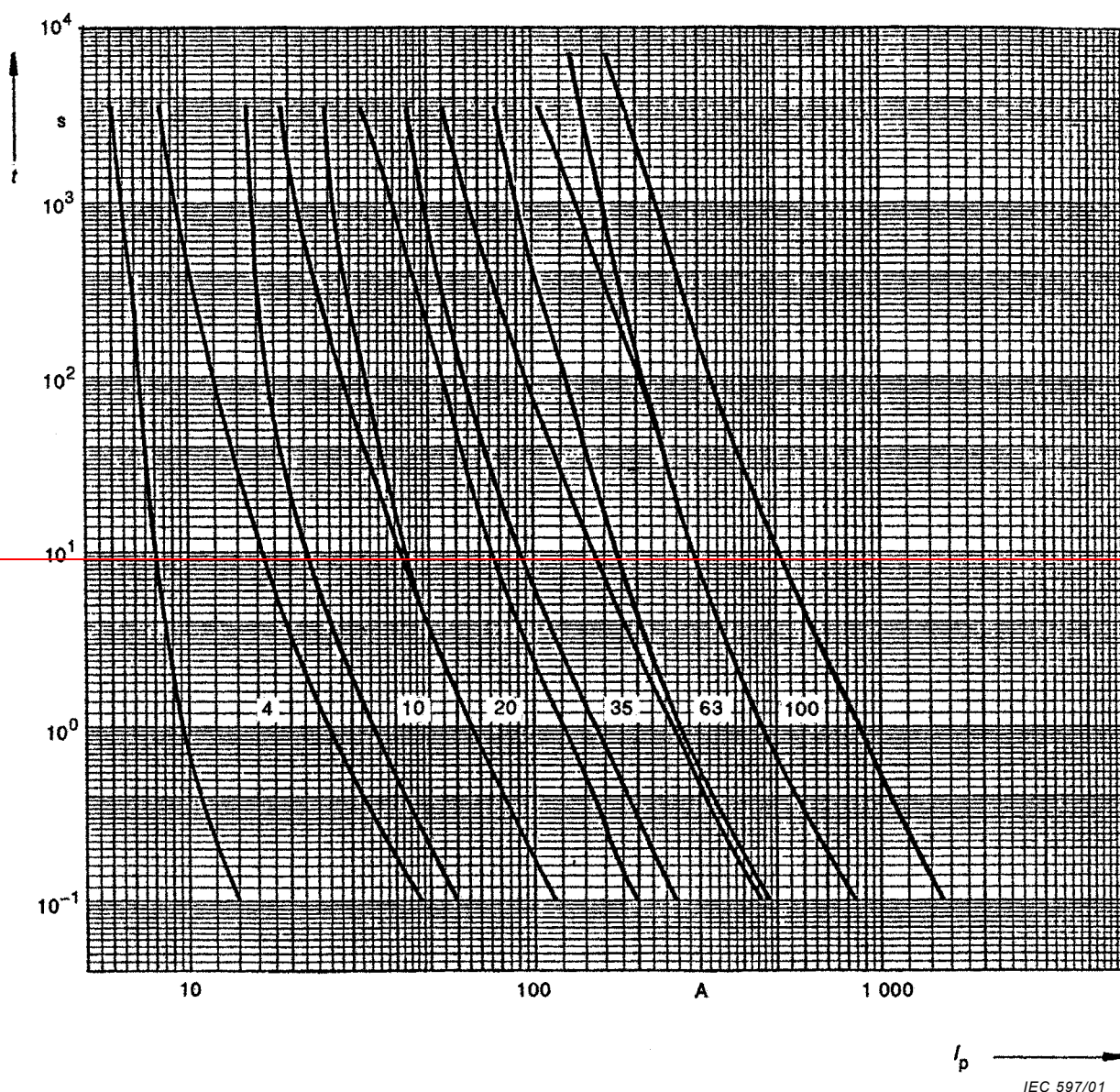


Figure 101 – Time-current zones for "gG" fuse-links



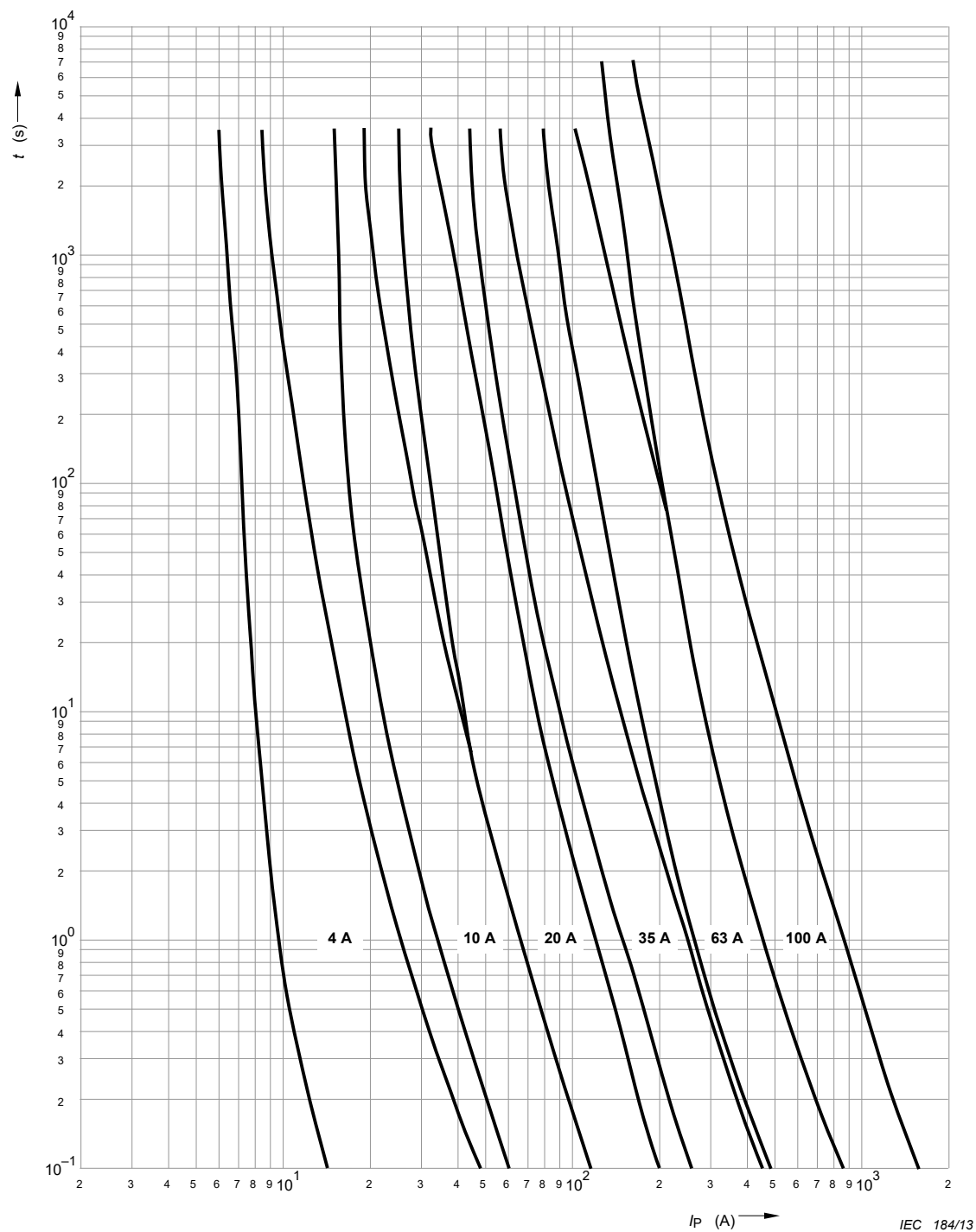
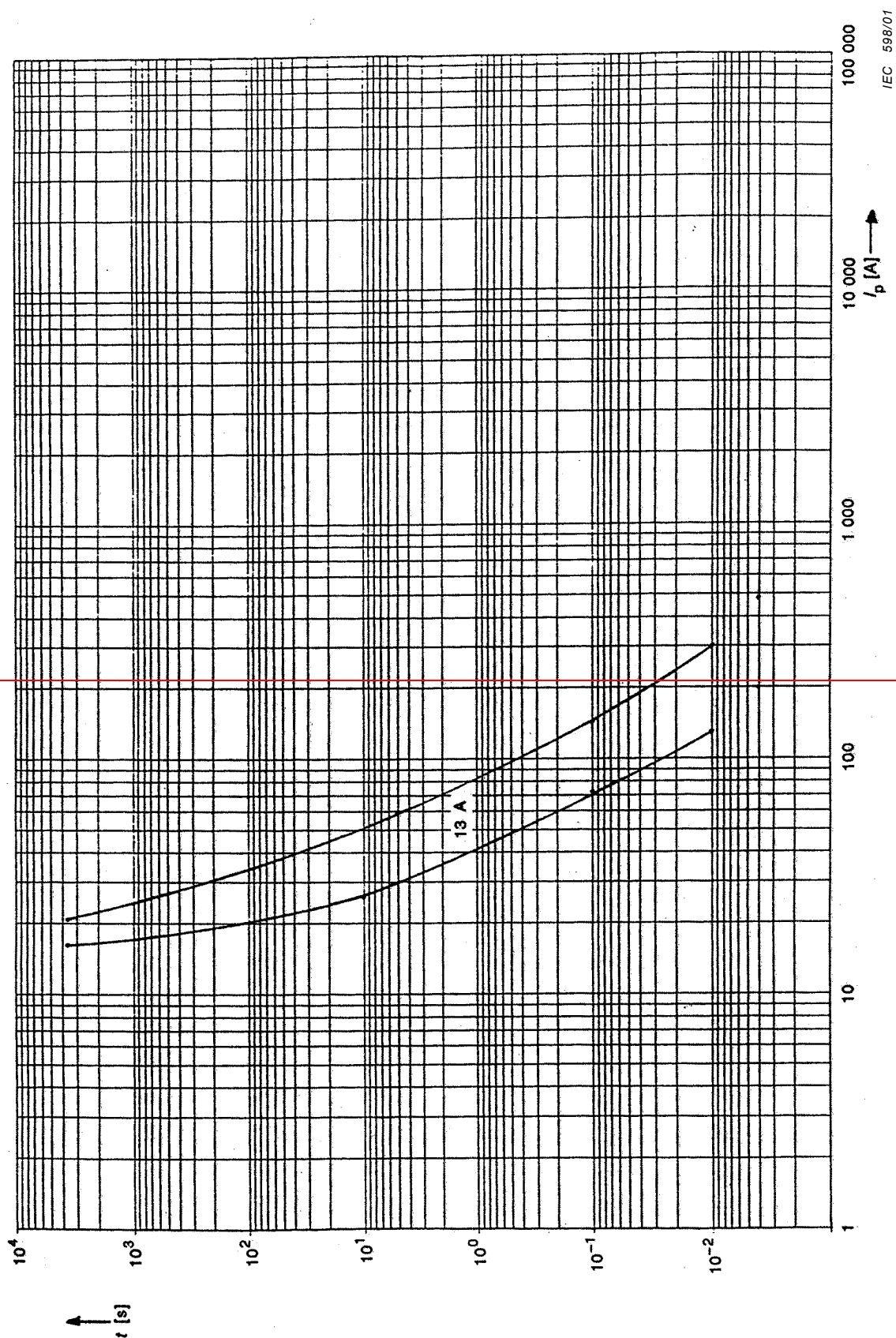


Figure 102 – Time-current zones for "gG" fuse-links



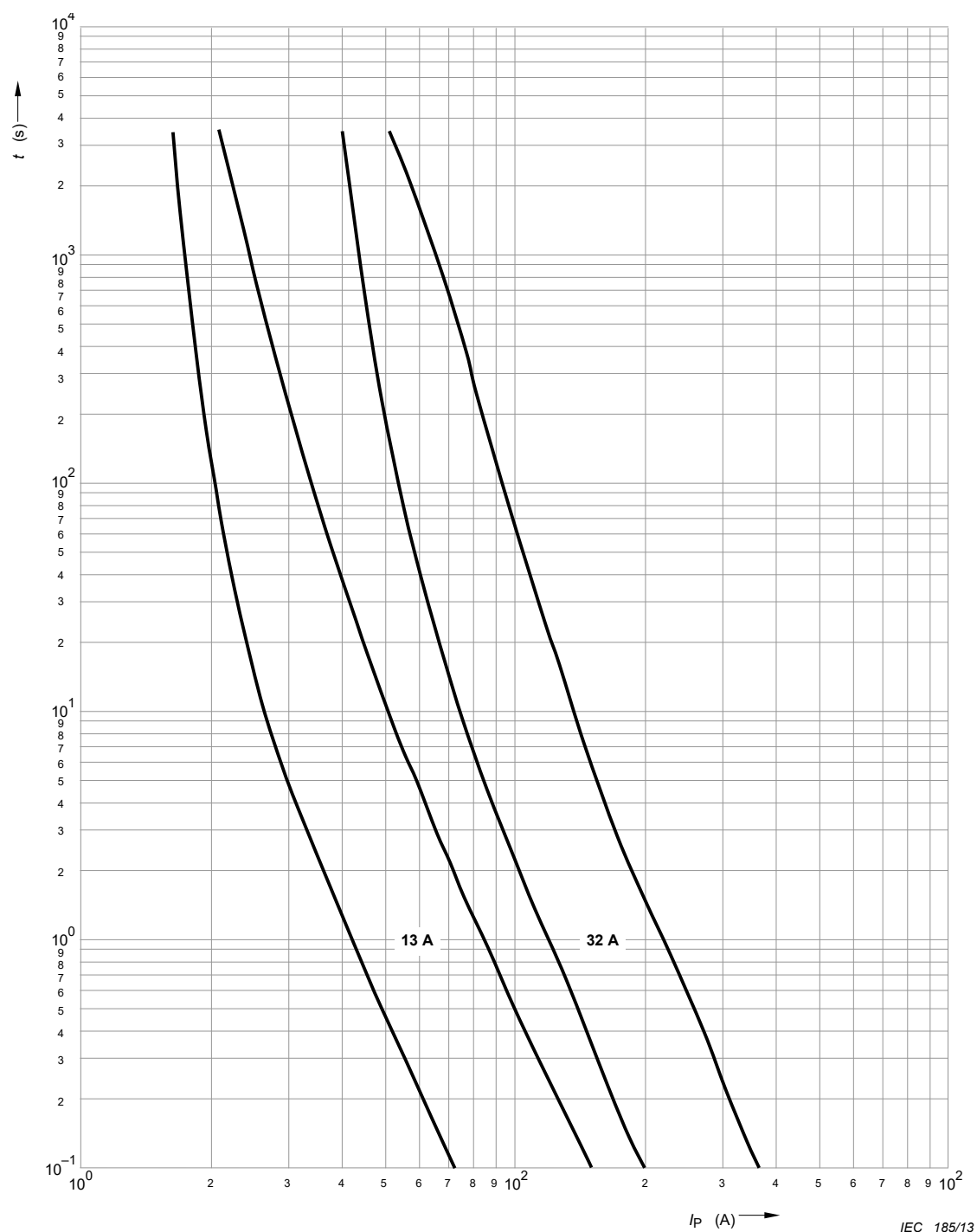


Figure 103 – Time-current zone for "gG" fuse-links 13 A and 32 A

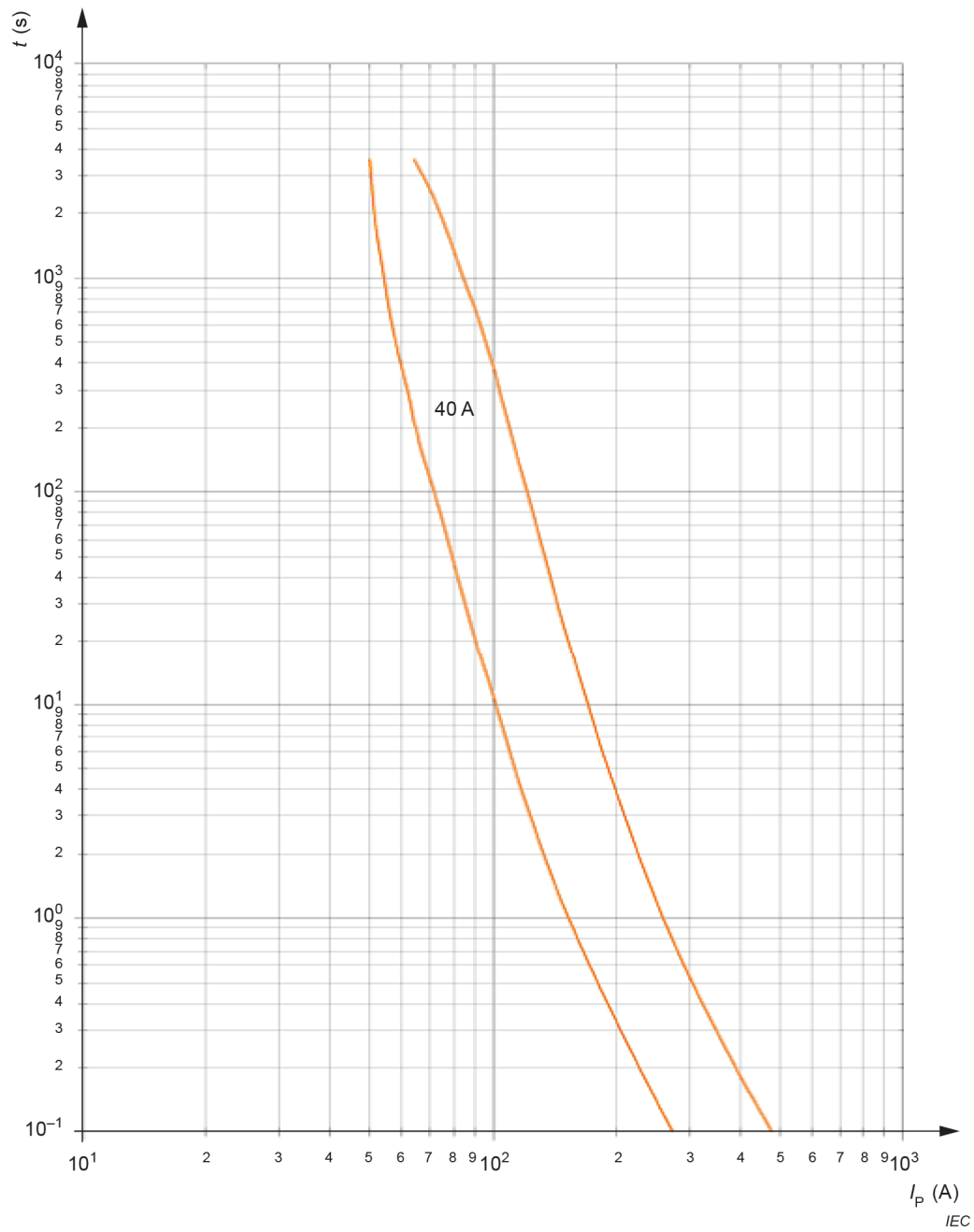
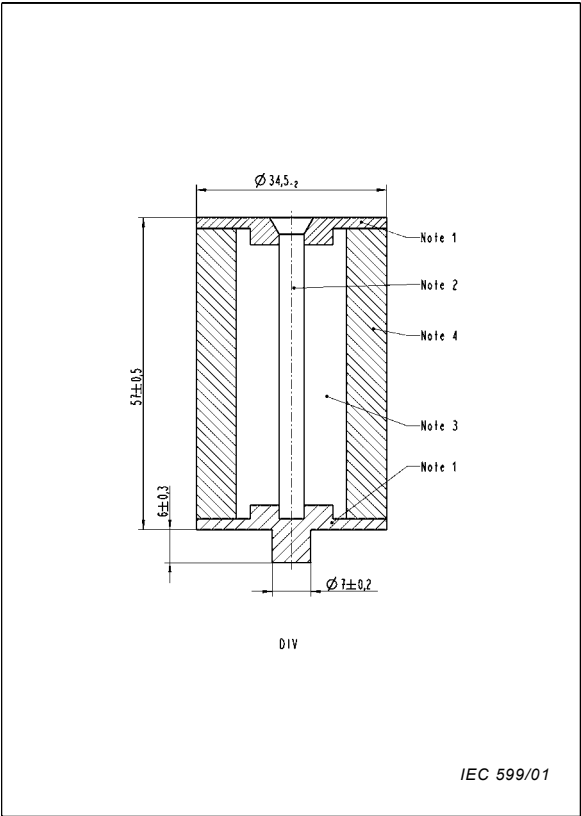
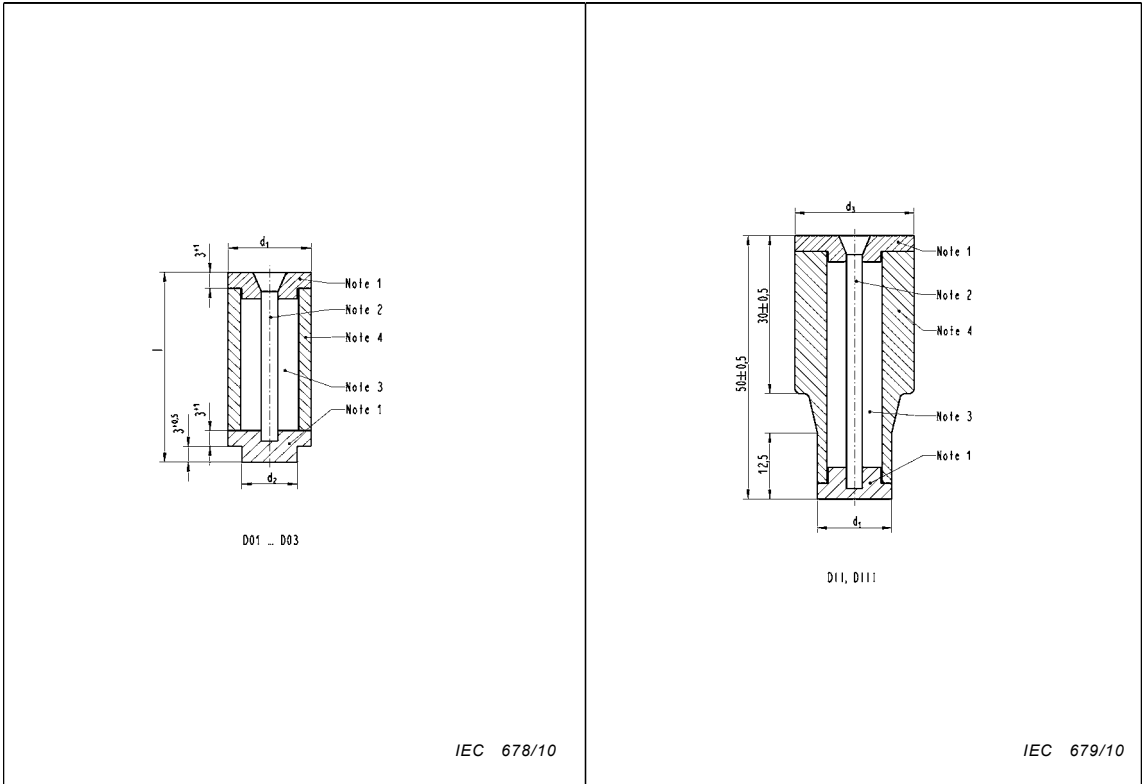


Figure 127 – Time-current zone for "gG" fuse-links 40 A



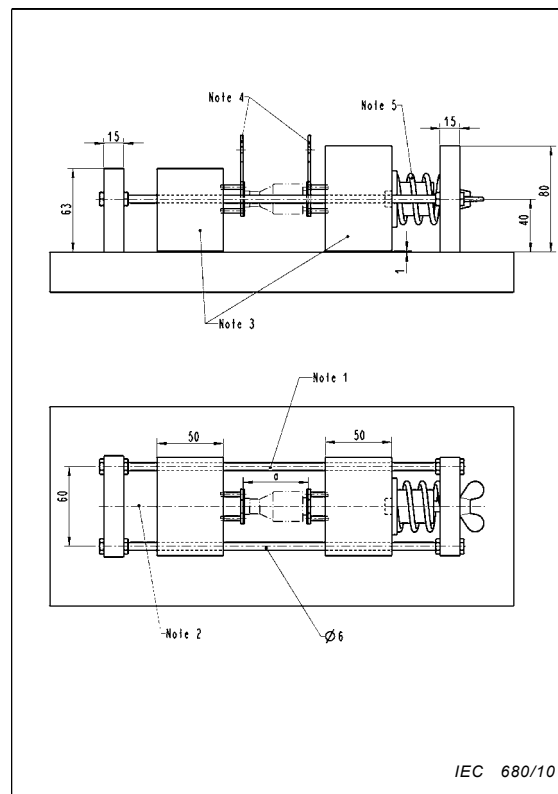
Size	$d_1 \begin{smallmatrix} 0 \\ -0,5 \end{smallmatrix}$	$d_2 \begin{smallmatrix} 0 \\ -0,5 \end{smallmatrix}$	$l \pm 0,5$
D01	10,5	6	36
D02	15	10	36
D03	22	18	43

Size	$d_1 \begin{smallmatrix} +0,2 \\ -0,4 \end{smallmatrix}$	$d_3 \begin{smallmatrix} 0 \\ -1,5 \end{smallmatrix}$
DII	14	22,5
DIII	20	28

- NOTE 1 Contact CuZn, silver-plated.
- NOTE 2 Cu56Ni44 or an equivalent material with similar values of specific resistance and temperature coefficient.
- NOTE 3 Quartz sand.
- NOTE 4 Ceramic body.

Dimensions in millimetres

Figure 104 – Dummy fuse-links according to 8.3 and 8.9.1.1



Dimensions in millimetres
Dimension *a* see Figure 106

NOTE 1 Metallic rod.

NOTE 2 Distance for adjusting of the contact force.

NOTE 3 Insulating material.

NOTE 4 Silver-plated contact pieces.

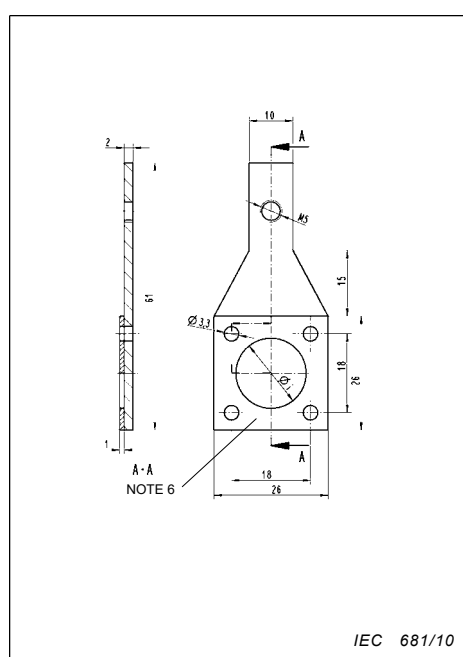
NOTE 5 Steel spring.

Figure 105 – Test rigs for fuse-links

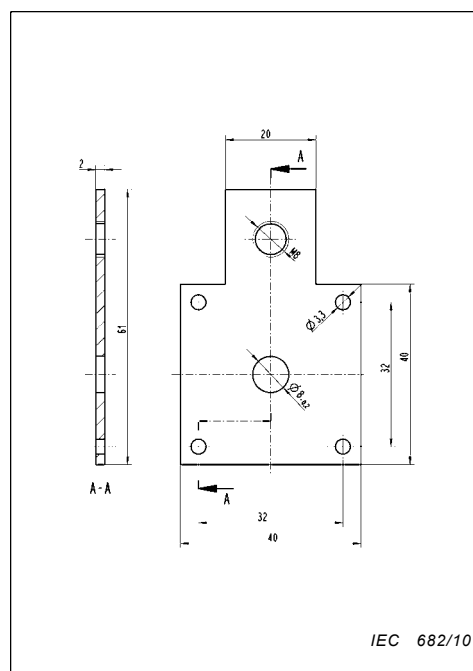
Size	Dimensions		Contact force N
	a ^a mm	∅ i mm	
D01	35 ⁺² ₀	11,5	40 ± 10 %
D02	35 ⁺² ₀	16,0	80 ± 10 %
D03	42 ⁺² ₀	23,0	120 ± 10 %
DII	49 ⁺² ₀	14,5	200 ± 10 %
DIII	49 ⁺² ₀	20,5	320 ± 10 %
DIV	56 ^{+2,5} ₀	–	550 ± 10 %
^a See Figure 105.			

Dimensions in millimetres

Silver-plated contact pieces (see Note 4 of Figure 105)



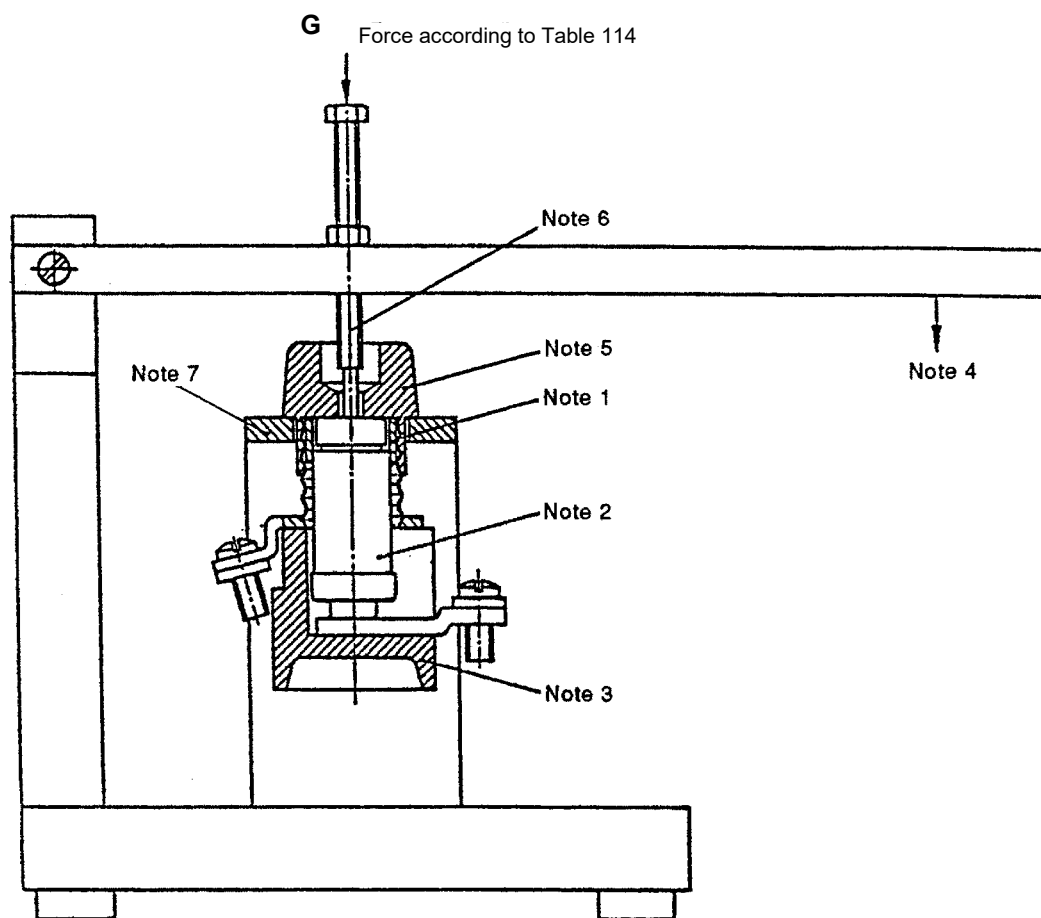
Sizes D01 to D03 and DII, DIII



Size DIV

NOTE 6 Centring plate of insulating material.

Figure 106 – Test rigs for fuse-links



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NOTE 1 Isolation between the end-cap and the screwed shell except at the face.

NOTE 2 Dummy fuse-link.

NOTE 3 Fuse-base.

NOTE 4 Direction of the applied force.

NOTE 5 Fuse-carrier.

NOTE 6 Piston.

NOTE 7 Assembly platform.

Figure 107 – Test arrangement for fuse-bases according to 8.9.1.2