IEC

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Edition 5.0 2024-08
COMMENTED VERSION

INTERNATIONAL STANDARD

Low- voltage fuses –
Part 3: Supplementary requirements for fuses for ~~use~~ operation by unskilled persons (fuses mainly for household or similar applications) – Examples of standardized systems of fuses A to F

IEC 60269-3:2024-08 CMV(en)

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FOREWORD

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This commented version (CMV) of the official standard IEC 60269-3:2024 edition 5.0 allows the user to identify the changes made to the previous IEC 60269-3:2010+AMD1:2013+AMD2:2019 CSV edition 4.2. Furthermore, comments from IEC SC 32B experts are provided to explain the reasons of the most relevant changes, or to clarify any part of the content.

A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text. Experts' comments are identified by a blue-background number. Mouse over a number to display a pop-up note with the comment.

This publication contains the CMV and the official standard. The full list of comments is available at the end of the CMV.

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

This fifth edition cancels and replaces the fourth edition published in 2010, Amendment 1:2013 and Amendment 2:2019. This edition constitutes a technical revision.

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

a) Introduction and general scope fully updated;
b) Normative references updated and editorial changes;
c) Terms “ordinary person”, “operation" and “non-interchangeability” defined;
d) In System A: Parts defined for removal;
e) In System A: Marking of fuse-bases added for direction of current flow;
f) In System A: Clarifications added for connection;
g) In System A: Clarification of construction of fuse-carrier and fuse-link;
h) In System A: Clarification of voltage drop measurement.

The text of this International Standard is based on the following documents:

Draft	Report on voting
32B/745/FDIS	32B/754/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This part is to be used in conjunction with IEC 60269-1:2024, *Low-voltage fuses – Part 1: General requirements.*

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 document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

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 applications) – 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*

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 this document 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 document 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 2

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 part of IEC 60269 is divided into four fuse systems, each dealing with a specific example of standardized fuses for use by unskilled persons.

All systems provide their own mechanical solution to avoid the use of a fuse-link with higher current rating (non-interchangeability) to ensure the protection of cables and lines. The applicant is required to take care to replace a fuse-link by the same type.

Fuse system	Principles of non-interchangeability
Fuse system A: D type fuse system 1)	Diameter and shape at bottom side of the fuse-links differs, fuse bases require gauge-pieces
Fuse system B: Cylindrical fuses (NF cylindrical fuse system) 2)	Fuse-links and suitable fuse-holders (fuse-carriers) provide unique dimensions
Fuse system C: Cylindrical fuses (BS cylindrical fuse system) 2)	Fuse-links and suitable fuse-holders (fuse-carriers) provide unique dimensions
Fuse system F: Cylindrical fuse-links for use in plugs (BS plugtop fuse system) 1)	Fuse-links and suitable fuse-holders (fuse-carriers) provide unique dimensions

NOTE 1 Applicants of system A and F may have fuse-bases in their installation not providing degree of protection IP2X all the time. The degree of protection may temporarily be reduced to IP1X, when replacing the fuse-link. 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. For future designs Annex CC recommends that the degree of protection against electric shock during the period of replacing a fuse-link should be at least IP2X.

NOTE 2 Fuse-links are not to be interchanged with fuse-links of the same dimension but with different characteristics (e. g. aM).

It is important for safety and therefore strictly forbidden to mix components of different fuse-systems such as fuse-links, fuse-holders and fuse-bases.

LOW-VOLTAGE FUSES –

Part 3: Supplementary requirements for fuses for use operation 1 by unskilled persons (fuses mainly for household and similar applications) – Examples of standardized systems of fuses A to F

1 General Scope 3

~~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 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 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.~~

This part of IEC 60269 is divided into four fuse systems, each dealing with a specific example of standardized fuses for use by unskilled persons.

This part applies to “gG” fuses only.

Unskilled persons do not have technical knowledge or sufficient experience. To avoid dangers, which electricity may create, the relevant part of the fuse standard shall provide requirements for maximum safety in service. IEC 60269-3 provides four systems for use by unskilled persons. Instructions for the safe operation of fuse-links are provided in the manufacturer’s literature.

All systems provide their own mechanical solution to avoid the use of a fuse-link with higher current rating (non-interchangeability) whereas the protection of cables and lines is ensured. The applicant is required to take care to replace a fuse-link by the same type.

Fuse system	Principles of non-interchangeability
Fuse system A: D type fuse system 1)	Diameter and shape at bottom side of the fuse-links differs, fuse bases require gauge-pieces
Fuse system B: Cylindrical fuses (NF cylindrical fuse system) 2)	Fuse-links and suitable fuse-holders (fuse-carriers) provide unique dimensions
Fuse system C: Cylindrical fuses (BS cylindrical fuse system) 2)	Fuse-links and suitable fuse-holders (fuse-carriers) provide unique dimensions

Fuse system F: Cylindrical fuse-links for use in plugs (BS plugtop fuse system) 1)	Fuse-links and suitable fuse-holders (fuse-carriers) provide unique dimensions

2 Normative references 4

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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~~2024, *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~~2015, *Electrical accessories – Circuit-breakers for overcurrent protection for household and similar installations – Part 1:Circuit-breakers for AC operation*
~~*Amendment 1(2002)*~~
~~*Amendment 2 (2003)*~~
IEC 60898-1:2015/AMD1:2019

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

IEC 60999-1:1999, *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 61439-1, *Low-voltage switchgear and controlgear assemblies – Part 1: General rules*

IEC 61439-3:2012, *Low-voltage switchgear and controlgear assemblies – Part 3: Distribution boards intended to be operated by ordinary persons (DBO)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60269-1:2024 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.1
ordinary person
person who is neither a skilled person nor an instructed person

3.2
operation
operation is defined for this standard as the exchange of the fuse-link

3.3
non interchangeability
limitations on shape and/or dimensions with the object of avoiding in a specific fuse-base the inadvertent use of fuse-links having electrical properties other than those ensuring the desired degree of protection

[SOURCE: IEC 60050-441:1984, 441-18-33]

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 AC and 500 V DC.

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 with the following additions.

2.1.13

Defined parts which can be removed from a fuse: fuse carrier and fuse-link. 5

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 AC, the standard values of rated voltages are 400 V for size D01, D02 and D03[1] and 500 V for size DII, DIII and DIV.

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

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

5.3.1 Rated current of the fuse-link

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

5.3.2 Rated current of the fuse-holder

The rated currents of the fuse-carriers are given in Figure 112, Figure 113 and Figure 114. The rated currents of the fuse-bases are given in Figure 118, Figure 119 and Figure 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 In A	Maximum power dissipation W	
	D01 to D03	DII to 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	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

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 Figure 101, Figure 102, Figure 103 and Figure 127. 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 101, Figure 102, Figure 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	Conventional time	Conventional current	
A	h	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 ≤ I_n ≤ 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	$I_{min.}$ (10 s)	$I_{max.}$ (5 s)	$I_{min.}$ (0,1 s)	$I_{max.}$ (0,1 s)
A	A	A	A	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 AC
- 8 kA DC

~~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

6 Markings

6.1 General

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. 7

6.2 Marking of fuse-bases

If the fuse-bases are not capable of bidirectional current flow, they shall be marked with the current flow direction at front or lateral side. For this, preferentially, the symbol 5107A in accordance with IEC 60417 should be used. The arrows may be covered in the installed state of the fuse-base. 8

In the case of fuse-bases for busbar mounting, the marking with the current flow direction is not required.

6.3 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. 9

IEC 60269-1 applies with the following additions and changes.

7.1.2 Connections including terminals

Mounting of all fuse-bases and the wiring must be done by authorized/skilled person. 10

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 mm^2 (size DII); 16 mm^2 (size DIII) and 35 mm^2 (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
Size	I_n	
	A	mm²
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 Figure 121, Figure 122, Figure 123 and Figure 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.

Defined according to Figure 112 for fuse-carrier D0 and Figure 113 for D Type fuses-carrier and for the fuse-links in Figure 110 for D0 and Figure 111 for D-Type fuse-links. 11

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 Figure 112, Figure 113, Figure 114, Figure 115 and Figure 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 without a tool.

A fuse-link has no interchangeable parts. Only the Gauge piece ensures the non-interchangeability. It is not possible to interchange a fuse-link with a higher rating. 12

In case the fuse-link 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 Figure 110 and Figure 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 Figure 115, Figure 117, Figure 118, Figure 119, Figure 120 and Figure 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 to DIV**	**D01 to 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 to DIV**	**D01 to 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 to DIV**	**D01 to 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 this 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.~~ 13

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

Instead of Table 5 of IEC 60269-1:2024, Table 106 applies. 14

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 of IEC 60269-1:2024, 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 60269-1:2024, the pre-arcing I^2t values given in Table 107 apply.

Table 107 – 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	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 document and of Table 7 of IEC 60269-1:2024 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 60269-1:2024.

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 I^2t values given in Table 108 shall be followed:

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

I_n A	I^2t_{min} A^2s	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~~ shall be measured (e.g. by means of a micrometer with pointed noses) **15**. The mean values of two sets of three measurements shall be at least equal to the value specified in Figure 112, Figure 113, Figure 114, Figure 118, Figure 119 and Figure 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.

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 toTable 109 and Table 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~~ are **16** 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 60269-1:2024. The fuse-holder shall be submitted to the test voltage given in Table 15 of IEC 60269-1:2024.

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 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. 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 of IEC 60269-1:2024 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 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 Figure 105 and Figure 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 ± 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 60269-1:2024, 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 60269-1:2024 and Table 102 of this document. The fuse-links shall not operate within the conventional time shown in Table 2 of IEC 60269-1:2024 and Table 102 of this document.

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 60269-1:2024 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 document.

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 V ± 5 V and the test current shall be 2 × 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 DC current, Table 21 of IEC 60269-1:2024 applies, with the exception given in Table 112.

Table 112 – Test according to 8.5.5.1

	No. 1, No. 2	No. 3, No. 4, No. 5
Time constant	15 $^{+5}_{0}$ ms [a]	≤3 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 60269-1:2024, tests in accordance with Table 20 of IEC 60269-1:2024 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 60269-1:2024, 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 AC test voltage is: $\dfrac{1{,}1 \times U_n}{\sqrt{3}}$

The other characteristics of the test circuit are the same as for the breaking-capacity test No. 2 (see Table 20 of IEC 60269-1:2006).

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 RMS	I^2t_{min} A²s	Prospective I_{max} kA RMS	I^2t_{max} A²s	
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 60269-1:2024, 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 °C ± 5 °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 °C ± 5 °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 ~~(≥42 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 60269-1:2024, 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 °C ± 5 °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~~ shall **17** 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 60269-1:2024 applies.

8.10.1 Arrangement of the fuse

Subclause 8.10.1 of IEC 60269-1:2024 applies, with the following addition.

The dummy fuse-link is given in Figure 104 of this document.

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 of IEC 60269-1:2024.

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 60269-1:2024. 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 of IEC 60269-1:2024 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 voltage drop measurement shall be ~~repeated~~ made after 250 cycles and, ~~if necessary, after 750 cycles~~ if equation (1) of 8.10.3 is not met, the measurement must be repeated after 750 cycles (see equation (2) of 8.10.3). **18**

The voltage drop of the contacts is measured after 50, 250 and 750 cycles at direct current of I_m = (0,05 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 μV.

The tolerance of I_m during the measurement shall not be greater than $^{+10}_{0}$ %. 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, 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, Figure 113 or Figure 114, which is screwed into a fuse-base complying with Figure 118, Figure 119 or Figure 120, a gauge-piece complying with Figure 121, Figure 122 or Figure 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 document. 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
≤ 2,6	0,4
> 2,6 ≤ 3,0	0,5
> 3,0 ≤ 3,5	0,8
> 3,5 ≤ 4,0	1,2
> 4,0 ≤ 5,0	2,0
> 5,0 ≤ 6,0	2,5
> 6,0 ≤ 8,0	5,5
> 8,0 ≤ 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 °C ± 5 °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 °C ± 5 °C.

A complete fuse shall be exposed for 1 h to a temperature of 150 °C ± 5 °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 60269-1:2024. 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 60269-1:2024, 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 60269-1:2024 and 7.1.8. of this document shall be verified by measuring and comparing the dimensions of fuse-links with the related dimensions of the other parts of the fuse.

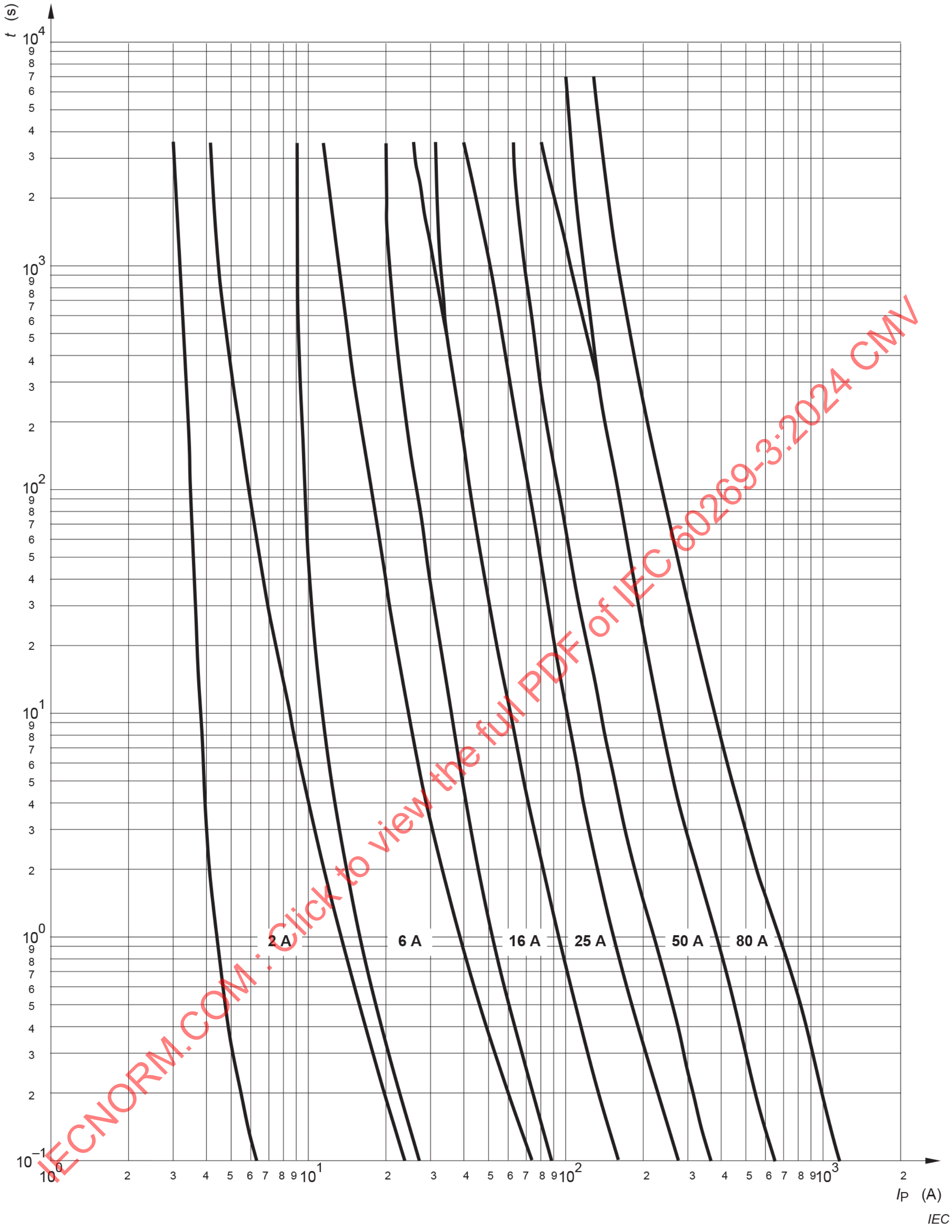


Figure 101 – Time-current zones for "gG" fuse-links

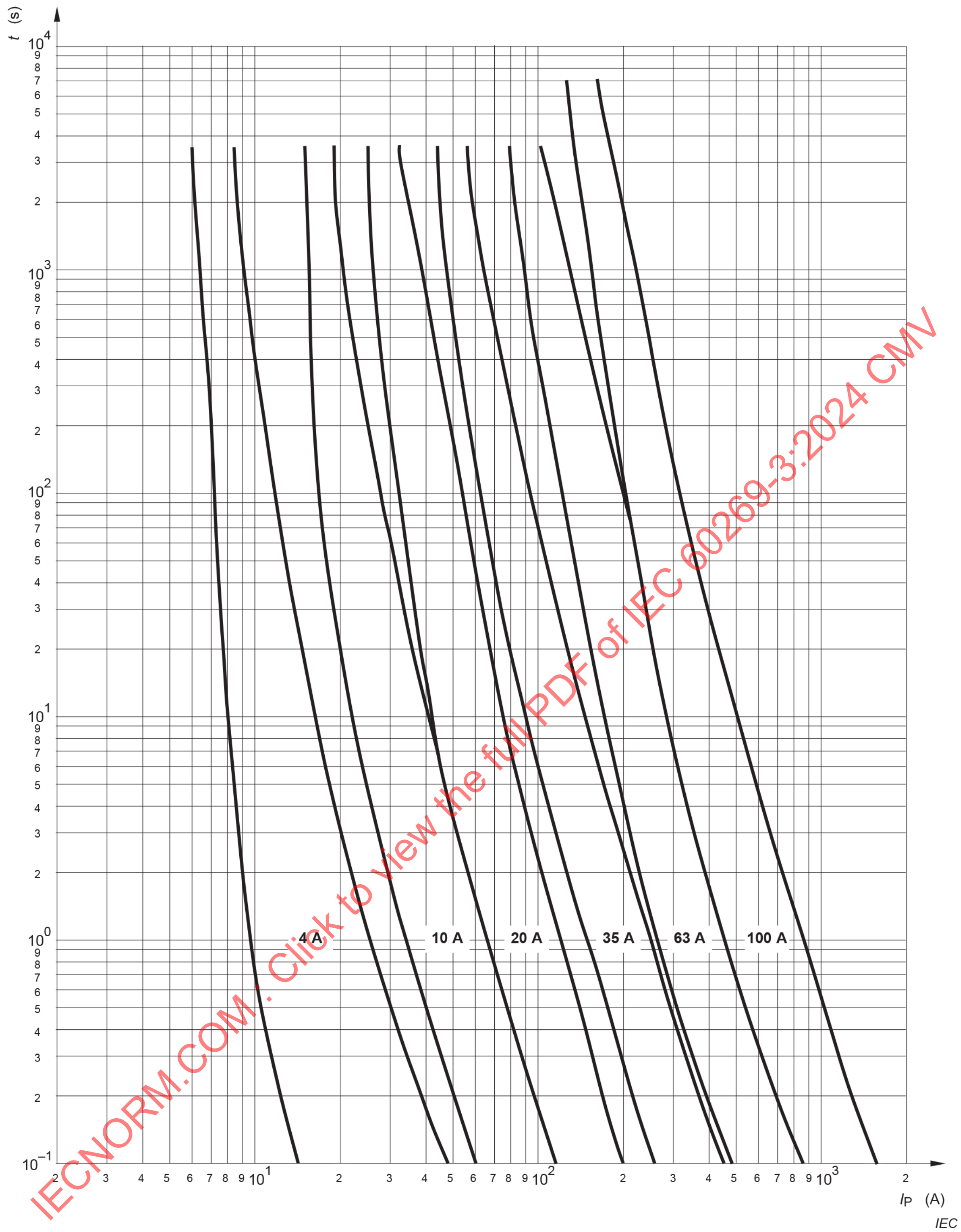


Figure 102 – Time-current zones for "gG" fuse-links

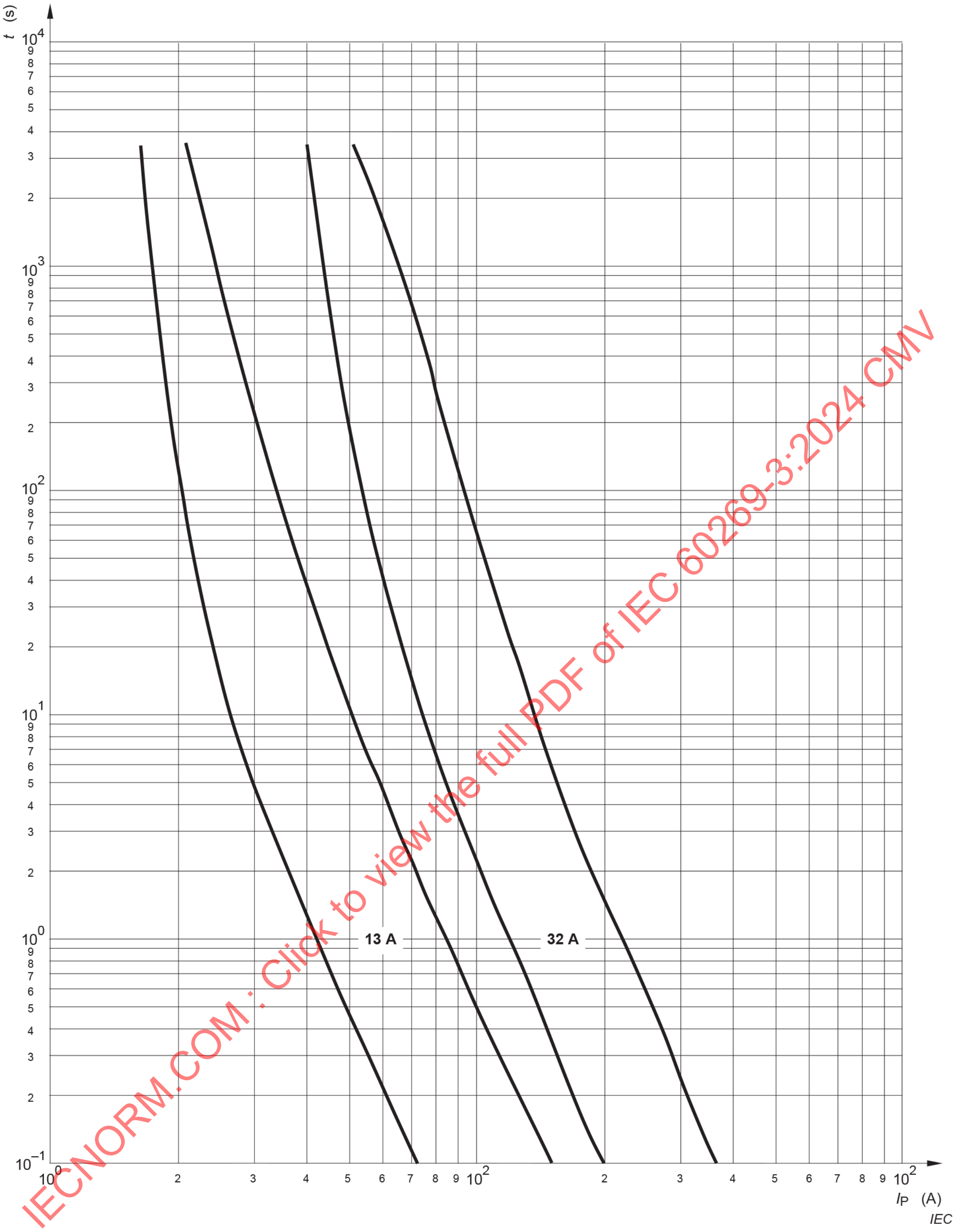
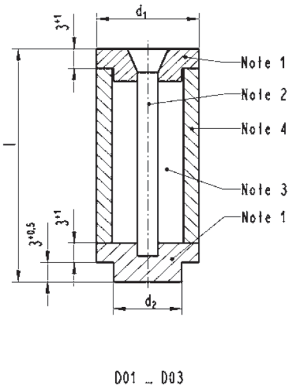


Figure 103 – Time-current zone for "gG" fuse-links 13 A and 32 A



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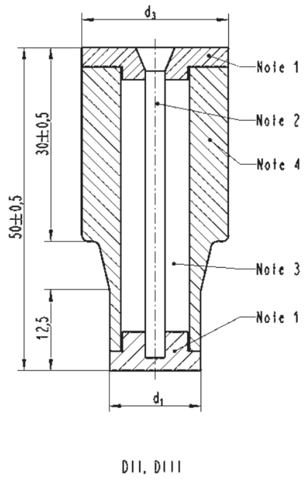

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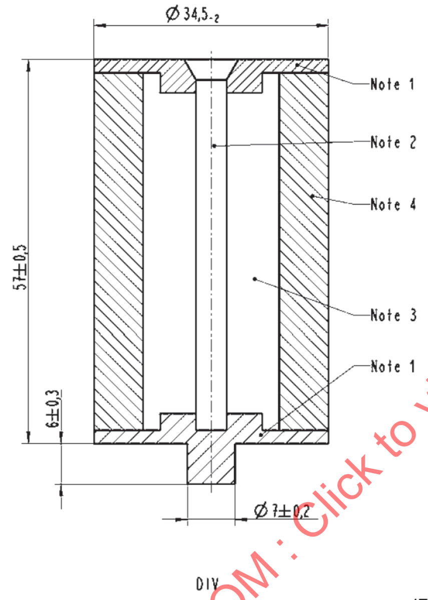
Dimensions in millimetres

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

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



IEC

NOTE 1 Contact CuZn, silver-plated.

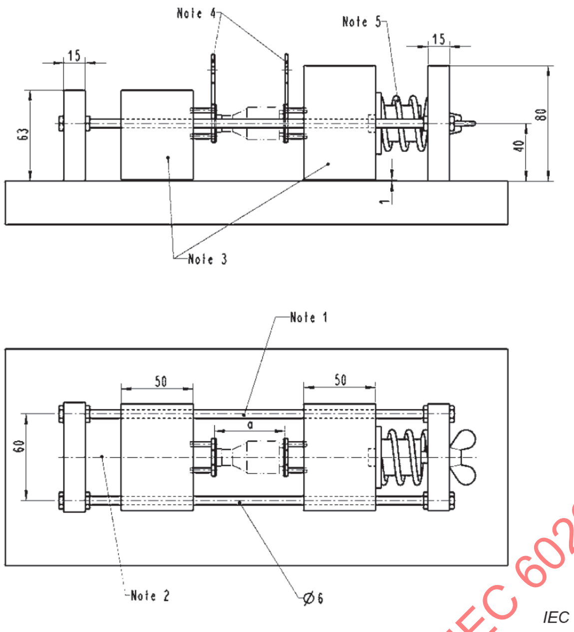
NOTE 2 Cu56Ni44 or an equivalent material with similar values of specific resistance and temperature coefficient.

NOTE 3 Quartz sand.

NOTE 4 Ceramic body.

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.

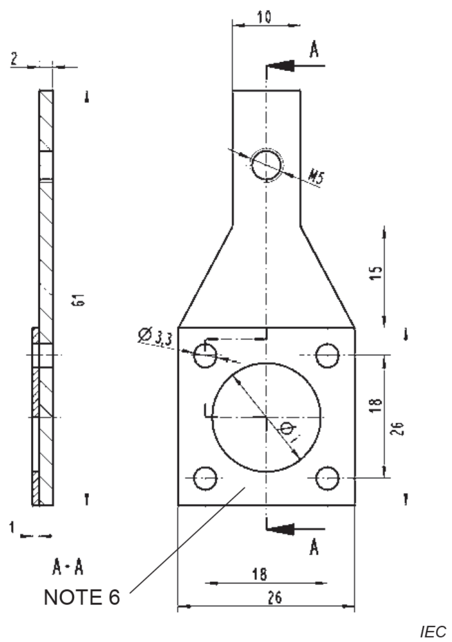
Figure 105 – Test rigs for fuse-links

Size	Dimensions		Contact force
	a [a] mm	∅ i mm	N
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 %

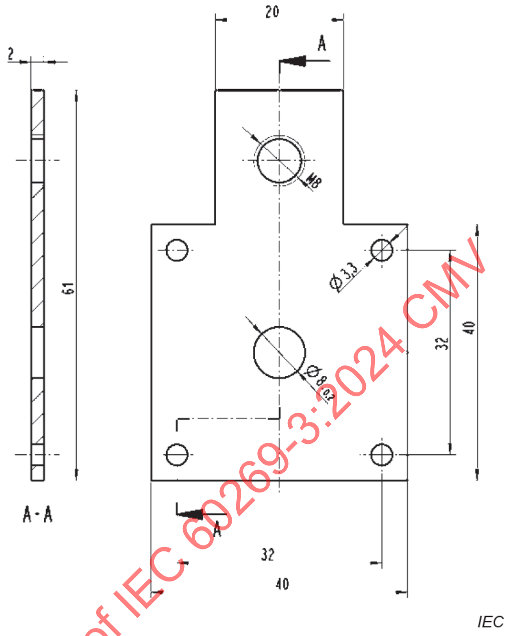
[a] See Figure 105.

Dimensions in millimetres

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



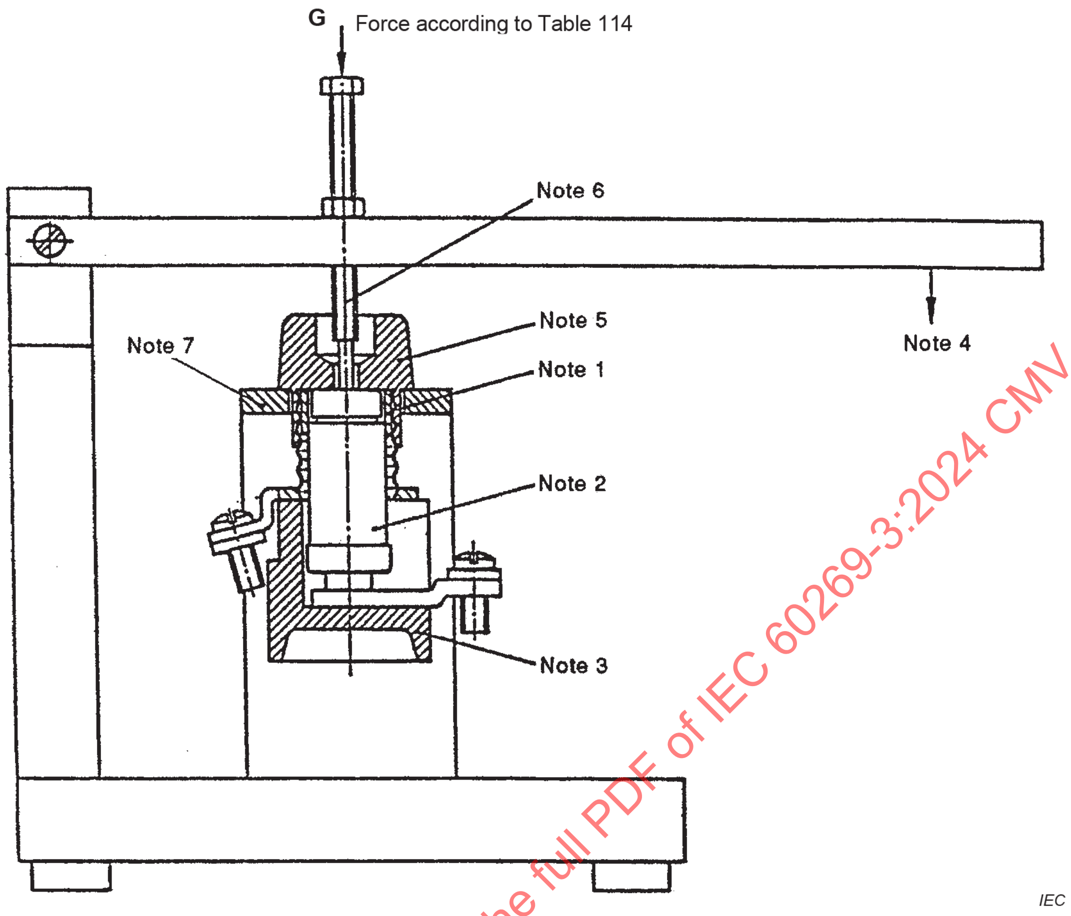
Sizes D01 to D03 and DII, DIII



Size DIV

NOTE 6 Centring plate of insulating material.

Figure 106 – Test rigs for fuse-links



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

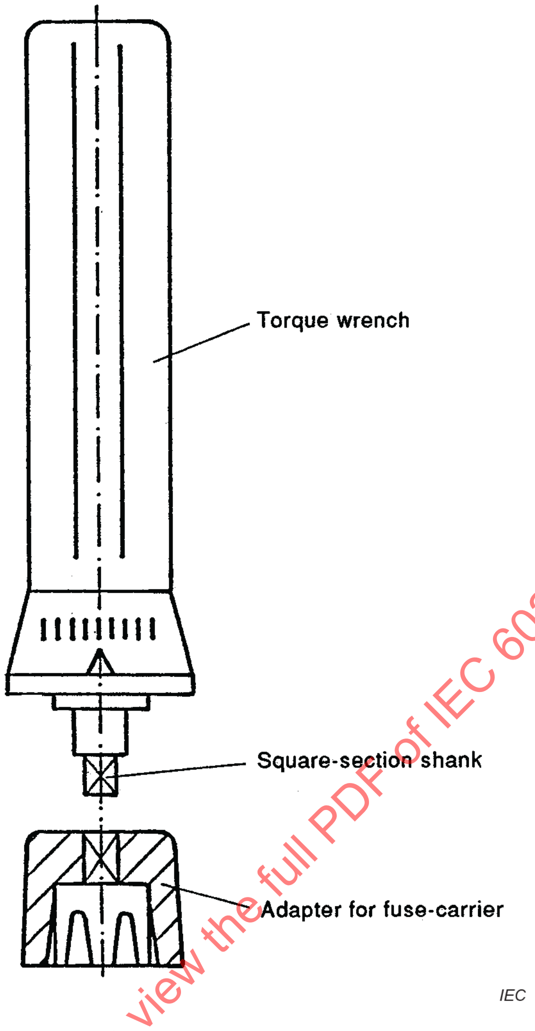


Figure 108 – Example of a torque wrench according to 8.9.2

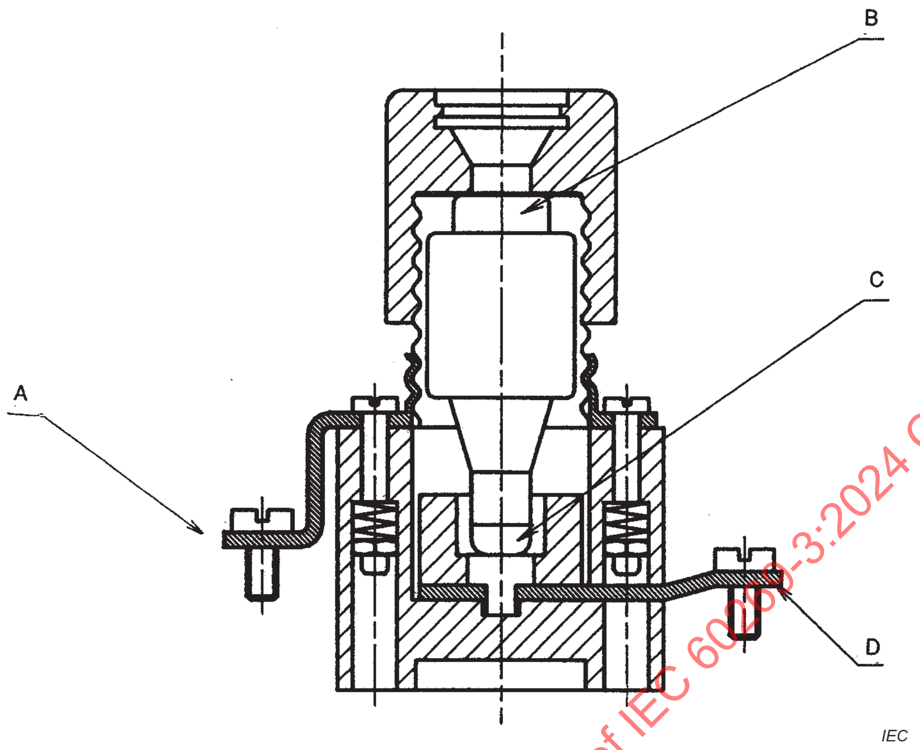
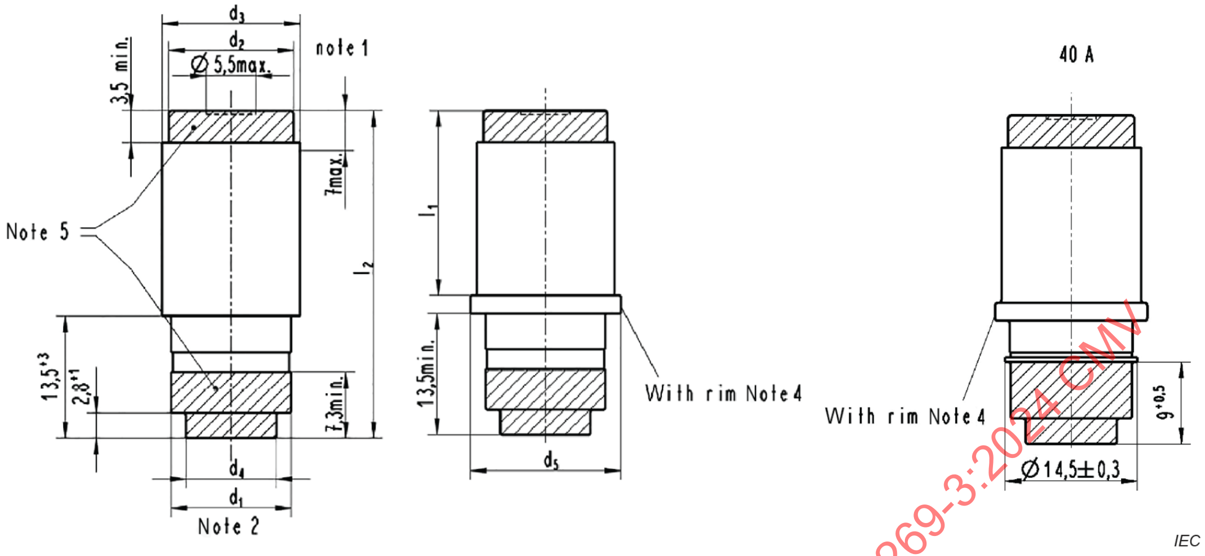


Figure 109 – Measuring points according to 8.3.3, 8.3.4.1 and 8.10.2 of fuse system A

Dimensions in millimetres



	I_n A	d_1 (note 2) ± 0,3 mm	d_2 (min.) mm	d_3 mm	d_4 (max.) mm	d_5 (note 4) mm	l_1 (note 4) mm	l_2 ± 1 mm	r (max.) mm
D01	2	7,3	9,8	11 $^{0}_{-0,7}$	6	–	–	36	1
	4	7,3							
	6	7,3							
	10	8,5							
	13	8,5							
	16	9,7							
D02	20	10,9	13,8	15,3 $^{0}_{-0,8}$	10	16,7 (max)	18,5	36	1
	25	12,1				16,7 max.)			
	32	13,3				16,7 (max)			
	35	13,3				16,7 (max)			
	40	13,3				16,7 (max)			
	50 (note 4)	14,5				16,7 $^{0}_{-1,3}$			
	63	15,9				16,7 (max.)			
D03	80 (note 4)	22	20,6	22,5 $^{0}_{-1}$	18	25,6 $^{0}_{-2,3}$	22,5	43	1,6
	100	25				25,6 (max.)			

NOTE 1 Diameter of fuse-indicator.

NOTE 2 The maximum value of d_1 shall not be exceeded within a range of 13,5 mm.

NOTE 4 Choice of manufacturer, obligatory for 50 A and 80 A. The rim is necessary for the 50 A and 80 A rating to ensure correct insertion. The rim may be used for other ratings in sizes D02 and D03.

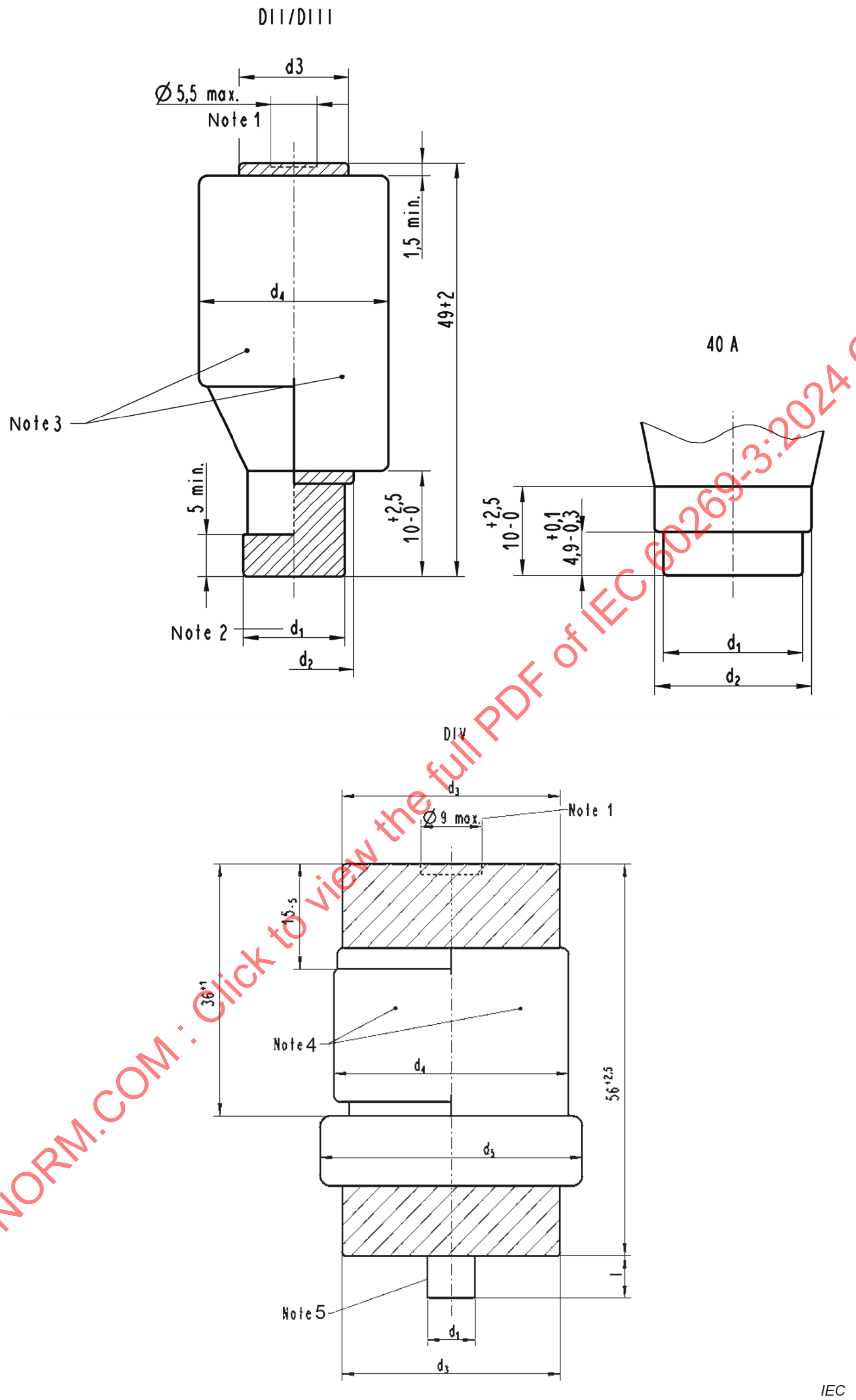
NOTE 5 Hatched areas specify contact areas.

Body of the fuse-link of ceramic material.

NOTE 6 The sketches are not intended to govern the design except as regards the dimensions shown.

Figure 110 – Fuse-link, D-type. Sizes D01-D03

Dimensions in millimetres



The sketches are not intended to govern the design except as regards the dimensions shown.

Hatched areas specify contact areas.

Body of the fuse-link of ceramic material.

	I_n A	d_1 (note 2) mm		d_2 (max.) mm	d_3 mm	d_4 mm	d_5 $^{0}_{-2}$ mm	l ±0,3 mm
DII	2	6	$^{+0,2}_{-0,4}$	14,2	11 min	22,5 $^{0}_{-1,5}$	–	–
	4							
	6							
	10	8						
	13							
	16	10			13 min			
	20	12						
	25	14						
DIII	32	16	$^{+0,2}_{-0,4}$	20,2	15 min	28 $^{0}_{-2}$	–	–
	35	16	$^{+0,2}_{-0,4}$	20,2	15 min	28 $^{0}_{-2}$	–	–
	40	16	±0,2	~~18 ± 0,2~~ 18,2	15 min	28 $^{0}_{-2}$	–	–
	50	18	$^{+0,2}_{-0,4}$	20,2	15 min	28 $^{0}_{-2}$	–	–
	63	20	$^{+0,2}_{-0,4}$	20,2	15 min	28 $^{0}_{-2}$	–	–
DIV	80 (6)	5	±0,2	–	32 $^{0}_{-8}$	34,5 $^{0}_{-2}$	38,5	6
	100	7						

I_n A	Colour of fuse-indicator
2	Pink
4	Brown
6	Green
10	Red
13	Black
16	Grey
20	Blue
25	Yellow
32	Violet
35	Black
40	Green
50	White
63	Copper
80	Silver
100	Red

NOTE 1 Diameter of fuse-indicator.

NOTE 2 The maximum value of d_1 shall not be exceeded within a range of 10 mm for fuse-links DII and DIII measured from the bottom contact.

NOTE 3 Alternative shape.

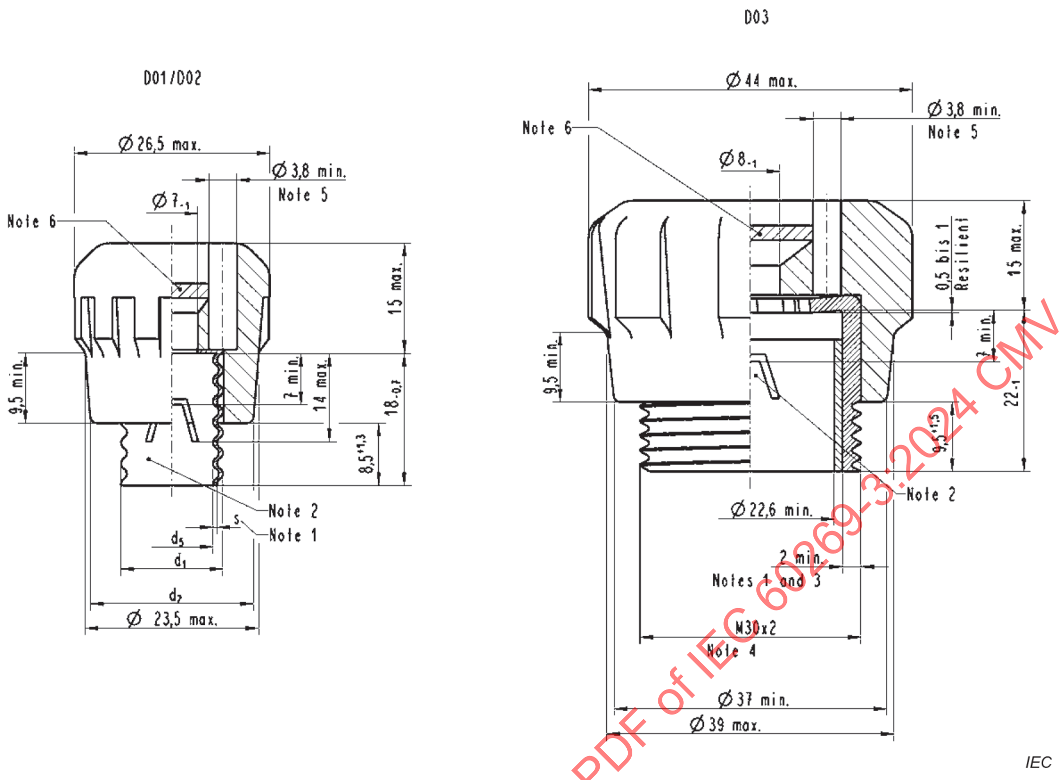
NOTE 4 Optional metal cover.

NOTE 5 The gauge-pin is not mandatory for fuse-links with rated current 80 A.

The use of these colours is mandatory also for sizes D01-D03.

Figure 111 – Fuse-link, D-type. Sizes DII-DIV

Dimensions in millimetres



The sketches are not intended to govern the design except as regards the dimensions shown.

Insulating parts of ceramic or other sufficiently heat-resistant material.

	I_n A	d_1 mm	d_2 **(min.)** mm	d_5 **(max.)** mm	s **(note 1)** **(min.)** mm
D01	16	E14	18	11,1	0,27
D02	63	E18	22	15,4	0,37

NOTE 1 Mean value.

NOTE 2 Retaining clip, other retaining means are allowed.

NOTE 3 Tolerance in the first turn of the thread $^{0}_{-0,25}$.

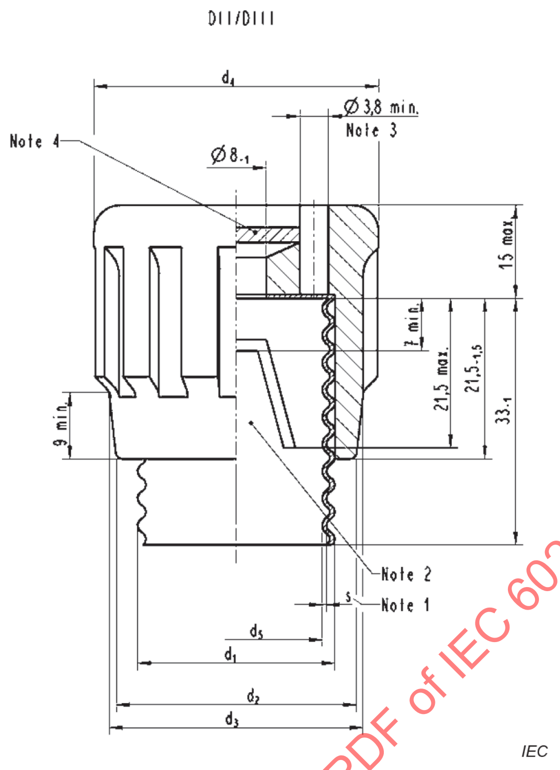
NOTE 4 Thread according to ISO 965-1, class designation 8g.

NOTE 5 The hole for the voltage tester is optional.

NOTE 6 Material: glass or other suitable transparent material.

Figure 112 – Fuse-carrier, D-type. Sizes D01-D03

Dimensions in millimetres



The sketches are not intended to govern the design except as regards the dimensions shown.

Insulating parts of ceramic or other sufficiently heat-resistant material.

	I_n A	d_1 mm	d_2 (min.) mm	d_3 (max.) mm	d_4 (max.) mm	d_5 (min.) mm	s (note 1) (min.) mm
DII	25	E27	32	34	38	22,6	0,27
DIII	63	E33	40	43	48	28,1	0,37

NOTE 1 Mean value.

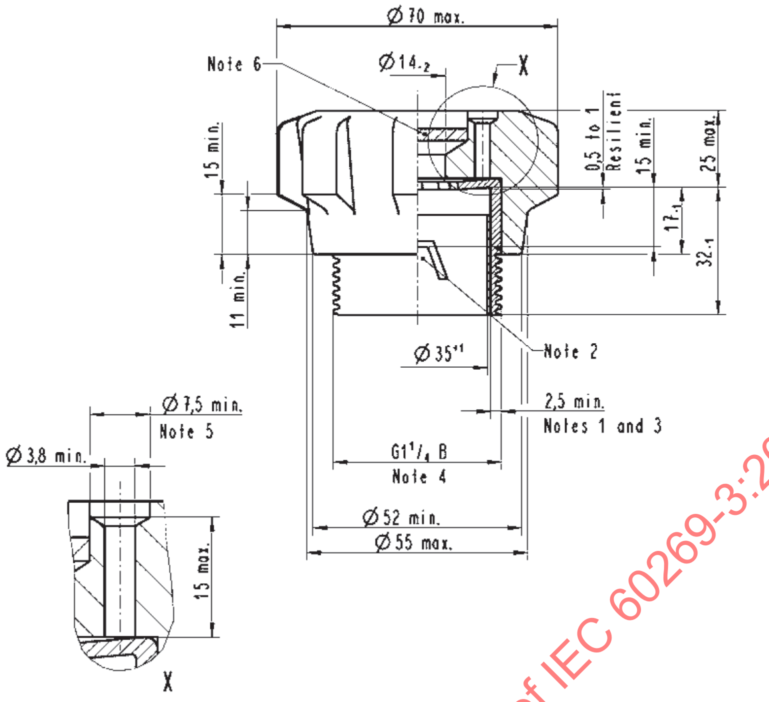
NOTE 2 Retaining clip, other retaining means are allowed.

NOTE 3 The hole for the voltage tester is optional.

NOTE 4 Material glass or other suitable transparent material.

Figure 113 – Fuse-carrier, D-type. Sizes DII-DIII

Dimensions in millimetres



The sketches are not intended to govern the design except as regards the dimensions shown.

NOTE 1 Mean value.

NOTE 2 Retaining clip, other retaining means are allowed.

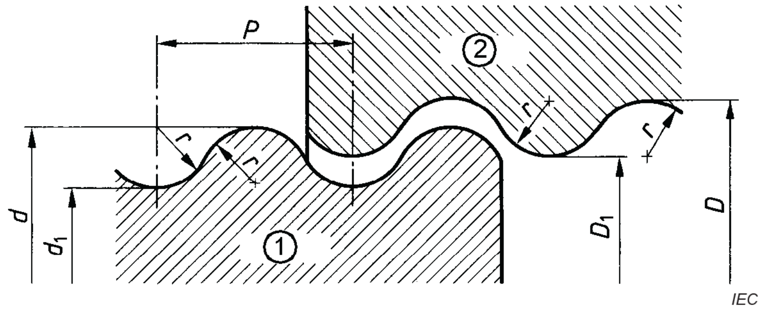
NOTE 3 Tolerance in the first turn of the thread $^{0}_{-0,5}$.

NOTE 4 Thread according to ISO 228-1; limit gauges according to ISO 228-2.

NOTE 5 The hole for the voltage tester is optional.

NOTE 6 Material: glass or other suitable transparent material.

Figure 114 – Fuse-carrier, D-type. Size DIV



Key

1 Bolt

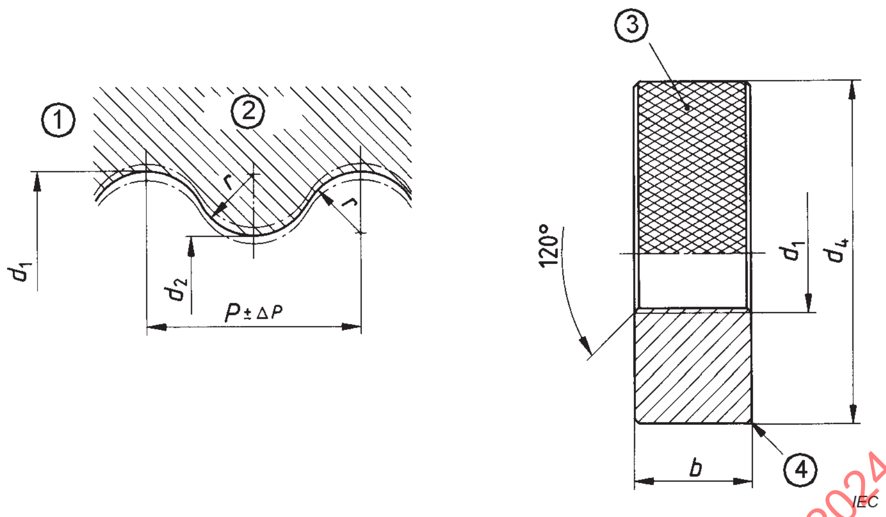
2 Nut

Dimensions in millimetres

Abbreviation	Bolt				Nut			
	External diameter *d*		Core diameter d_1		External diameter *D*		Core diameter D_1	
	Max.	Min.	Max.	Min.	Min.	Max.	Min.	Max.
E 14	13,89	13,7	12,29	12,1	13,97	14,16	12,37	12,56
E 18	18,5	18,25	16,8	16,55	18,6	18,85	16,9	17,15
E 27	26,45	26,15	24,26	23,96	26,55	26,85	24,36	24,66
E 33	33,05	32,65	30,45	30,05	33,15	33,55	30,55	30,95

Abbreviation	Threads per 25,4 mm *z*	Pitch *P*	Rounding *r*
E 14	9	2,822	0,822
E 18	≈ 8,5	3	0,875
E 27	7	3,629	1,025
E 33	6	4,233	1,187

Figure 115 – Edison thread for D-type fuses; limit dimensions



Key

1 Thread profile

2 Gauge

3 (Reference removed)

4 Chamfered or rounded

Material: steel, parts exposed to wear shall be hardened.

Dimensions in millimetres

Ring gauge	b	d_1 [a] mm	d_2 [b] mm	d_4 mm	P	r	Torques M Nm
E 14-D	16	13,89	12,29	38	2,822	0,822	1
E 18-D	20	18,5	16,8	45	3	0,875	1
E 27-D	24	26,45	24,26	63	3,629	1,025	1
E 33-D	32	33,05	30,45	71	4,233	1,187	1,5

[a] Maximum value of the external diameter of the bolt thread according to Figure 115.

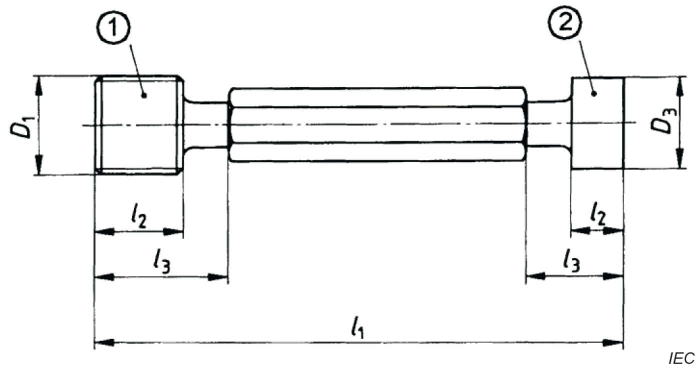
[b] Maximum value of the core diameter of the bolt thread according to Figure 115.

Ring gauge	Manufacturing tolerance for d_1 and d_2	Permissible wear for d_1 and d_2	Tolerance for the pitch T_p [c]
E 14-D	0 –0,025	+0,02 0	±0,01
E 18-D	0 –0,025	+0,02 0	±0,01
E 27-D	0 –0,03	+0,03 0	±0,01
E 33-D	0 –0,03	+0,04 0	±0,01

[c] The tolerance for the pitch is valid for any number of threads within the length of thread of the ring gauge.

It shall be possible to screw the go gauge on the whole length of the thread with the maximum torque M.

Figure 116 – Gauges for Edison thread for D-type fuses for screwed shells of fuse-carrier go ring gauges



Key

1 Thread plug gauge go

2 Thread plug gauge not-go

For details, see the drawing on the next page.

Material: steel, parts exposed to wear shall be hardened.

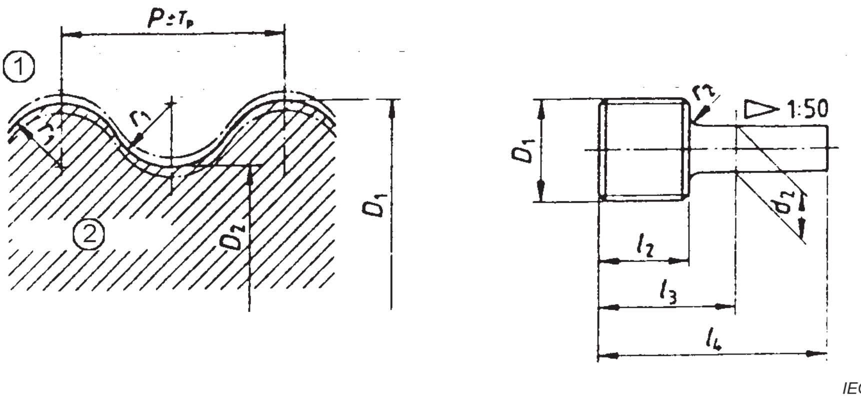
Dimensions in millimetres

Plug gauge	D_1 [a]	D_3 [b]	l_1 [c]	l_2		l_3	
				Thread go gauge $^{0}_{-0,3}$	**Not go gauge** $^{0}_{-0,3}$	**Thread go gauge**	**Not go gauge**
E 14-D-Gd	13,97	12,56 $^{+0}_{-0,025}$	103	16	8	24	16
E 18-D-Gd	18,6	17,15 $^{+0}_{-0,025}$	120	20	10	30	20
E 27-D-Gd	26,55	24,66 $^{+0}_{-0,03}$	142	24	14	36	26
E 33-D-Gd	33,15	30,95 $^{+0}_{-0,03}$	167	32	15	47	30

[a] See the following table.

[b] Maximum value of the core diameter of the nut thread according to Figure 115.

[c] The total length l_1 is an approximate dimension.



Key

1 Thread profile

2 Plug gauge

Dimensions in millimetres

Go plug gauge	D_1 [a]	D_2 [b]	d_2 ±0,01 mm	l_2 $^{0}_{-0,3}$	l_3 min.	l_4	P	r_1	r_2
E 14-D-Gk	13,97	12,37	7	16	24	44	2,822	0,822	2
E 18-D-Gk	18,6	16,9	12	20	30	52	3	0,875	2,5
E 27-D-Gk	26,55	24,36	12	24	36	60	3,629	1,025	2,5
E 33-D-Gk	33,15	30,55	16	32	47	72	4,233	1,187	4

[a] Lower limit of the external diameter of the nut thread according to Figure 115.

[b] Lower limit of the core diameter of the nut thread according to Figure 115.

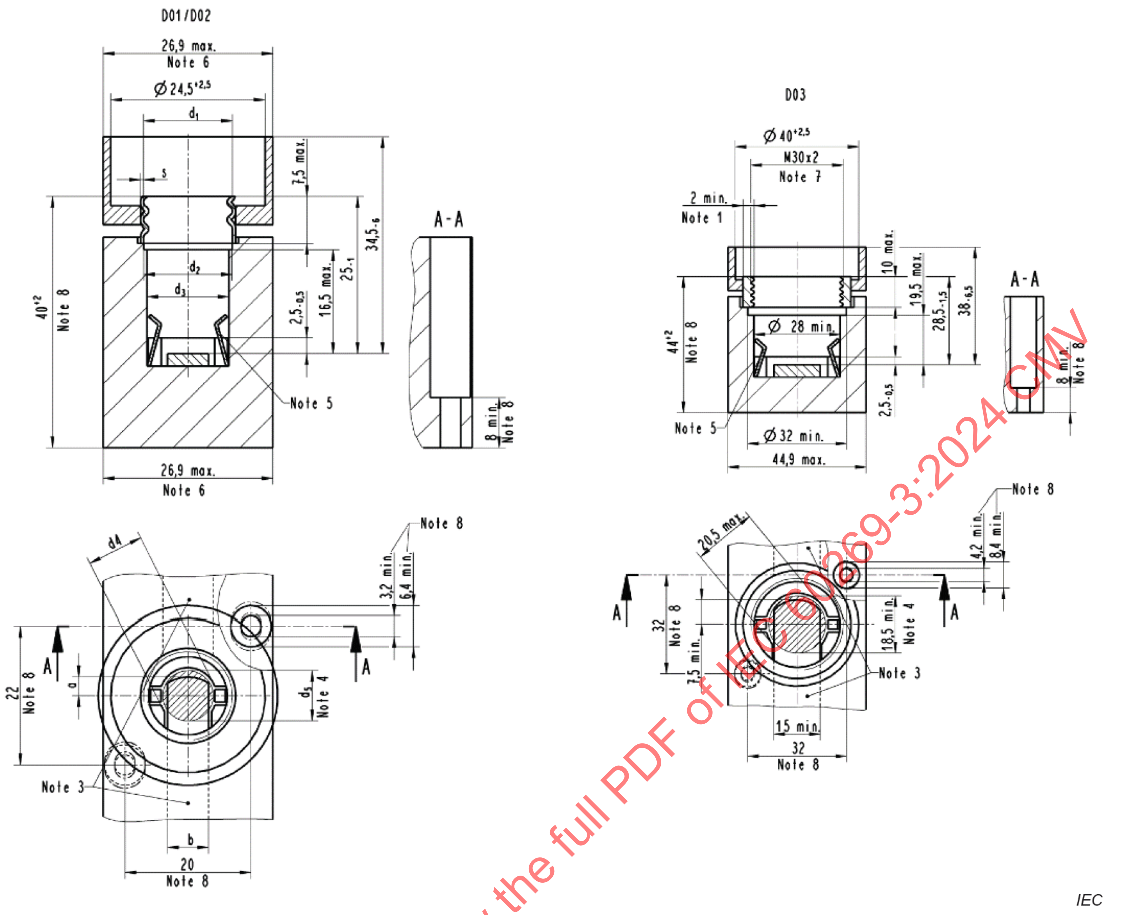
Go plug gauge	Manufacturing tolerance for D_1 and D_2	Permissible wear for D_1 and D_2	Tolerance for the pitch T_p [c]	Torque M Nm
E 14-D-Gk	+0,025 0	0 –0,02	±0,01	1
E 18-D-Gk	+0,025 0	0 –0,02	±0,01	1
E 27-D-Gk	+0,03 0	0 –0,03	±0,01	1
E 33-D-Gk	+0,03 0	0 –0,04	±0,01	1,5

[c] The tolerance for the pitch T_p is valid for any number of the thread being within the length of thread.

It shall be possible to screw the go gauge home at least with the maximum torque M. The not- go gauge shall not engage under its own weight.

Figure 117 – Gauges for Edison thread, D-type fuses, go and not-go plug gauges for screwed shells of fuse-bases

Dimensions in millimetres



	I_n	a (min.)	b (min.)	d_1	d_2 (min.)	d_3 (min.)	d_4	D_6 (min.)	s (min.)		Q (note 3) (min.)
	A	mm	mm	mm	mm	mm	mm	mm	mm	Tolerance (note 1)	mm^2
D01	16	2,5	5	E14	15	13	9,7 max.	6,5	0,3	–0,05	10
D02	63	4	6	E18	19,5	17	13,7 max.	10,5	0,65	–0,15	30
D03	100	See sketch								–0,25	60

NOTE 1 Tolerance in first turn of the thread.

NOTE 2 Preferred value – for fuse-bases for rail-mounting, this value refers to the top edge of the mounting rail.

NOTE 3 Cross-sectional area of the connecting strips at least Q mm^2. The cross-sectional area of the connecting strips may be reduced in the region of their own fixing means and in the region of terminals. The cross-sectional area of the connecting strips is calculated for an alloy containing at least 62 % copper. Connecting strips made of pure copper or other materials with better conductivity than that of the calculated copper alloy may have corresponding lower cross-sectional areas.

NOTE 4 Within the hatched circle area no projection is allowed above the contact area.

NOTE 5 Resilient grip for gauge-piece. A conductive connection between the grip and live parts is not allowed.

NOTE 6 For multiple fuse-bases, the multiple value is relevant.

NOTE 7 Thread according to ISO 965-1, class designation 7H.

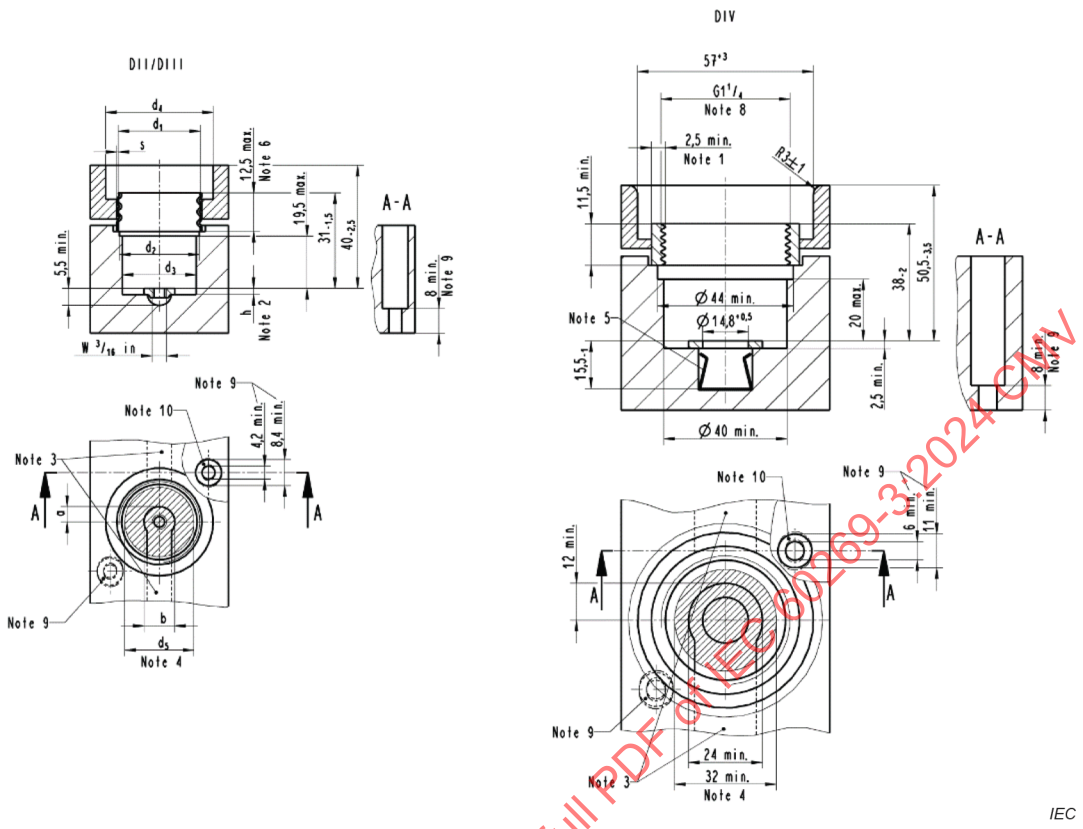
NOTE 8 Not applicable for fuse-bases for busbar mounting.

Insulating parts of ceramic or other sufficiently heat resistant material.

The sketches are not intended to govern the design except as regards the dimensions shown.

Figure 118 – Fuse-base, D-type. Sizes D01-D03

Dimensions in millimetres



The sketches are not intended to govern the design except as regards the dimensions shown.

Insulating parts of ceramic or other sufficiently heat-resistant material.

	I_n	*a* (min.)	*b* (min.)	d_1	d_2 (min.)	d_3 (min.)	d_4 (note 7)	d_5 (min.)	*h* (note 2) (min.)	*s* (min.)		*Q* (note 3) (min.)
	A	mm	mm	mm	mm	mm	mm	mm	mm	mm	Tolerance (note 1)	mm²
DII	25	5	10	E27	27	25,5	$35\ ^{+2}_{0}$	24,5	2	0,5	–0,1	15
DIII	63	6	12	E33	33,5	31,5	$45\ ^{+2,5}_{0}$	30,5	2,5	0,65	–0,15	30
DIV	100	See sketch									–0,5	60

NOTE 1 Tolerance in first turn of the thread.

NOTE 2 Only the thickness of the bottom of the connecting strip, minimum effective length of thread in connecting strip: 2,2 mm (DII) and 3,2 mm (DIII) for W3/16 in.

NOTE 3 Cross-sectional area of the connecting strip at least *Q* mm². The cross-sectional area of the connecting strips may be reduced in the region of their own fixing means and in the region of terminals. The cross-sectional area of the connecting strips is calculated for an alloy, containing at least 62 % copper. Connecting strips, made of pure copper or other materials with improved electrical and thermal conductivity than the calculated copper alloy may have corresponding lower cross-sectional areas.

NOTE 4 Within the hatched circle area no projection is allowed above the contact area.

NOTE 5 Resilient grip for gauge-piece.

NOTE 6 Effective thread length at least 7 mm from the top of the screwed shell.

NOTE 7 When fuse-bases of size DIII are used in assemblies (for example, consumer units) the tolerance of the diameter d_4 of the corresponding protection covers may be reduced to $45\ ^{0}_{-1,5}$.

NOTE 8 Thread according to ISO 228-1; limit gauges according to ISO 228-2.

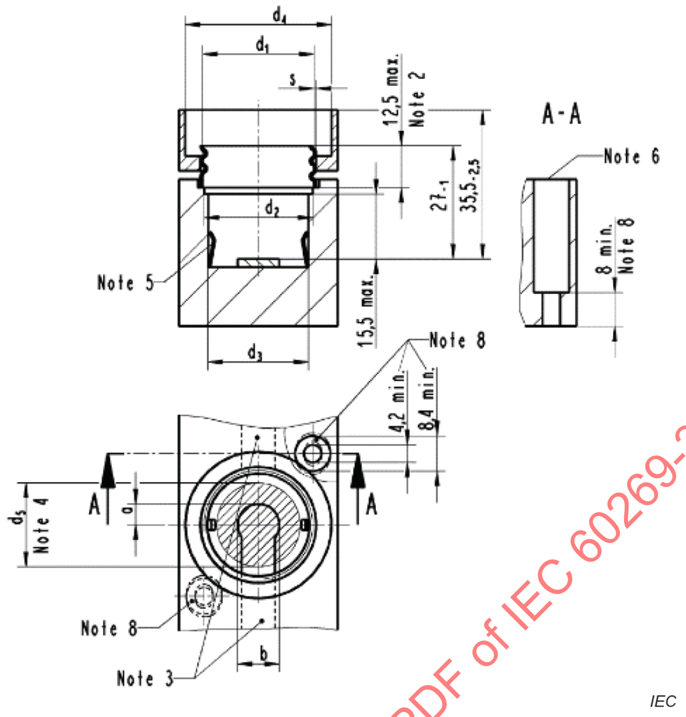
NOTE 9 Not applicable for fuse-bases for busbar mounting.

NOTE 10 Alternatively closed or open, oval holes permitted.

Figure 119 – Fuse-base, D-type. Sizes DII-DIV

The sketches are not intended to govern design except as regards the dimensions shown.

Dimensions in millimetres



Dimensions in millimetres

	I_n	a (min.)	b (min.)	d_1	d_2 (min.)	d_3 (min.)	d_4 (note 7)	d_5 (min.)	s (min.)		Q (note 3) (min.)
	A	mm	mm	mm	mm	mm	mm	mm	mm	Tolerance (note 1)	mm²
DII	25	5	10	E27	27	25,5	$35\ ^{+2}_{0}$	24,5	0,5	–0,1	15
DIII	63	6	12	E33	33,5	31,5	$45\ ^{+2,5}_{0}$ (7)	30,5	0,65	–0,15	30

Insulating parts of ceramic or other sufficiently heat-resistant material.

Current-carrying parts of copper or copper alloy.

NOTE 1 Tolerance in first turn of the thread: $^{0}_{-0,1}$ (E27)

$^{0}_{-0,15}$ (E33).

NOTE 2 Effective thread length at least 7 mm from the top of the screwed shell.

NOTE 3 Cross-sectional area of the connecting strips: at least Q mm². The cross-sectional area of the connecting strips may be reduced in the region of their own fixing means and in the region of terminals. The cross-sectional area of the connecting strips is calculated for an alloy, containing at least 62 % copper. Connecting strips, made of pure copper or other material with improved electrical and thermal conductivity than the calculated copper alloy may have corresponding lower cross-sectional areas.

NOTE 4 Within the hatched circle area, no projection is allowed above the contact area.

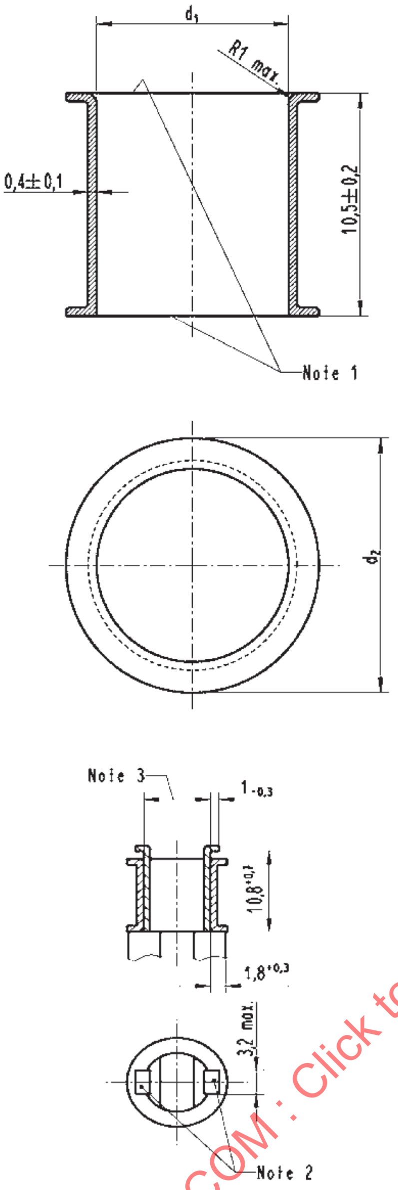
NOTE 5 Resilient grip for gauge-piece.

NOTE 6 Alternatively closed or open, oval holes permitted.

NOTE 7 When fuse-bases size DIII are used in assemblies (for example, consumer units), the tolerance of the diameter d_4 of corresponding protection covers may be reduced to $45\ ^{0}_{-1,5}$ mm.

NOTE 8 Not applicable for fuse-bases for busbar mounting.

Figure 120 – Fuse-base, D-type for push-in gauge pieces. Size DII-DIII



IEC

	I_n A	d_1 ±0,1	d_2 ±0,1
D01	2	7,9	12
	4	7,9	
	6	7,9	
	10	9,1	
	13	9,1	
	16	(note 4)	(note 4)
D02	20	11,5	16,6
	25	12,7	
	32	13,9	
	40	15,1	
	35	13,9	
	50	15,1	
	63	(note 4)	(note 4)
D03	80	23	27
	100	(note 4)	(note 4)

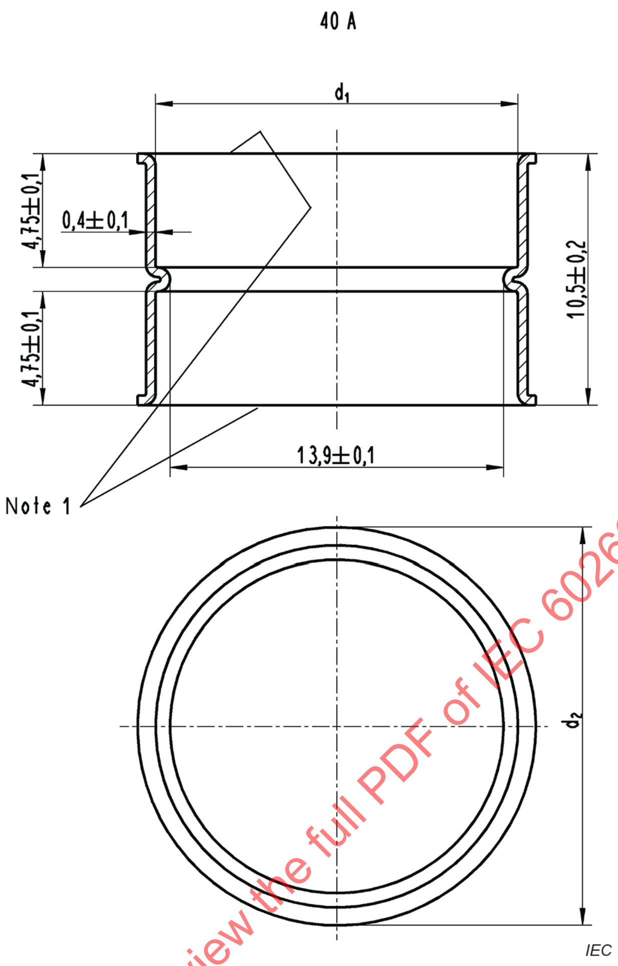
NOTE 1 Coloured according to Figure 111 (table).

NOTE 2 Grip of the working head.

NOTE 3 Resilient between 5 mm and 24 mm.

NOTE 4 Gauge-pieces do not apply to the maximum rating.

Dimensions in millimetres



Gauge-piece 40A

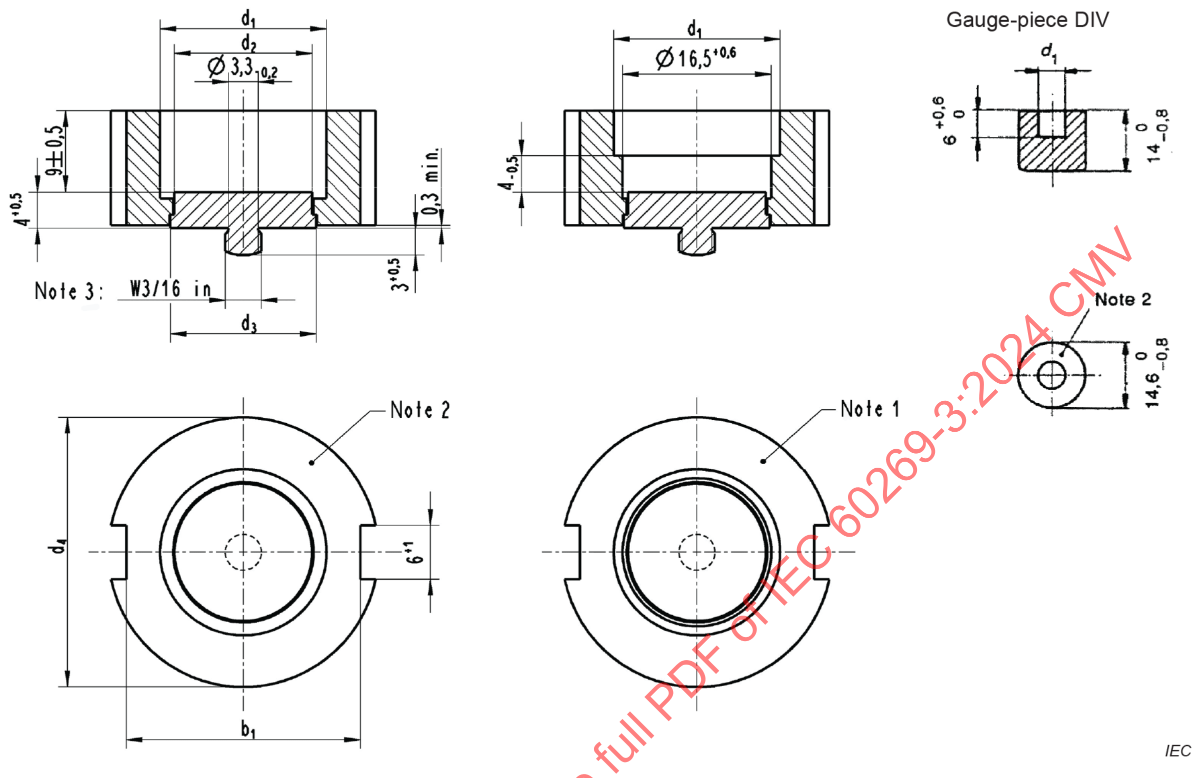
The sketches are not intended to govern design except as regards the dimensions shown.

Figure 121 – Gauge-piece and hand-key, D-type. Sizes D01-D03

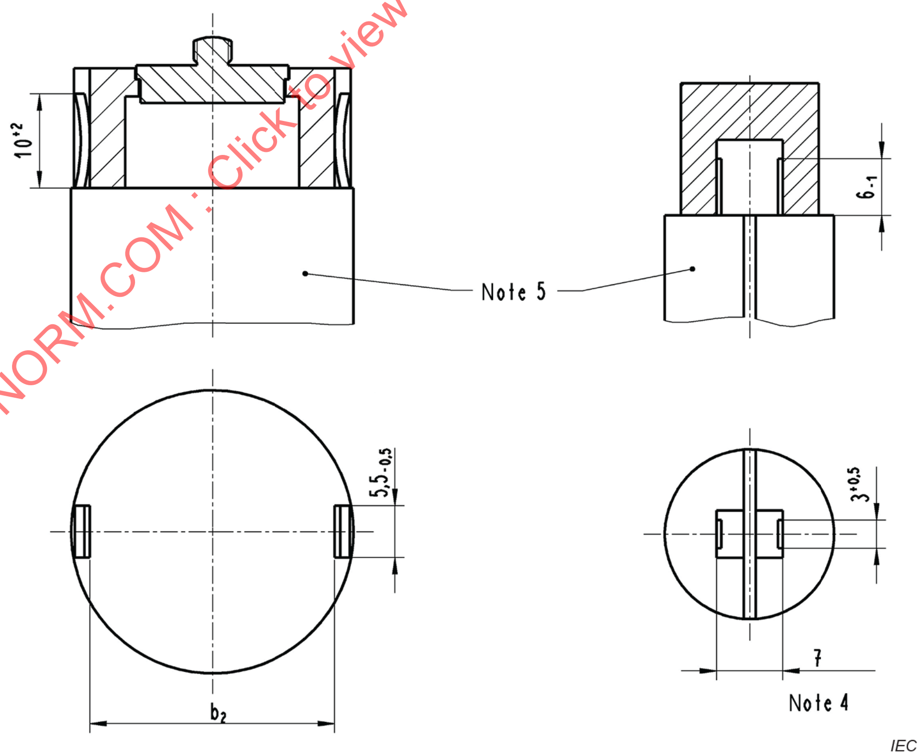
Dimensions in millimetres

Screw-in gauge piece

40A



Insulating part of ceramic material



The sketches are not intended to govern design except as regards the dimensions shown.

	I_n A	d_1 mm		d_2 (min.) mm	d_3 (min.) mm	d_4 $^{0}_{-1,5}$ mm	b_1 (min.) $^{0}_{-1,5}$ mm	b_2 (max.) mm
	2	6,5						
	4	6,5		4,5	6,5	24	20	19 (note 6)
	6	6,5						
	10	8,5						
DII	13	8,5	$^{+0,8}_{0}$	6,5				
	16	10,5		8,5	8,5			
	20	12,5		9,5	9,5			
	25	14,5						
	32	16,5	$^{+0,8}_{0}$	15	15	30	26	25 (note 7)
	35	16,5						
DIII	40	18,5	$^{+0,6}_{0}$	15	15	30	26	25 (note 7)
	50	18,5	$^{+0,8}_{0}$	15	15	30	26	25 (note 7)
	63	20,5	$^{+0,8}_{0}$	15	15	30	26	25 (note 7)
DIV	80	6	±0,5	–	–	–	–	–
	100	8		–	–	–	–	–

NOTE 2 Coloured according to Figure 111 (table).

NOTE 3 Effective thread length at least 2,5 mm.

NOTE 4 Resilient between 5 mm and 9 mm.

NOTE 5 Insulating material.

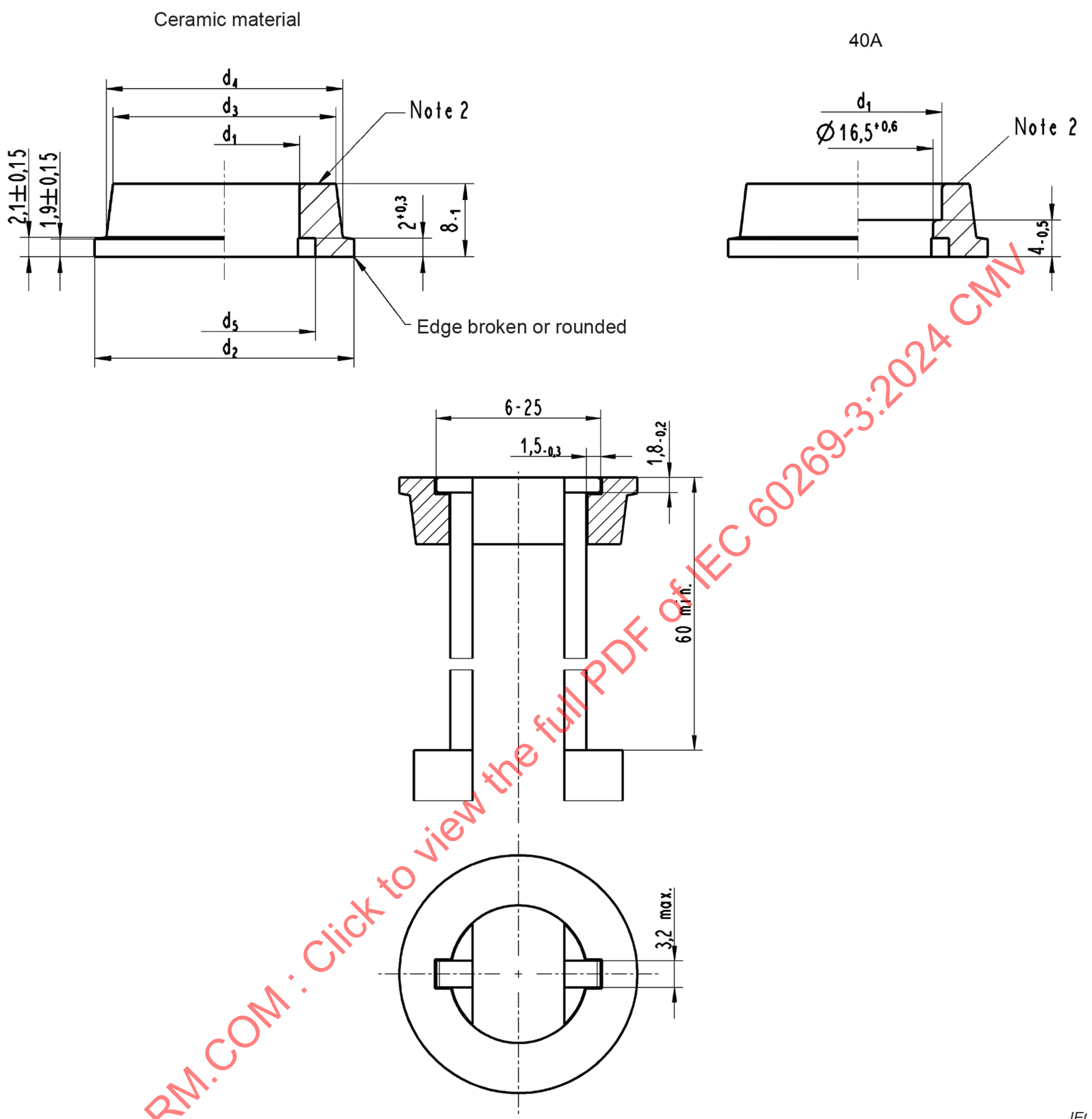
NOTE 6 Resilient between 18 mm and 20,5 mm.

NOTE 7 Resilient between 24 mm and 26,5 mm.

Figure 122 – Gauge-piece and hand-key, D-type. Sizes DII-DIV

Gauge-piece DII/DIII

Dimensions in millimetres



The sketches are not intended to govern design except as regards the dimensions shown

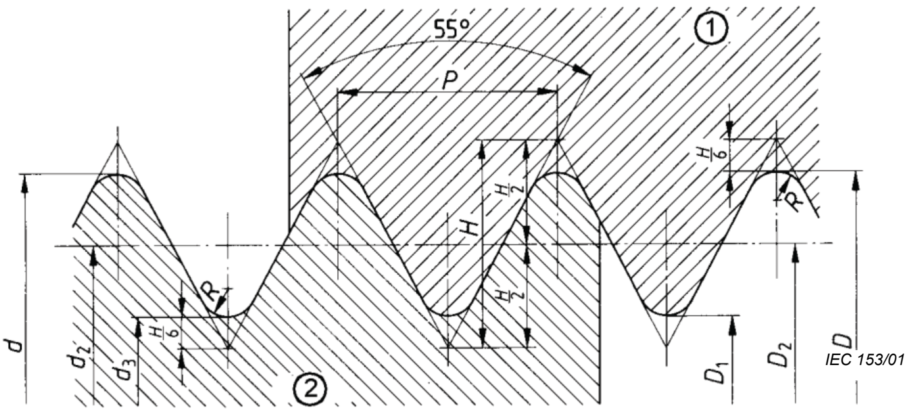
	I_n A	d_1 +0,8 mm	d_2 ±0,5 mm	d_3 ±0,5 mm	d_4 ±0,5 mm	d_5 (min.) mm	**Colour of the front surface**
	2						Pink
	4	6,5				10	Brown
	6						Green
DII	10	8,5	22,5	18,5	20,5	12	Red
	16	10,5				14	Grey
	20	12,5				15,5	Blue
	25	(see Note 3)					
	2						Pink
	4	6,5				10	Brown
	6						Green
	10	8,5				12	Red
	16	10,5				14	Grey
	20	12,5	28,5	24,5	26,5	16	Blue
DIII	25	14,5				18	Yellow
	32	16,5				20	Violet
	35	16,5				20	Black
	40			See Figure			Green
	50	18,5				21,5	White
	63	(see Note 3)					

NOTE 2 Coloured surface.

NOTE 3 Gauge-pieces do not apply to the maximum ratings.

Figure 123 – Gauge-piece and hand-key, D-type push-in gauge rings. Size DII-DIII

Dimensions in millimetres



$P = \frac{25{,}4}{z}$

$R = 0{,}13733\ P$

$H = 0{,}96049\ P$

IEC

Key

1 Nut

2 Bolt

Nominal sizes

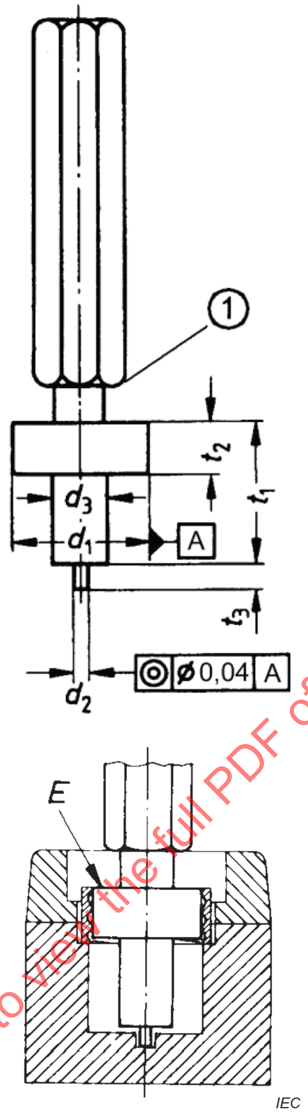
Abbreviation	**Full thread** $d = D$	**Threads per 25,4 mm** z	**Pitch** P	**Thread-pitch diameter** $d_2 = D_2$	**Core diameter** $d_3 = D_1$	**Core cross-section** mm^2
$W^3/_{16}$	4,762	24	1,058	4,084	3,406	9,1

Thread limits

Abbreviation	**Bolt thread**						**Nut thread**				
	External diameter		**Thread-pitch diameter**		**Core diameter**		**External diameter**	**Thread-pitch diameter**		**Core diameter**	
	d		d_2		d_3		D	D_2		D_1	
	mm		mm		mm						
	Max.	Min.	Max.	Min.	Max.	Min.	Min.	Max.	Min.	Max.	Min.
$W^3/_{16}$	4,732	4,593	4,054	3,965	3,376	3,183	4,762	4,216	4,084	3,744	3,406

Figure 124 – Whitworth thread W 3/16 for screw-in gauge rings and corresponding fuse-bases of sizes DII and DIII

Dimensions in millimetres



Key

1 Slightly rounded edge

Size	d_1		d_2		d_3	t_1		t_2		t_3		Gauge
	Max.	Min.	Max.	Min.		Max.	Min.	Max.	Min.	Max.	Min.	
DII	24,3	24,2	3	2,9	12	31	30,5	11,5	11	5	4,5	C 17 A
DIII	30,5	30,4	3	2,9	12	31	30,5	11,5	11	5	4,5	C 17 B
DIV	38,9	38,8	14,4	14,3	24	38	37,5	17	16,5	14	13,5	C 17 C
D01	12,3	12,2	6,2	6,1	10	22	21,75	7	6,5	3	2,75	C 17 E
D02	16,85	16,75	10,2	10,1	14	22	21,75	7	6,5	3	2,75	C 17 F
D03	27,7	27,6	18,2	18,1	22	25,5	25,25	9,5	9	3	2,75	C 17 G

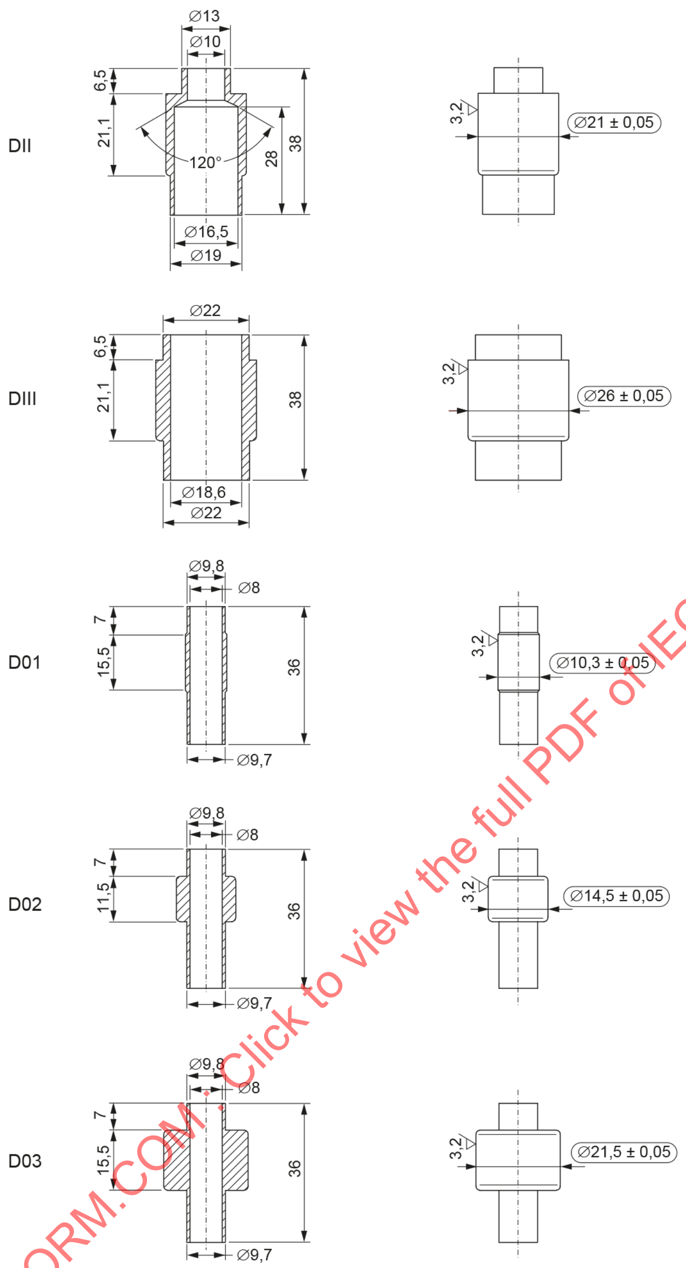
The gauges are intended for checking that the hole for the gauge-piece in the bottom contact (sizes DII to DIV) or that the hollow space (sizes D01 to D03) is concentric with the thread of the screwed shell.

It shall be possible to introduce the gauge without undue force into the fuse-base so that the surface E is approximately level with the upper edge of the screwed shell.

Material: steel.

Figure 125 – Gauges C 17 for concentricity of fuse-bases

Dimensions in millimetres
Undimensioned radiuses R0,6



Size	Weight
DII	33 g ± 2 g
DIII	57 g ± 2 g
D01	8 g ± 1 g
D02	15 g ± 1 g
D03	42 g ± 2 g

IEC

Material: hardened steel

Surface quality in the cylindrical area Ra = 3,2µm

NOTE The dimension "21,1" has ben corrected in DII.

Figure 126 – Test dummies DII, DIII, D01, D02 and D03 for fuse-carrier test

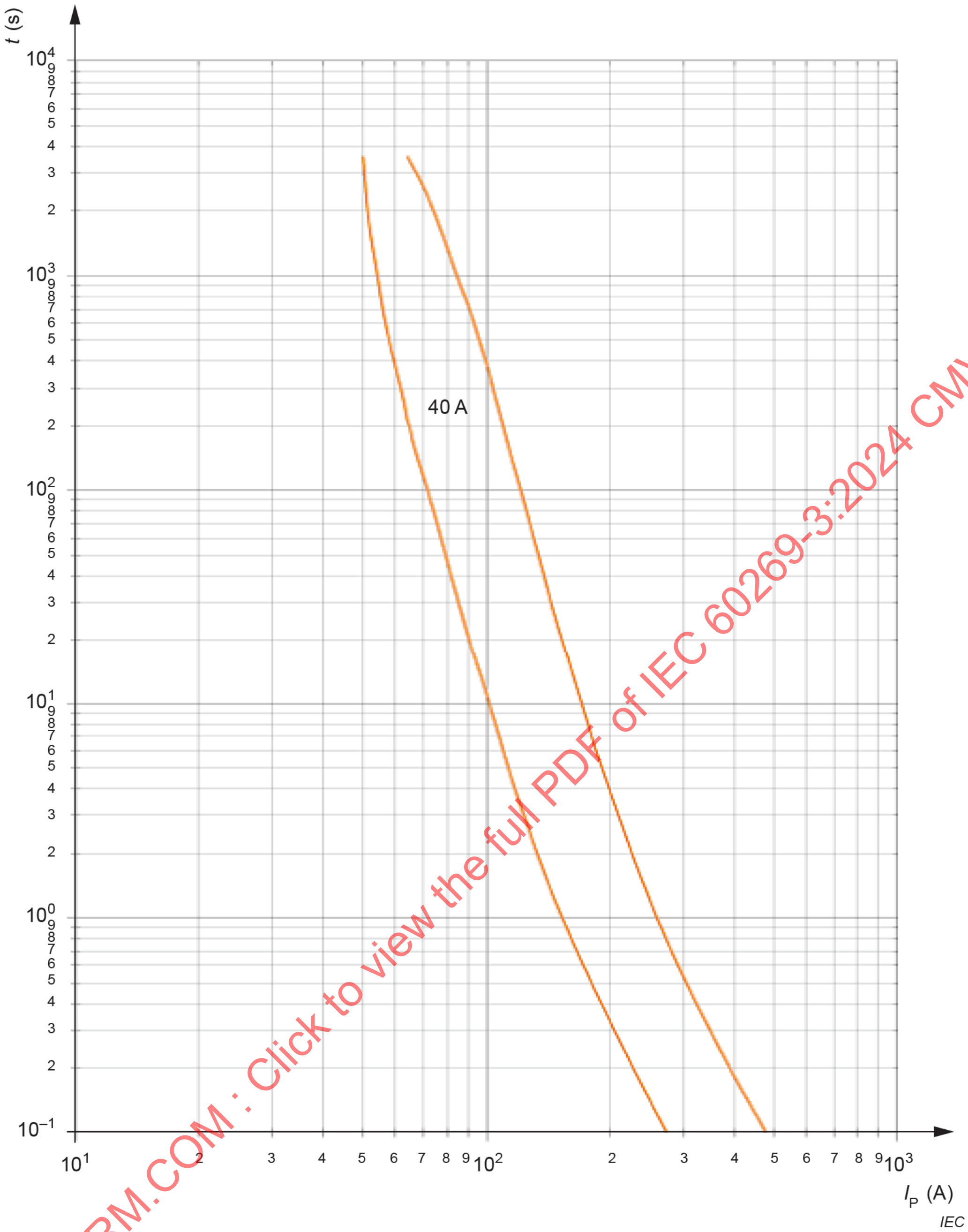


Figure 127 – Time-current zone for "gG" fuse-links 40 A

Annex AA
(informative)

Special test for cable overload protection[2] (for fuse system A)

Fuses with I_n > 10 A shall be tested as follows.

AA.1 Arrangement of the fuse

One fuse comprising fuse-base, fuse-carrier, gauge-piece, cover and the relevant fuse-link is submitted to the test.

The test arrangement is that specified in 8.3.1 of IEC 60269-1:2006. The test shall be carried out at an ambient air temperature of 30^{+5}_{0} °C.

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

AA.2 Test method and acceptability of test results

A test current equal to 1,13 I_n flows through the fuse during the conventional time as given in Table 2 of IEC 60269-1:2024. The fuse-link shall not operate. The test current is then raised without interruption within 5 s to I_t = 1,45 I_n. The fuse-link shall operate within the conventional time.

2 See note to 8.4.3.5.

Fuse system B –
Cylindrical fuses
(NF cylindrical 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 having fuse-links, satisfying the dimensional requirements given in Figure 201 of this fuse system. Their rated current does not exceed 63 A and their rated voltages are 230 V or 400 V AC.

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 with the following supplementary requirements.

Definitions concerning terminals are given in IEC 60999-1.

For the purpose of this fuse system, the following terms and definitions apply.

2.1.201
screw-type terminal
terminal for the connection and subsequent disconnection of a conductor or the interconnection of the two or more conductors capable of being dismantled, the connection being made, directly or indirectly, by means of screws or nuts of any kind

2.1.202
pillar terminal
terminal with screw-clamping in which the conductor is inserted into a hole or cavity, where it is clamped under the shank of the screw(s)

Note 1 to entry: The clamping pressure may be applied direct by the shank of the screw or through an intermediate clamping member to which pressure is applied by the shank of the screw.

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 shall be 230 V or 400 V AC.

5.3.1 Rated current of the fuse-link

The maximum rated currents of fuse-links are given in the table of Figure 201.

5.3.2 Rated current of the fuse-holder

The rated currents of the fuse-holders are the same as the maximum values of the fuse-links (see 5.3.1 of this fuse system).

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 of the fuse-links and the rated acceptable power dissipation of the fuse-holders are given in Table 201.

Table 201 – Maximum values of rated power dissipation and values of rated acceptable power dissipation

Dimensions mm	Rated current I_n A	Rated voltage U_n V	Power dissipation / acceptable power dissipation W
6,3 × 23	6	230	1,0
8,5 × 23	10	230	1,3
10,3 × 25,8	16	230	2,3
8,5 × 31,5	20	400	2,6
10,3 × 31,5	25	400	3,2
10 × 38	32	400	3,2
16,7 × 35	63	400	6,8

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 202.

Table 202 – Conventional times and currents for "gG" fuse-links

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
$16 \leq I_n \leq 63$	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 203 apply.

Table 203 – Gates for specified pre-arcing times of "gG" fuse-links with rated currents 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
6	11,0	28,0	26,0	72,0
10	22,0	46,5	47,0	110,0

5.7.2 Rated breaking capacity

The minimum breaking capacities are specified in Table 204.

Table 204 – Minimum rated breaking capacities

Rated voltage V	Minimum rated breaking capacity kA
230	6
400	20

6 Markings

IEC 60269-1 applies.

If the fuse-bases are not capable of bidirectional current flow, they shall be marked with the current flow direction at front or lateral side.

For this, preferentially, the symbol 5107A in accordance with IEC 60417 should be used. The arrows may be covered in the installed state of the fuse-base. 19

In the case of fuse-bases for busbar mounting, the marking with the current flow direction is not required.

7 Standard conditions for construction

IEC 60269-1 applies with the following supplementary requirements.

7.1 Mechanical design

The dimensions of the cartridge shall be in accordance with Figure 201.

7.1.2 Connections including terminals

See IEC 60269-1 and IEC 60999-1.

Within the framework of this document, only those terminals intended for receiving external copper conductors are included.

The base shall be fitted with terminals designed to receive copper conductors of cross-sectional area and current rating as in the following table.

Table 205 – Nominal section of copper conductors that the terminals shall accept

Rated current of fuse-base A	Flexible conductors (note 1) mm^2	Rigid conductors of solid core or cables (note 2) mm^2
6	0,5 to 1	0,75 to 1,5
10	0,75 to 1,5	1 to 2,5
16	1 to 2,5	1,5 to 4
20	1,5 to 4	1,5 to 4
25	1,5 to 4	2,5 to 6
32	2,5 to 6 (NOTE 1)	4 to 10
63	6 to 16	10 to 25

NOTE 1 Attention is drawn to the fact that, for certain applications, more space is necessary.

NOTE 2 It is admitted that for conductors sizes 1 mm^2 to 6 mm^2, the terminals are intended only for clamping rigid solid conductors.

Verification is to be carried out by measurement and by the insertion of conductors of the smallest and largest section successively.

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.

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.

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.

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.

7.2 Insulating properties and suitability for isolation

As described in 7.2 of IEC 60269-1:2024 and pending the application of the requirements of the IEC 60664 series, the clearances and creepage distances given in Table 206 shall be respected.

The verification of this prescription is made by measurements. The measurements are performed on a sample without conductors, or on a sample fitted with conductors of the maximum cross-sectional area specified in Table 205.

The requirements stated above do not apply to metal covers and enclosures, if these are isolated with an internal insulating sheet.

If an enclosure of insulating material is covered internally by a metal sheet, this is in any case considered as an accessible metal part.

The thickness of the filling material exceeding a groove is not to be taken into account for evaluation of creepage distance.

The verification of this condition is made by examination.

Table 206 – Creepage distances and clearances

		Minimum creepage distances and clearances	mm
1		Between live parts of the same polarity separated during breaking operation:	3
2		Between live parts of different polarities:	3
3		Between live parts and:	
	a)	metallic accessible parts not listed in 5, decorative parts and metallic covers, parts of mechanism, if these are isolated from live parts,	
	b)	screws of fixing means for surface mounting base of devices	3
	c)	screws or fixing means for the base of devices in flush-mounting housings,	
	d)	screws of covers or cover sheets,	
	e)	conduits entering the apparatus:	
4		Between metallic parts of the mechanism and the accessible metallic parts, including frame-works used as support to flush-mounting device bases if an insulation is required:	3
5		Between live parts other than terminals for one part, and for the other part, metallic enclosures, or cases as well as the supporting surface of the bases:	4
6		Between terminals and the metallic enclosures or cases, as well as the supporting surface of the bases:	6
		Shortest distance	mm
7		Between live parts covered by minimum 2 mm of sealing compound and the supporting surface of the bases:	3
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 is ignored in computing the total clearance.			

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

Instead of Table 5 of IEC 60269-1:2024, Table 207 applies.

Table 207 – 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 of IEC 60269-1:2024, 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 60269-1:2024, the pre-arcing I^2t values given in Table 208 apply.

Table 208 – 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
6	24,00	225,00
10	100,00	576,00

7.7.2 Operating I^2t values

The maximum pre-arcing I^2t values given above are considered as the maximum operating I^2t values. For fuse-links with rated currents greater than 16 A, the maximum pre-arcing I^2t values of Table 7 of IEC 60269-1:2024 are considered as the maximum operating I^2t values.

7.8 Overcurrent discrimination of "gG" fuse-links

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

7.9 Protection against electric shock

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

As specified in 7.9 of IEC 60269-1:2024, the following details are given with regard to this subclause:

a) the fuses shall be so designed that no contact can be made between different poles with fuse-carriers and fuse-links;

b) it shall be possible to replace easily a fuse-link without touching the live parts;

c) the live parts of devices protected against direct contact shall not be accessible when the fuse-base is installed and connected with conductors as in normal use, either fitted with its fuse-link or not, the fuse-carrier being in place;

NOTE In case of a fuse unprotected against direct contact and intended to be incorporated in appliances, this requirement does not apply to parts for which the protection should be provided by screens or by construction in the appliance itself.

d) when the fuse-carrier is withdrawn, the accessibility to the live parts shall be possible only after a deliberate action.

These requirements are verified by the test according to 8.8 of this fuse system.

8 Tests

IEC 60269-1 applies with the following supplementary requirements.

8.1.5.1 Complete tests

The following additional test is required according to Table 209.

Table 209 – Survey of tests on fuse-link

Test according to subclause	Number of test samples			
	1	1	1	1
8.7.4 Verification of overcurrent discrimination	x	x	x	x

8.1.6 Testing of fuse-holders

The following additional test is required according to Table 210.

Table 210 – Survey of tests on fuse-holder and number of fuse-holders to be tested

Test according to subclause	Number of test samples
	1
8.12 Verification of the reliability of terminals	x

8.2.2.3.1 This test shall be performed immediately after the humidity treatment described in 8.2.2.3.2 of IEC 60269-1:2024.

The fuse-holder shall be submitted to the test voltage given in Table 15 of IEC 60269-1:2024.

8.3.1 Arrangement of the fuse

The screws of the screw terminals shall be tightened with a torque of two-thirds the torque given in Table 211.

Table 211 – Screw-thread diameters and applied torques

Nominal diameter of thread				Torque		
mm				Nm		
				I	II	III
		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
Over	4,1	up to and including	4,7	0,8	1,8	1,8
Over	4,7	up to and including	5,3	0,8	2,0	2,0
Over	5,3	up to and including	6,0	1,2	2,5	3,0
Over	6,0	up to and including	8,0	2,5	3,5	6,0
Over	8,0	up to and including	10,0	–	4,0	10,0
Over	10,0	up to and including	12,0		(Under consideration)	
Over	12,0	up to and including	15,0		(Under consideration)	

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 other screws, which are tightened by means of a screwdriver.

Column III applies to screws and nuts, which are tightened by means other than a screwdriver.

8.3.3 Measurement of the power dissipation of the fuse-link

The fuse-links are tested in open air, in a vertical position in one of the test rigs according to Figure 203 and Figure 204, according to the indications given in Table 212.

The sliding pin shall be well guided.

The ferrules and other parts of the fuse-base shall be made from brass with 58 % to 70 % copper, except springs, screws for connections, and the test piece used as specified in the following subclauses for measuring the contact resistance. Furthermore, the ferrules shall be silver-plated.

After each test, it is necessary to verify the good condition of the contact surface.

Table 212 – Values concerning the choice and the adjustment of the test base

Cartridge Rated current A	No. of the base (see Figure 203)	No. of the ferrule (see Figure 203)	Distance *b* mm	Contact force N
6	1	1	48	6 to 8
10	1	2	48	6 to 8
16	2	3	56	14 to 17
20	2	3	62	14 to 17
25	2	3	62	14 to 17
32	2	3	68	18 to 22
63	3	4	80	38 to 42

8.3.4.1 Temperature rise of the fuse-holder

The dummy fuse-link shall have the maximum power dissipation given in Table 201 and the dimensions in accordance with Figure 202.

8.4 Verification of operation

8.4.1 Arrangement of the fuse

The fuse-links are tested in one of the test-rigs according to Figure 203, chosen from the indications given in Table 212. The cartridge is placed under a housing in polyacryl resin according to Figure 205. Before each test, it is necessary to verify the good condition of the ferrule surface.

8.4.3.6 Operation of indicating devices and strikers, if any

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

If the tests are performed at reduced voltages, the test circuit voltage shall be 100 V ± 5 V.

8.5 Verification of the breaking capacity

8.5.1 Arrangement of the fuse

The fuse-links are tested in a test-base according to Figure 206 adjusted according to indications given in Table 213. The contact ferrules are of silver-plated brass.

Before beginning the test, it is necessary to verify the good condition of the ferrule surfaces.

Table 213 – Values for adjustment of the test base

Cartridge rated current A	No. of the ferrule	Distance *b* mm	Contact force N
6	5	70	8 to 10
10	5	70	8 to 10
16	6	73	14 to 16
20	5	79	14 to 16
25	6	79	14 to 16
32	6	85	22 to 24
63	7	85	38 to 42

8.5.5 Test method

8.5.5.1 In order to verify that the fuse satisfies the conditions of 7.5 of IEC 60269-1:2024, tests in accordance with Table 20 of IEC 60269-1:2024 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

Subclause 8.5.8 of IEC 60269-1:2024 applies, under the following restrictions. The following is permissible:

– malfunction of the indicating device;

– any crack of the cartridge which does not prevent its withdrawal without a tool;

– small blisters, localized bumps on the ferrules also small holes, provided that these are not sufficient to damage the fuse-base or the fuse-carrier.

8.7.4 Verification of overcurrent discrimination

To verify the requirements specified in 7.7.1 and 7.7.2 of this fuse system, four supplementary samples are tested, two to verify the minimum pre-arcing I^2t values and the other two to verify the total I^2t values.

The samples are arranged as for the breaking capacity test according to 8.5 of IEC 60269-1:2024.

The test voltage to verify the operating I^2t values shall be

$$\frac{1{,}1 \times 400\ \text{V}}{\sqrt{3}}$$

for 400 V fuses and 1,1 × 230 V for 230 V fuses.

8.8 Verification of the degree of protection of enclosures

8.8.1 Verification of protection against electric shock

To verify the requirements given in 7.9, the procedure is as follows:

– requirement b) is verified by examination;

– requirement c) is verified by means of the test finger shown in Figure 9 of IEC 60898-1:2002;

– requirement d) is verified by means of the test finger shown in Figure 9 of IEC 60898-1:2002.

In the case of the protecting screen or of parts intended to be knocked out, the test finger is applied with a 20 N force.

NOTE It is recommended to use a lamp to detect the contact, the supply voltage being at least 40 V. 20

8.9 Verification of resistance to heat

The following two tests are performed.

a) Test in a heating cabinet

This test is performed with the specimen being kept in a heating cabinet at a temperature of 100 °C ± 5 °C for 1 h.

At the end of this test, significant deteriorations shall not be observed, and live parts protected with sealing compound shall not become exposed.

NOTE Slight displacement of the sealing compound is permitted.

a) Ball pressure test

External parts of insulating material other than ceramic are, furthermore, submitted to a ball pressure test by means of the apparatus shown in Figure 16 of IEC 60898-1:2002.

A steel ball of 5 mm diameter is pressed with a force of 20 N against one part of the external surface placed horizontally. The test is performed in a heating cabinet at a temperature of 125 °C ± 5 °C. After 1 h in the heating cabinet, the pressure is released, the ball is removed and after 5 min, the diameter of the impression is measured, which shall not exceed 2 mm.

Following these tests, the fuse-carrier is (without fuse-link) withdrawn and inserted by hand 50 times.

After this operation, it is verified that the force to withdraw the cover from the fuse-base, exerted in a direction perpendicular to the mounting plane of the fuse-base, is higher than 1,5 N.

The force is exerted without jerks by means of a mass of 150 g. The cover shall not be separated from the fuse-base.

8.10 Verification of non-deterioration of contacts

8.10.1 Arrangement of the fuse

A dummy fuse-link with its maximum power dissipation and its dimensions is given in 8.3.4.1 of this fuse system and Figure 202. A typical fuse-base with its spring-loaded contact pieces is given in Figure 204.

Torques to be applied to the screws of the terminals are specified in 8.3.1 of this fuse system.

In addition, 7.3 of this fuse system and 8.3.1 of IEC 60269-1:2024 apply.

8.10.2 Test method

The load period is 75 % of the conventional time.

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

The test current is the non-fusing current.

The conventional time, as well as the non-fusing current, is stated in Table 2 of IEC 60269-1:2024.

A lower test voltage may be used.

8.10.3 Acceptability of test results

After 250 cycles, the measured temperature rise values of terminals shall not exceed the temperature rise measured at the beginning of the test (first cycle) by more than 15 K.

After 750 cycles, if necessary, the temperature rise values of terminals shall not exceed the values measured at the beginning of the tests (first cycle) by more than 20 K.

8.11.1.1 Mechanical strength of the fuse-holder

To verify that a fuse has satisfied the requirements of 7.11 of IEC 60269-1:2024 it is submitted to the following tests.

8.11.1.1.1 Verification of resistance to shock

The verification is made by means of the apparatus described in 8.11.1.1.1.1 of this fuse system. The test conditions are given in 8.11.1.1.1.2 of this fuse system.

8.11.1.1.1.1 Test apparatus

The test apparatus, according to Figure 10 of IEC 60898-1:2002, consists of an arm swinging round an axis and fitted at its lower part with a hammer.

The arm is made with a steel tube of 9 mm external diameter and 8 mm internal diameter and includes

– on its higher part, a device fitted with a swinging axis, the distance of which to the frame of the apparatus is adjustable, so that the pendulum can move only in a vertical plane perpendicular to the supporting side of the frame;
– on its lower part, a device designed to hold one of the hammers described below.

The length of the tube is such that the distance between the swinging axis of the pendulum and the hammer axis mounted on the pendulum arm is equal to 1 m.

The hammer has, as applicable, such a mass as, fixed on the tube by means of the device shown in Figure 11 of IEC 60898-1:2002, the vertical force to apply in the axis of the hammer to maintain the pendulum arm horizontal, is:

– 2 N in case of type a, hammer so-called "of 150 g" shown in Figure 11 of IEC 60898-1:2002.

According to dimensions, the apparatus is fixed on one support shown in Figure 12 of IEC 60898-1:2002.

The support is so arranged that it is possible

– to place the apparatus so that the target is in the vertical plane passing by the pendulum swinging axis;
– to turn the apparatus round one vertical axis;
– to displace the apparatus horizontally, in parallel to the pendulum swinging axis.

8.11.1.1.1.2 Test procedure

The enclosure is fixed on the support as in normal use; the conductor apertures are left open and the cover screws are tightened with a torque equal to two-thirds of that given in Table 211.

Enclosures intended for flush mounting are placed in the recessed portion of a block of plywood so that the edge of the enclosure box, if any, is flush with the surface of the block.

The enclosure box is tested separately and maintained against the support, its front side being directed towards the hammer.

By acting on the position of the support and that of the swinging axis of the pendulum, the enclosure is placed in such a way that the target is in the vertical plane passing by the pendulum axis and the hammer is allowed to fall down from the prescribed height, measured vertically between the target on the enclosure and the strike point of the hammer at its free fall point.

NOTE The blows are not applied to the knock-out holes.

The hammer to be used and the height of fall according to the enclosure classification with regard to the resistance to shocks are indicated in Table 214.

Table 214 – Hammer and height of fall for test for verification of resistance to shocks

Type of apparatus	Type of hammer	Height of fall
		cm
Ordinary enclosure	a	15

The apparatus is subjected to 10 blows, evenly distributed over the enclosure and if any, over the cover sheet.

The first series of five blows is applied as follows:

– in the case of flush-fitting enclosures, one blow on the centre, one blow on each end of the cover sheet and the two remaining at about half-distance;
– in the case of other types, one blow on the centre, one blow on each lateral side and the two remaining blows on intermediary positions, the enclosure being turned after each blow, with the appropriate angle but not more than 60°, around a vertical axis.

The second series of five blows is then applied in the same way but after having turned the enclosure to 90° around its perpendicular axis to the support.

If there are cable entries, the two lines of targets on the specimens are chosen to be at the mid-way of the cable entries.

After the test, the enclosure shall show no damage that could decrease its protective function. It shall neither show any cracks nor deformations that could impair the operating characteristics, or alter the guaranteed qualities of the specimens.

Small cracks, which do not alter the protection against direct contact, may be neglected.

Fracture of the external cover sheet is permissible provided that this sheet is double and the second one satisfies the test, the live parts not being exposed.

8.11.1.1.2 Verification of the constructional requirements

The fuse-carriers shall comprise a device intended to maintain the fuse-link in place during the withdrawal of the fuse-carrier.

The efficiency of this device is verified by using a fuse-base corresponding to the fuse-carrier under test.

The fuse-carrier is equipped with a gauge-piece, the dimensions of which are in accordance with those given in Figure 207 for the rated current of the fuse considered, and fitted together with the fuse-base as in normal use.

The fuse-carrier is then withdrawn from the fuse-base and, where an elastic device (for example, a spring clip) is used to hold the fuse-link, the fuse-carrier is kept in its most unfavourable position during about 10 s.

The test-piece shall not fall out from the fuse-carrier under the effect of its own weight.

In the case of the screw-type fuse-carrier, the threaded sleeve shall be fixed securely and shall not present a rough surface on the live surface of contact.

The verification of these conditions is made by examination and by the following test.

The fuse-carrier of a fuse-link having the maximum dimensions is screwed in fully and unscrewed 50 times consecutively as in normal use, by exerting during each screwing stroke a torque as indicated in Table 215.

Table 215 – Torque to be applied to the fuse-carrier

Rated current of the fuse-base A	Torque Nm
6	0,6
10	0,6
16	1,0
20	1,0
25	1,0
32	1,0
63	1,7

8.11.1.4 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 10 times in the case of non-metallic thread by means of a suitable test spanner or screwdriver, applying a torque as indicated in Table 216.

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 216 – Mechanical strength of screw-thread

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

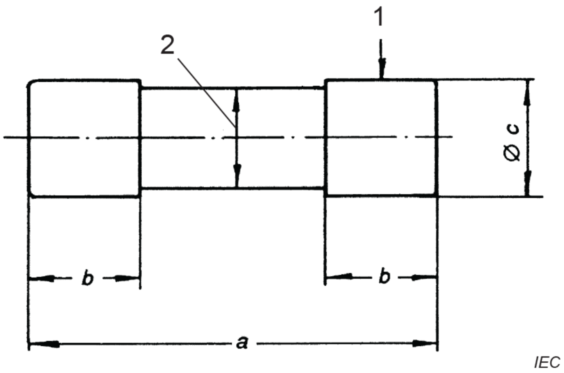
During the test, no change impairing the further use of the screwed connection shall occur.

8.11.2.6 Dimensions and non-interchangeability

Compliance with 8.1.4 of IEC 60269-1:2024 and 7.1.8. of this fuse system shall be verified by measuring and comparing the dimensions of fuse-links with the related dimensions of the other parts of the fuse.

8.12 Verification of the reliability of terminals

Follow the tests described in IEC 60999-1:1990, Clause 8.



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

2) The diameter of the cartridge between the end caps shall not exceed diameter c.

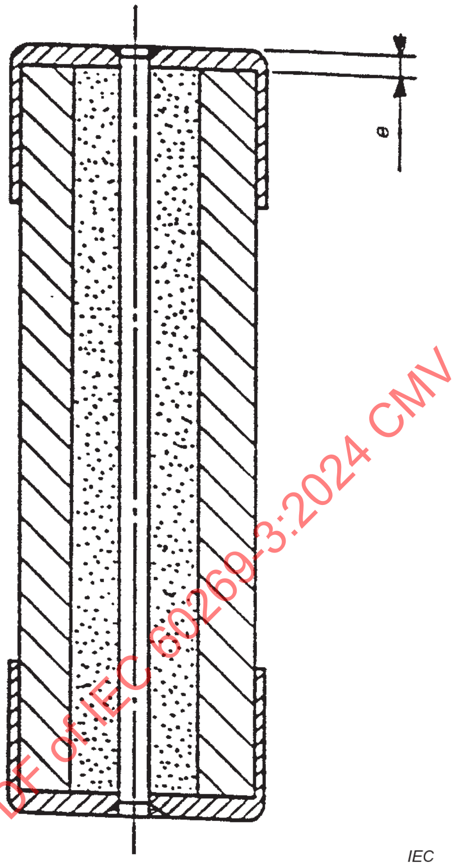
Dimensions in millimetres

230 V/400 V					
Dimensions	$I_{n\ max}$ A	U_n V	a	b	c
6,3 × 23	6	230	$23{,}0\ ^{0}_{-0{,}8}$	$5{,}0\ ^{+0{,}2}_{-0{,}6}$	6,3 ± 0,1
8,5 × 23	10	230	$23{,}0\ ^{0}_{-0{,}8}$	$5{,}0\ ^{+0{,}2}_{-0{,}6}$	8,5 ± 0,1
10,3 × 25,8	16	230	25,8 ± 0,4	6,3 ± 0,4	10,3 ± 0,1
8,5 × 31,5	20	400	31,5 ± 0,5	6,3 ± 0,4	8,5 ± 0,1
10,3 × 31,5	25	400	31,5 ± 0,5	6,3 ± 0,4	10,3 ± 0,1
10 × 38	32	400	$38^{+0{,}9}_{-0{,}6}$	$10{,}0\ ^{+0{,}5}_{-0{,}3}$	10,3 ± 0,1
16,7 × 35	63	400	$35{,}0\ ^{+0{,}8}_{-0{,}1}$	9,5 ± 0,5	16,7 ± 0,1

The sketch is not intended to govern the design except as regards the dimensions shown.

Figure 201 – Fuse-link

Dimension *e*	
6 A	0,5 mm
10 A	1 mm
16 A	1,5 mm
20 A	1,5 mm
25 A	1,5 mm
32 A	2 mm
63 A	2 mm



The end caps are of nickel-plated and silver-plated copper.

The body is of ceramic material.

The fuse-element is of CuNi 56/44 alloy or of an equivalent material with similar values of specific resistance and temperature coefficient and is connected to the end caps by welding or brazing.

The filling and arc extinction material is identical to that commonly used in fuse-links.

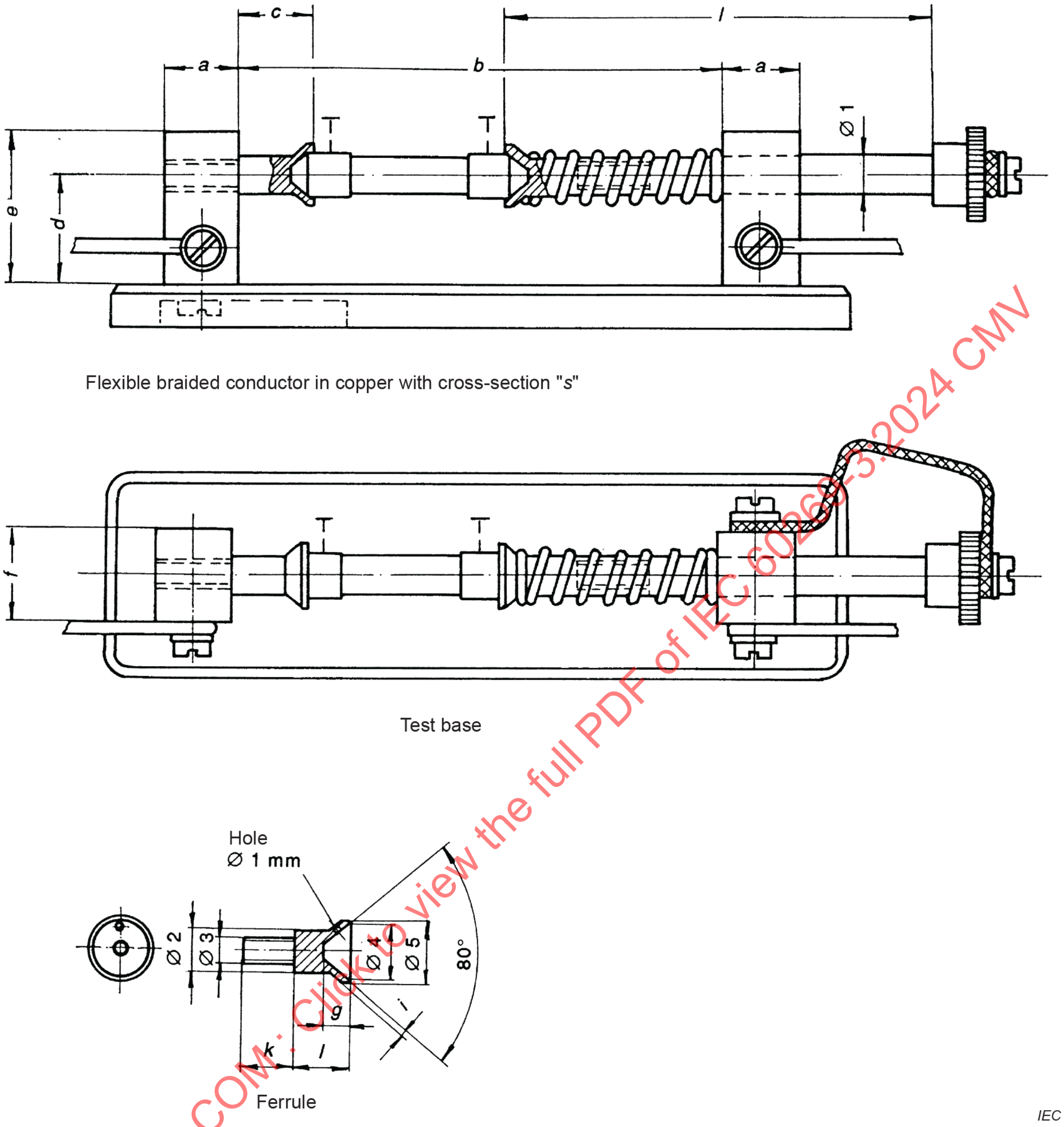
The other dimensions are indicated in Figure 201.

The values of power dissipation are indicated in Table 201 with a tolerance of $^{+5}_{0}$ %.

The sketch is not intended to govern the design except as regards the dimensions shown.

Figure 202 – Dummy fuse-link

Dimensions in millimetres



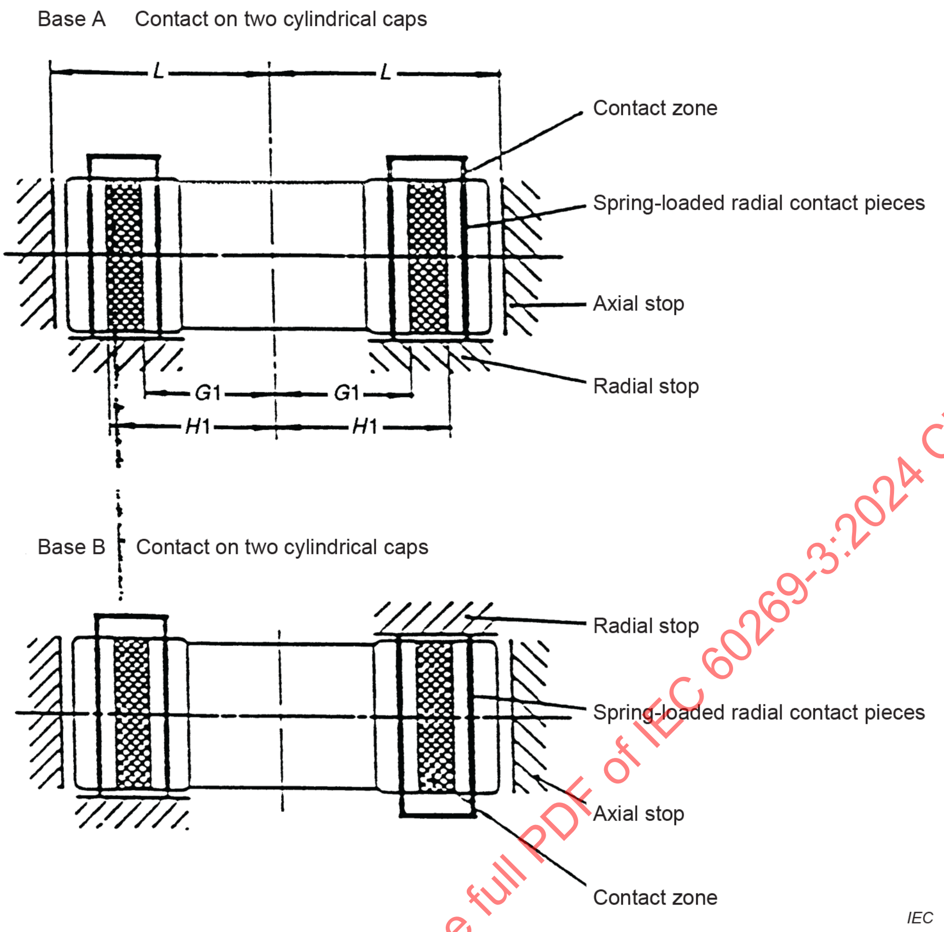
NOTE The measurement of the voltage drop should be made on the points T indicated in Figure 203.

No. of test base	*a*	*b**	*c*	*d*	*e*	*f*	*l*	Ø1	*s*
				mm					mm²
1	8		10	12	17,5	8	50	5	4,6
2	12		10	17,5	24	15	65	6	13
3	20		10	30	40	20	75	12	30

* This dimension is given in Table 212.

No. of the ferrule	Ø2	Ø3	Ø4	Ø5	*g*	*i*	*l*	*k*
1	5	4	9	10	4	1	10	8
2	5	4	13	14	5	1	10	8
3	10	4	15	17	6	1,5	10	8
4	12	8	21,5	24	7	2	10	18

Figure 203 – Test-rig and ferrules for the measurement of the voltage drop and the verification of operating characteristics of the cartridge



Dimensions in millimetres

Size	I_n A	G1 max.	H1 min.	L
6,3 × 23	6	8	9,5	$11,5^{+0,8}_{0}$
8,5 × 23	10	8	10	$11,5^{+0,8}_{0}$
10,3 × 25,8	16	8,5	10,5	$13,10^{+0,8}_{0}$
8,5 × 31,5	20	11,5	14	$16^{+0,8}_{0}$
10,3 × 31,5	25	11,5	14	$16^{+0,8}_{0}$
10,3 × 38	32	12,5	15	$19,30^{+0,8}_{0}$

Figure 204 – Fuse-base, A-type and B-type

Dimensions in millimetres

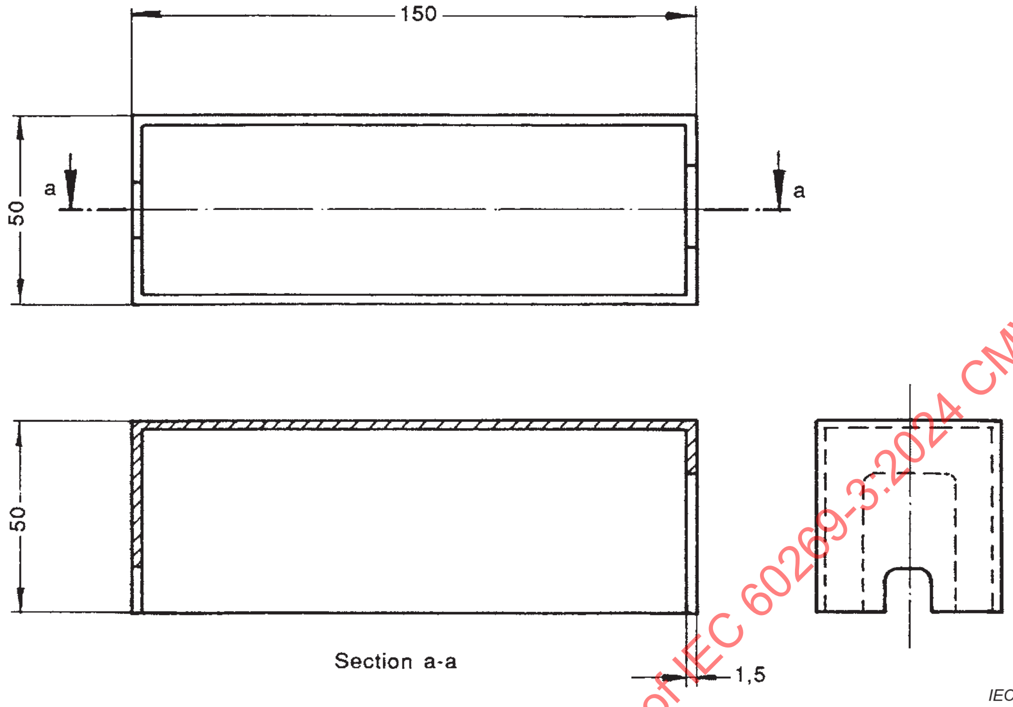
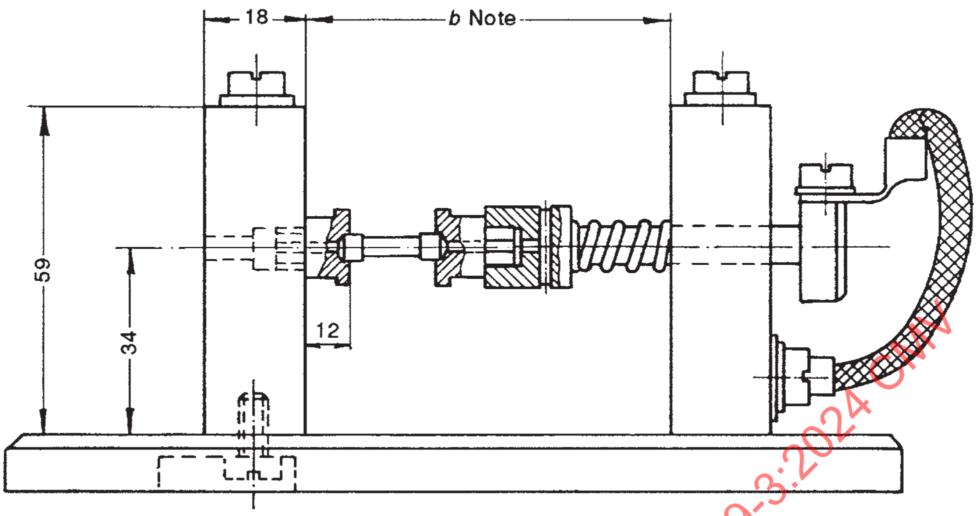
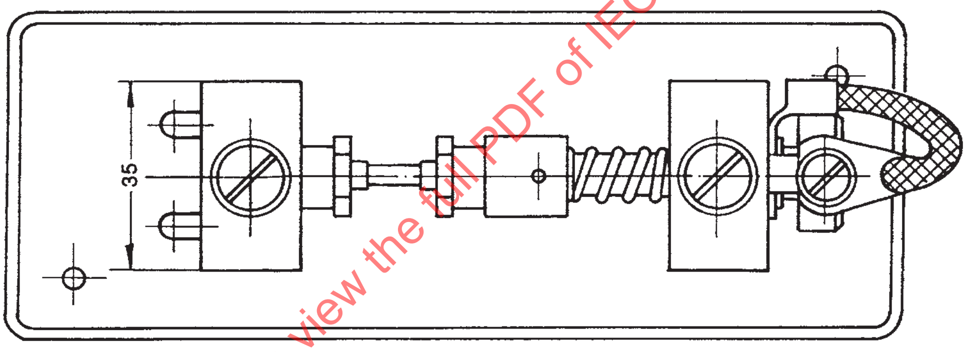


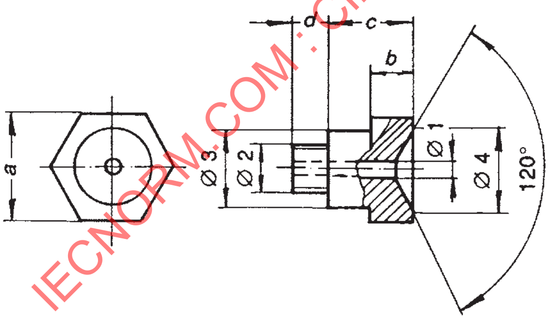
Figure 205 – Housing for verification of operation of the fuse-links with a test rig according to Figure 203

Dimensions in millimetres



NOTE This dimension is given in Table 213.



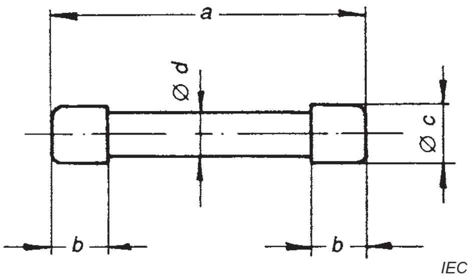


IEC

Dimensions in millimetres

No. of the ferrule	Ø 1	Ø 2	Ø 3	Ø 4	*a*	*b*	*c*	*d*
5	2,5	8	12	10	14	5	12	5
6	2,5	8	12	12	17	6	12	5
7	2,5	8	12	18,5	24	8	12	5

Figure 206 – Test rig and ferrules for verification of breaking capacity



Material: solid steel parts exposed to wear shall be hardened.

Dimensions mm	Rated current A	Rated voltage V	*a* mm	*b* mm	*c* mm	*d* mm
6,3 × 23	6	230	$22{,}2\,^{0}_{-0{,}1}$	$4{,}4\,^{+0{,}1}_{0}$	$6{,}2\,^{0}_{-0{,}02}$	$5{,}2\,^{0}_{-0{,}05}$
8,5 × 23	10	230	$22{,}2\,^{0}_{-0{,}1}$	$4{,}4\,^{+0{,}1}_{0}$	$8{,}4\,^{0}_{-0{,}02}$	$7{,}4\,^{0}_{-0{,}05}$
10,3 × 25,8	16	230	$25{,}4\,^{0}_{-0{,}1}$	$5{,}9\,^{+0{,}1}_{0}$	$10{,}2\,^{0}_{-0{,}02}$	$9{,}2\,^{0}_{-0{,}05}$
8,5 × 31,5	20	400	$31{,}0\,^{0}_{-0{,}1}$	$5{,}9\,^{+0{,}1}_{0}$	$8{,}4\,^{0}_{-0{,}02}$	$7{,}4\,^{0}_{-0{,}05}$
10,3 × 31,5	25	400	$31{,}0\,^{0}_{-0{,}1}$	$5{,}9\,^{+0{,}1}_{0}$	$10{,}2\,^{0}_{-0{,}02}$	$9{,}2\,^{0}_{-0{,}05}$
10 × 38	32	400	$37{,}4\,^{0}_{-0{,}1}$	$9{,}7\,^{+0{,}1}_{0}$	$10{,}2\,^{0}_{-0{,}02}$	$9{,}2\,^{0}_{-0{,}05}$
16,7 × 35	63	400	$34{,}9\,^{0}_{-0{,}1}$	$9{,}1\,^{+0{,}1}_{0}$	$16{,}6\,^{0}_{-0{,}02}$	$15{,}6\,^{0}_{-0{,}05}$

Figure 207 – Gauge for verification of the upholding of the cartridge in the fuse-carrier during withdrawal

Fuse system C –
Cylindrical fuses
(BS cylindrical 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 in domestic or similar applications having cylindrical fuse-links:

Type I: rated currents up to and equal 45 A AC and a rated voltage of 230 V AC.

Type II: rated currents up to and equal 100 A AC and a rated voltage of 400 V AC.

NOTE 1 These fuses are intended for use on systems employing the future standardised voltage of 230/400 V AC 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 AC and therefore these fuses will continue to be supplied and tested as 240 V AC or 415 V AC rating until such time as all supplies have evolved to the recommended values of 230 V and 400 V.

NOTE 2 For type II fuse-links, in most cases a part of the associated equipment for power supplies to buildings serves the purpose of a fuse-carrier and fuse-base.

Owing to the great variety of equipment no general rules can be given; the suitability of such equipment to serve as a fuse-carrier and fuse-base ~~should be subject to agreement between the manufacturer and user~~ must be stated in the manufacturer's instructions. However if separate fuse-carriers and fuse-bases are used they ~~should~~ must comply with the appropriate requirements of IEC 60269-1 as stated in the manufacturer's instructions. **21**

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

The values of standardised rated voltages given in Table 1 of IEC 60269-1:2024 applicable to this document are:

Type I fuse-links – 230 V AC

Type II fuse-links – 400 V AC

(See NOTE 1 of 1.1)

5.3 Rated current

5.3.1 Rated current of the fuse-link

The maximum rated currents are shown in Figure 301.

5.3.2 Rated current of the fuse-holder

The rated currents of typical fuse-holders are shown in Figure 302 and Figure 303.

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

The maximum power dissipation of the fuse-links is given in Figure 301.

The acceptable power dissipation of the fuse-holders is given in Figure 302 and Figure 303.

5.6 Limits of time-current characteristics

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

In addition to the limits of the pre-arcing time given by the gates and the conventional time and currents, the time-current zones, excluding manufacturing tolerances, are given in Figure 304 and Figure 305. The tolerances on individual 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 301.

Table 301 – Conventional time and current for "gG" fuse-links

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

5.7 Breaking range and breaking capacity

5.7.2 Rated breaking capacity

The rated breaking capacity shall be a minimum of 16 kA for Type I fuse-links and a minimum of 31,5 kA for Type II fuse-links.

6 Markings

IEC 60269-1 applies with the addition of colour coding for designated current ratings of Type I fuse-links given in Figure 301. For all other Type I current ratings the markings shall be in black.

If the fuse-bases are not capable of bidirectional current flow, they shall be marked with the current flow direction at front or lateral side.

For this, preferentially, the symbol 5107A in accordance with IEC 60417 should be used. The arrows may be covered in the installed state of the fuse-base. **22**

In the case of fuse-bases for busbar mounting, the marking with the current flow direction is not required.

7 Standard conditions for construction

IEC 60269-1 applies with the following supplementary requirements.

7.1 Mechanical design

7.1.2 Connections including terminals

Reference is made to IEC 60999-1:1990, Clause 7.

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.

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

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.

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 position 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.

7.2 Insulating properties and suitability for isolation

Under consideration

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

Instead of Table 5 of IEC 60269-1:2024, Table 302 applies.

Table 302 – 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 60269-1:2024, for the corresponding rated current of the fuse-base shall not exceed	65K

7.7 I^2t characteristics

The I^2t values given in IEC 60269-1 apply with the exception that the pre-arcing I^2t_{max} value of 86,0 × 10^3 for I_n = 100 A shall be deleted and replaced by 68,0 × 10^3.

7.9 Protection against electric shock

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.

8.1 General

8.1.4 Arrangement of the fuse

The dimensions of the fuse-links are given in Figure 301 and typical fuse-holders in Figure 302 and Figure 303.

8.3 Verification of temperature rise and power dissipation

8.3.1 Arrangement of the fuse

The test arrangement for the fuse-links is given in Figure 306. The test arrangement shall be mounted vertically.

8.3.3 Measurement of the power dissipation of the fuse-link

The fuse-link shall be tested in the test rig shown in Figure 306.

8.4 Verification of operation

8.4.1 Arrangement of fuse

The test arrangement for the fuse-link is specified in 8.3.1 of this fuse system.

8.5 Verification of breaking capacity

8.5.1 Arrangement of the fuse

The test arrangement of the fuse-link is given in Figure 307.

8.5.2 Characteristics of the test circuit

IEC 60269-1 applies with the exception that the power factor for test No. 1 and test No.2 shall be 0,25 to 0,35.

8.5.5 Test method

8.5.5.1 In order to verify that the fuse satisfies the conditions of 7.5 of IEC 60269-1:2024, tests in accordance with Table 20 of IEC 60269-1:2024 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

The requirements of IEC 60269-1 apply, and, in addition, fuse-links shall operate without the melting of the fine wire fuse which indicates arcing to the metal enclosure and without mechanical damage to the test rig.

8.10 Verification of non-deterioration of contacts

8.10.1 Arrangement of the fuse

The test arrangement is given in 8.3.1 of this fuse system.

The dummy fuse-links shall have dimensions that comply with Figure 301.

The power dissipation of the dummy fuse-links shall not be less than the maximum rated power dissipation given in Figure 301 when tested in the standardized power-dissipation test rig according to Figure 306.

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

8.10.2 Test method

The load period is 75 % of the conventional time.

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

The test current is the non-fusing current.

The conventional time, as well as the non-fusing current, are stated in Table 2 of IEC 60269-1:2024.

A lower test voltage may be used.

8.10.3 Acceptability of test results

After 250 cycles, the measured temperature rise values of terminals shall not exceed the temperature rise measured at the beginning of the tests (1st cycle) by more than 15 K.

After 750 cycles, if necessary, the temperature rise values of terminals shall not exceed the values measured at the beginning of the tests (1st cycle) by more than 20 K.

8.11.1.4 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 10 times in the case of non-metallic thread by means of a suitable test spanner or screwdriver, applying a torque as indicated in Table 303.

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.

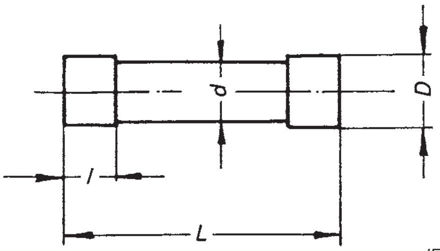
Table 303 – Mechanical strength of screw-thread

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

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

8.11.2.6 Dimensions and non-interchangeability

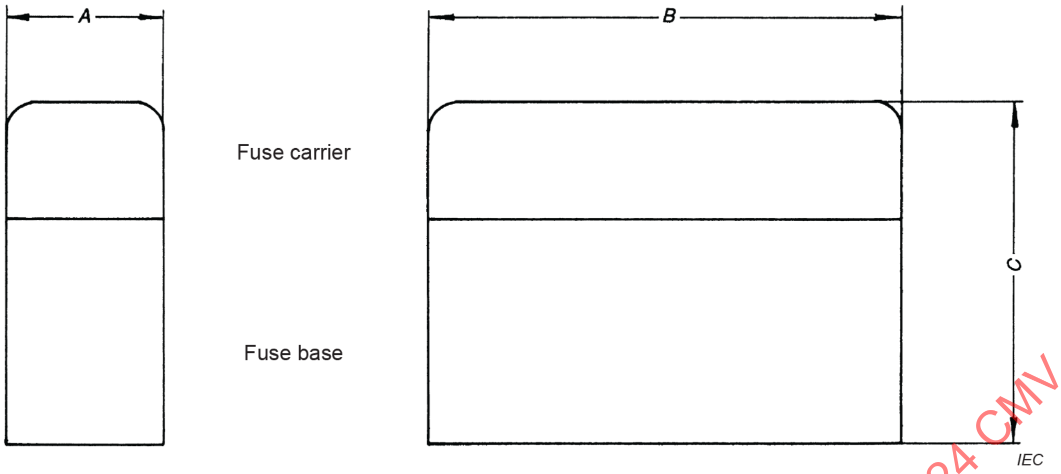
Compliance with 8.1.4 of IEC 60269-1:2024 and 7.1.8. of this document shall be verified by measuring and comparing the dimensions of fuse-links with the related dimensions of the other parts of the fuse.



Type	Maximum rated current A	Colour coding	Maximum power dissipation W	Length *L* mm	Length *l* of endcap mm	Diameter *D* of endcap mm
Ia	5	White	1,1	$23\ ^{+0}_{-0,8}$	4,8 ± 0,5	6,35 ± 0,1
Ib	16 20	Blue Yellow	2,0 2,5	$26\ ^{+0,2}_{-0,6}$	6,4 ± 0,5	10,32 ± 0,1
Ic	32	Red	3,0	29 ± 0,4	8,0 ± 0,5	12,7 ± 0,1
Id	45	Green	3,5	$35\ ^{+0,8}_{-0,1}$	9,5 ± 0,5	16,67 ± 0,1
IIa	63 80	-	5 6	57 ± 1,0	16 ± 0,5	22,23 ± 0,1
IIb	100	-	6	57 ± 1,0	16 ± 0,5	30,16 ± 0,1

The maximum diameter (d) of the cartridge between the endcaps shall be less than the diameter D of the end caps.

Figure 301 – Details of cylindrical fuse-links



Rated current A	Fuse-link type	Acceptable power dissipation W	*A* max. mm	*B* max. mm	*C* max. mm
5	Ia	1,1	25,4	77,0	56,0
20	Ib	2,5	25,4	77,0	56,0
32	Ic	3,0	28,0	77,0	56,0
45	Id	3,5	30,0	80,0	60,0

NOTE This figure 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 302 – Typical outline dimensions of carriers and bases for 230 V cylindrical fuse-links

Under consideration

Figure 303 – Typical carrier and base for 400 V cylindrical fuse-links

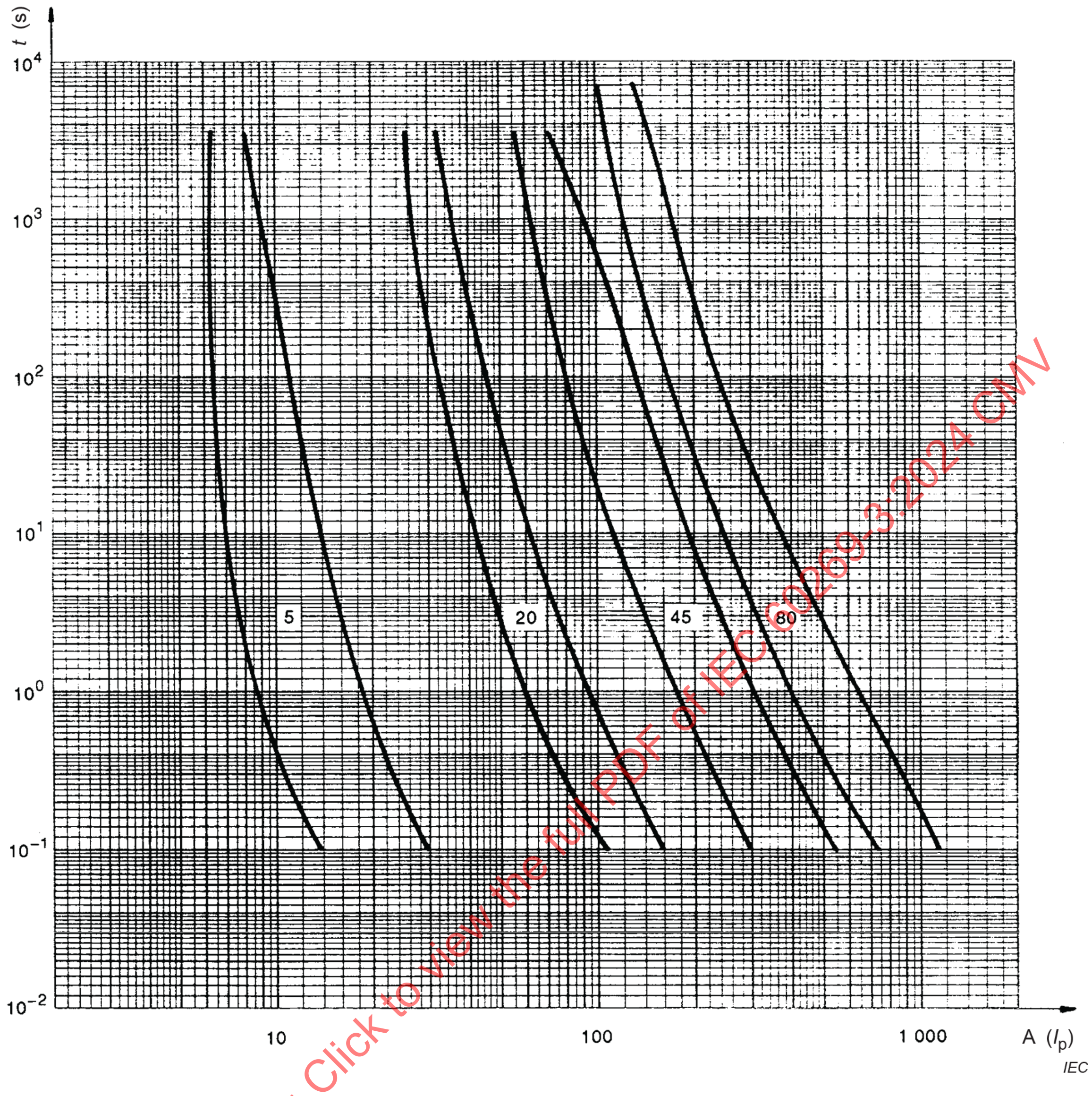


Figure 304 – Time-current zones for "gG" fuse-link

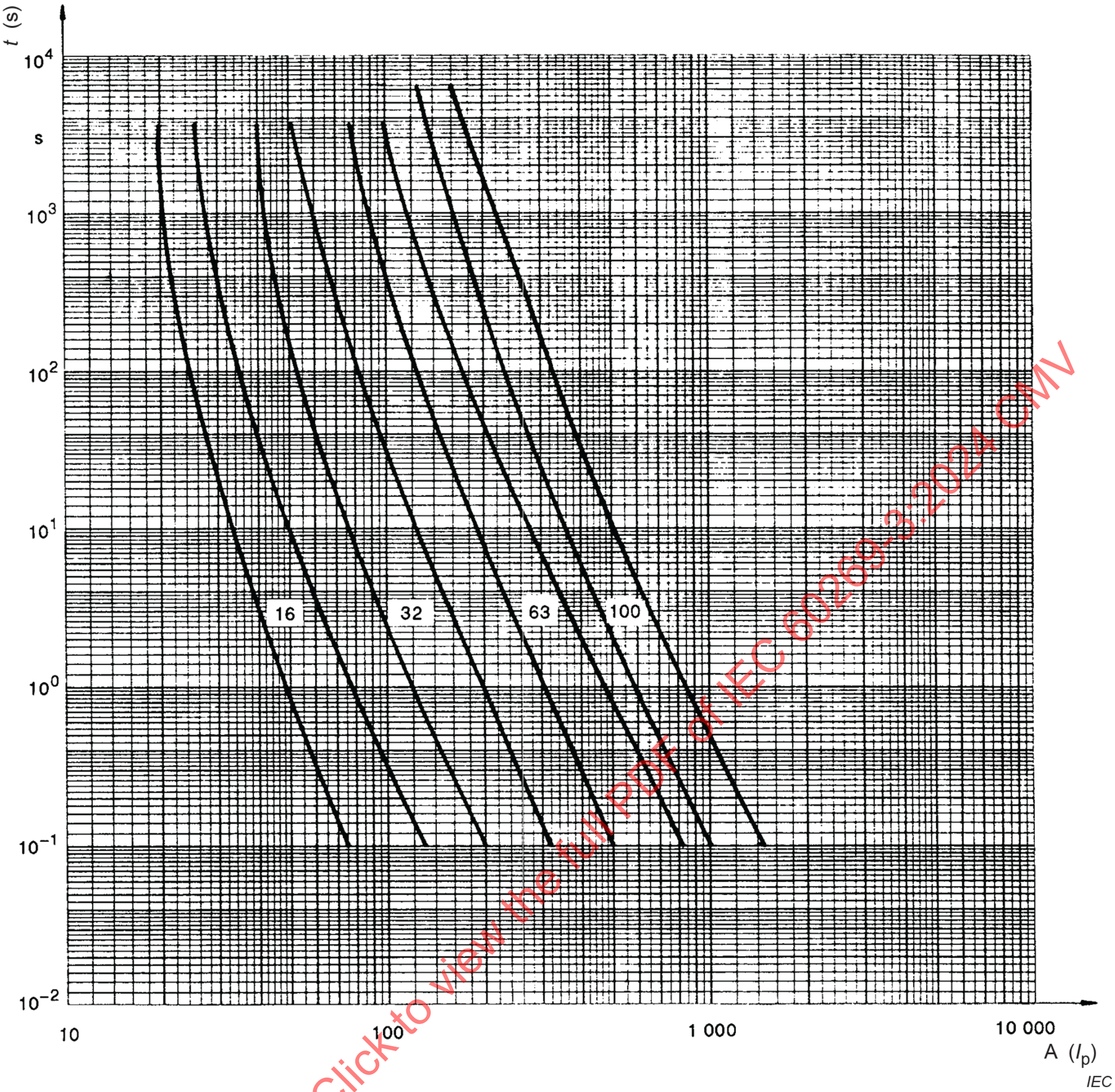
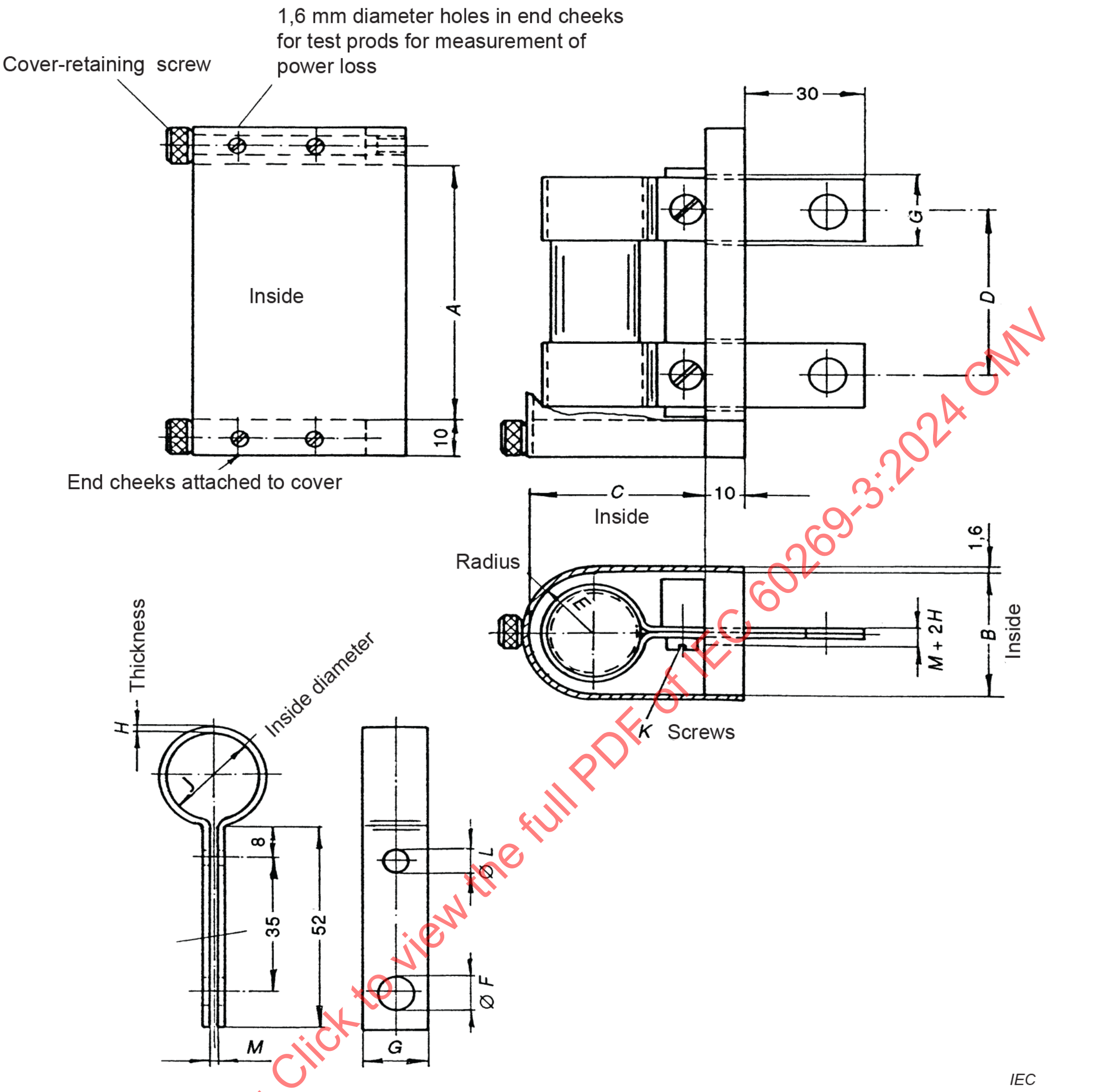


Figure 305 – Time-current zones for "gG" fuse-link

Dimensions in millimetres



Materials

Base, end cheeks and cover: insulating material

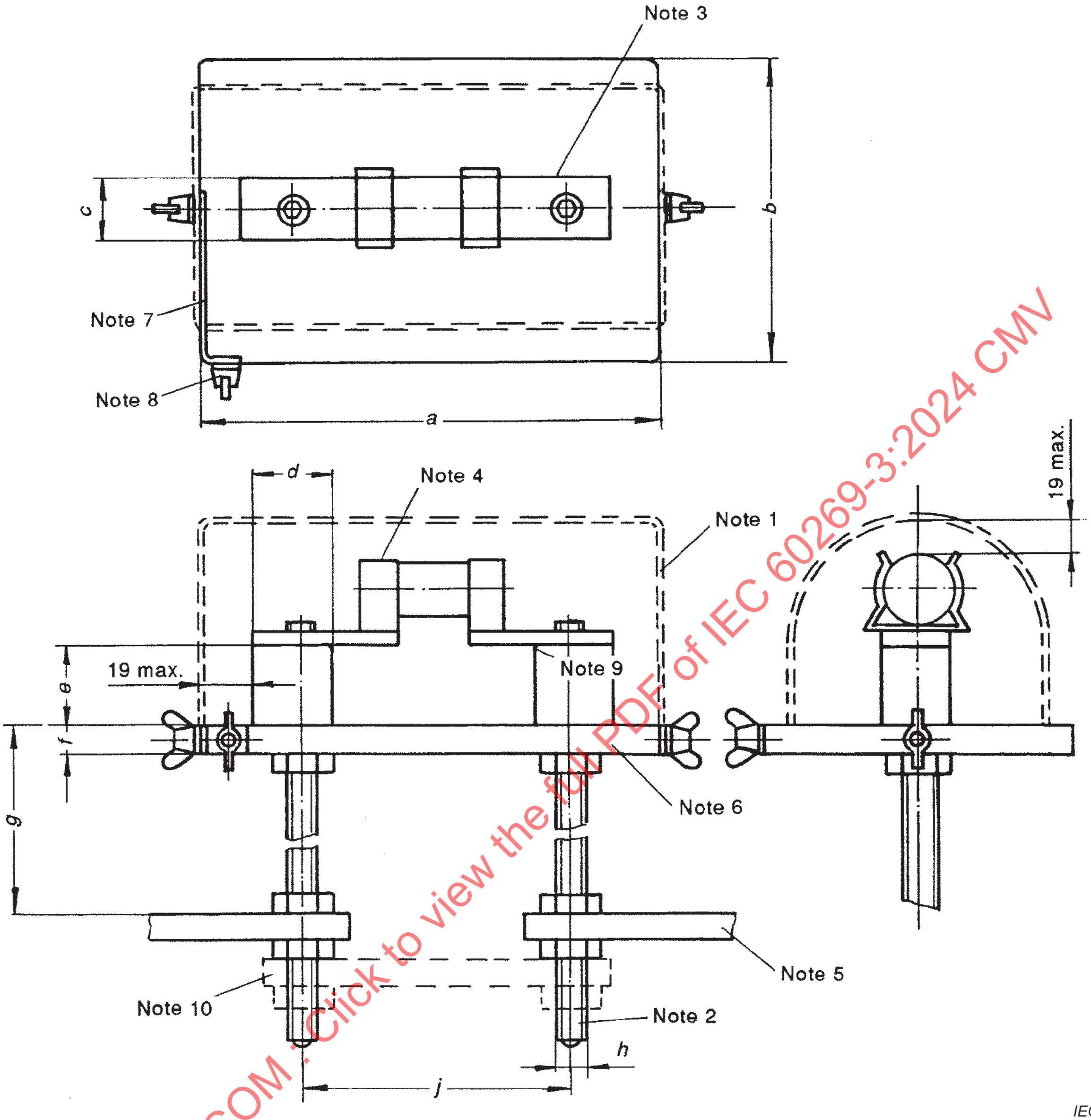
Clips: tin-plated

A (max.)	Type	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*J*	*K*	*L*	*M* [a]
100	IIb	63,5	38	47,7	41,3	19	8,7	16	1,2	30,1	M5	5,2	1,6
63	IIa	63,5	30	40	41,3	15	8,7	16	1,2	22,2	M5	5,2	1,6
45	Id	42	25	34	25,5	12,5	5	10	0,6	16,7	M3,5	4	1,6
32	Ic	42	25	34	25,5	12,5	5	10	0,6	12,7	M3,5	4	1,6
20	Ib	29	19	28	19	9,5	4	6,5	0,6	10,3	M3,5	4	1,6
5	Ia	29	19	28	19	9,5	4	6,5	0,6	6,3	M3,5	4	0,8

[a] These dimensions are for guidance only. They should be adjusted to give adequate contact pressure between the clips and the fuse endcaps.

Figure 306 – Standard test rig for power-dissipation test

Dimensions in millimetres



Fuse-link reference	*a*	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*j*
Types I, IIa and IIb	187	127	25	36,5	38	12,7	114	M12	111

NOTE 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.

NOTE 2 Connecting studs of high conductivity copper.

NOTE 3 Copper adaptor plates of minimum section 25 mm × 6,3 mm length and fixing centres appropriate to the fuse-link under test.

NOTE 4 Fuse clips of a size appropriate to the fuse-links under test. Specific dimensions are pending.

NOTE 5 The arrangement of the test connections beyond the test rig is not specified (the second paragraph of 8.5.1 of IEC 60269-1:2006 does not apply).

NOTE 6 The base shall be made from insulating material and the test rig shall be of sufficient rigidity to withstand the forces encountered without applying external loads to the fuse-link under test.

NOTE 7 Copper strip.

NOTE 8 Fine wire fuse of copper wire approximately 0,1 mm diameter, with a free length of not less that 75 mm, connected between the terminal and one pole of the test supply.

NOTE 9 Chamfer.

NOTE 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 307 – Breaking-capacity test rig

Fuse system F – Cylindrical fuse-links for use in plugs (BS plugtop system)

1 General

IEC 60269-1 applies with the following supplementary requirements.

1.1 Scope

Special requirements for "gG" fuse-links for use by unskilled persons for domestic and similar applications, primarily for use in plugs with rated currents not exceeding 13 A and rated voltages not exceeding 240 V AC. Dimensions of these fuse-links are given in Figure 601.

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

The rated voltage shall be 240 V AC.

5.3.1 Rated current of the fuse-link

For adequate protection of flexible conductors, the preferred ratings are 3 A and 13 A. Other ratings shall be below 13 A and selected from the R10 and R20 series rounded to the nearest whole number.

5.3.2 Rated current of the fuse-holder

Fuses used in plugs may require special current ratings to protect adequately flexible conductors.

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

To ensure that the plug is maintained within acceptable temperature rise limits, the rated power dissipation of the fuse-links shall not exceed 1 W when carrying rated current under specified conditions of test.

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

The time-current zones are given in Figure 602.

5.6.2 Conventional times and currents

Conventional times and currents are given in Table 601.

Table 601 – Conventional times and conventional currents

Rated current for fuse-link I_n A	Conventional time h	Conventional currents	
		I_{nf}	I_f
≤13	0,5	1,6 I_n	1,9 I_n

5.6.3 Gates

Gates for specified pre-arcing times are given in Table 602.

Table 602 – Gates for specified pre-arcing times of "gG" fuse-links for use in plugs

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
3	5,5	9,5	7	19
13	30	55	70	140

5.7.2 Rated breaking capacity

The minimum value of the rated breaking capacity shall not be less than 6 kA AC.

6 Markings

IEC 60269-1 applies with the following supplementary requirements.

The markings on the fuse-link barrel shall be in brown for a 13 A rating and red for a 3 A rating. For all other ratings the markings shall be in black.

If the fuse-bases are not capable of bidirectional current flow, they shall be marked with the current flow direction at front or lateral side.

For this, preferentially, the symbol 5107A in accordance with IEC 60417 should be used. The arrows may be covered in the installed state of the fuse-base. 23

In the case of fuse-bases for busbar mounting, the marking with the current flow direction is not required.

7 Standard conditions for construction

IEC 60269-1 applies with the following supplementary requirements.

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

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.

7.2 Insulating properties and suitability for isolation

Under consideration

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

Instead of Table 5 of IEC 60269-1:2024, Table 603 applies.

Table 603 – 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 of IEC 60269-1:2024, 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

Limits are standardized for fuse-links rated at 3 A and 13 A as in Table 604.

Table 604 – 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
3	5	45
13	275	1 200

7.9 Protection against electric shock

A fuse shall be so designed that live parts are not accessible when the fuse-base is installed and wired as in normal use with gauge-piece(s), if any, fuse-link and fuse-carrier in position. Where fuse-bases have exposed live parts which are intended to be covered, when installed, by shields not forming a part of the fuse, these live parts are considered to be not accessible.

The degree of protection shall be at least IP2X when the fuse is under normal service conditions. When replacing the fuse-link, the degree of protection may temporarily be reduced to IP1X (see Annex CC).

Where a fuse-carrier is used, it shall retain the fuse-link during insertion in and removal from the fuse-base.

8 Tests

IEC 60269-1 applies with the following supplementary requirements.

8.1.4 Arrangement of the fuse-link for tests

For all electrical tests, the fuse-links shall be mounted in the test fuse-base shown in Figure 603 with the axis of the fuse-link vertical.

8.1.5 Testing of fuse-links

For each rating to be tested, 45 samples are required. All the tests are performed unless the fuse-links constitute a homogeneous series (see 8.1.5.2 of IEC 60269-1:2024), in which case the tests to be made are given in Table 605.

If the test has to be repeated for reasons other than the failure of the fuse-link, spare fuse-links, having approximately the same initial cold resistance as the original samples, shall be used for the repeated test.

Table 605 – Survey of tests on fuse-links

	Sample numbers to be tested														
Sample numbers in order of decreasing initial cold resistance	1 to 3	4 to 6	7 to 9	10 to 12	13 to 15	16 to 18	19 to 21	22 to 24	25 to 27	28 to 30	31 to 33	34 to 36	37 to 39	40 to 42	43 to 45
Tests on maximum rated current in a series	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Tests on intermediate rated current in a series	×	×	×	*	*	*	×	×	×			*	*	×	
Tests on lowest rated current in a series	×	×	×	*	*	*	×	×	×		×	*	*	×	
Test according to subclause	Tests to be made														
8.3 Verification of temperature rise and power dissipation	×														
8.4.3.1 Conventional non-fusing current a)		×	×												
Conventional fusing current b)			×												
8.4.3.2 Verification of rated current	×														
8.4.3.3.2 Verification of gates* a) c)				×	×										
b) d)													×	×	
8.5 Breaking capacity No. 5							×								
8.5 Breaking capacity No. 4								×							
8.5 Breaking capacity No. 3									×						
8.5 Breaking capacity No. 2										×					
8.5 Breaking capacity No. 1											×				
8.7.3 * Verification of pre-arcing I^2t at 0,01 s a) I^2t_{min}						×									
b) I^2t_{max}												×			
8.11.1 Mechanical strength															×

* Notwithstanding the range submitted by a manufacturer, these tests are mandatory for 3 A and 13 A fuse-links. All ranges submitted by a manufacturer shall include 3 A and 13 A fuse-links.

Table 605 replaces Tables 11, 12 and 13 of IEC 60269-1:2024.

The initial cold resistance of the samples shall be measured when carrying not more than 10 % of the rated current. They shall then be sorted and numbered consecutively in descending order of cold resistance. These numbers are then used to determine which samples shall be used to the various tests, as indicated in Table 605.

8.1.5.2 Testing of fuse-links of a homogeneous series

In addition to IEC 60269-1, the following shall apply.

The grain size may vary between different rated currents.

8.2.4 Acceptability of test results

There shall be no failure in any of the tests.

8.3 Verification of temperature rise and power dissipation

8.3.1 Arrangement of the fuse

The connections of the test base (see 8.1.4 of this fuse system) shall be by means of single-core copper cables with PVC or similar insulation, with a length of 0,3 m ± 0,05 m and a cross-section of 2,5 mm^2. The surroundings shall be free from draughts, and the ambient air temperature, measured by a suitable thermocouple or thermometer at a horizontal distance of 1 m to 2 m from the fuse-link, shall be within the range of 15 °C to 25 °C.

8.3.4 Test method

Three fuse-links, selected in accordance with Table 605, shall be tested. After carrying rated current continuously for 1 h, the cover of the test base shall be removed. The millivolt drop shall then be measured between the end surfaces of the endcaps of the fuse-links whilst carrying rated current. Direct current is recommended for this test, but if AC is used, care should be taken to avoid errors, for example, by distorted waveform.

8.3.5 Acceptability of test results

The product of the measured millivolt drop, multiplied by the rated current, shall not exceed 1 W for any rated current.

8.4 Verification of operation

8.4.1 Arrangement of the fuse

This shall be as specified in 8.3.1 of this fuse system. The tests shall be made using AC of substantially sinusoidal waveform.

8.4.3.1 Verification of conventional non-fusing and fusing current

Six fuse-links, selected in accordance with Table 605, shall carry the conventional non-fusing current (1,6 I_n) for a conventional time of 30 min and shall not operate during this time.

Three fuse-links, selected in accordance with Table 605, shall be subjected to the conventional fusing current (1,9 I_n). They shall operate satisfactorily within the conventional time of 30 min. The recorded time to operate can be used to verify the time-current characteristics.

8.4.3.2 Verification of rated current of "gG" fuse-links

During the following tests, the current shall be maintained within ±2,5 % of the adjusted value.

Three fuse-links, selected from those used for the power-loss test of 8.3, having been allowed to cool down to approximately ambient temperature, shall be subjected to 100 cycles of the current. Each cycle shall comprise an on-period of 1 h at 1,2 I_n, followed by an off-period of 15 min. This test should be run continuously but, where unavoidable, a single interruption is permitted.

Following this, a current of 1,4 I_n shall be passed through the fuse-link for a period of 1 h.

Finally, the millivolt drop at rated current shall again be measured as in 8.3.4 and the values obtained shall not exceed those recorded in the original test by more than 10 % and the marking of the fuse-link shall still be legible.

8.5 Breaking-capacity tests

8.5.1 Arrangement of the fuse

The fuse-links shall be mounted in the enclosed fuse-base shown in Figure 603. However, the cable soldering sockets shown in this figure shall be removed and the fuse-base bolted directly to two copper bars of a cross-section of approximately 25 mm × 3 mm by means of the test terminals.

Substantial terminals shall be provided in these copper bars adjacent to the mounting terminals, so that the fuse-base can be shorted by a copper-link of negligible impedance during the calibration test.

A typical arrangement for the test-circuit connections is shown in Figure 604. The metal enclosure of the test fuse-base shall be connected to one pole of the supply through a fine wire fuse (FW) wired with a copper wire of diameter not greater than 0,1 mm and having a free length of not less than 75 mm.

8.5.2 Characteristics of the test circuit

Subclause 8.5.2 of IEC 60269-1:2024 applies, with the exception that Table 20 is to be replaced by Table 606.

Table 606 – Values for breaking-capacity tests

Breaking capacity test No.	1	2	3	4	5
Prospective current	6 000 A	Depends on rated current[a]	I_3 = 6,3 I_n	I_4 = 4 I_n	I_5 = 2,5 I_n
Tolerance on test current	$^{+10}_{0}$ [b] %	±10 %			
Power factor	0,3[b] – 0,4	Not specified (see 8.5.4)			
Making angle after voltage zero	70° $^{+10°}_{-10°}$	0° $^{+20°}_{-0}$	Not specified		
Power-frequency recovery voltage (RMS)	110 $^{+5}_{0}$ [b] % of the rated voltage				

a) See Table BB.1.

b) By agreement with the manufacturer, this tolerance may be exceeded.

8.5.4 Calibration of the test circuit

The power factor shall be determined as described in Annex A of IEC 60269-1:2024, preferably by using method 1.

The required current values for tests 2 to 5 (see Table 606) shall be obtained by adjustment of the series resistance only, the air-cored reactor remaining as adjusted for test 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 60269-1:2024, tests in accordance with Table 20 of IEC 60269-1:2024 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

The fuse-links shall operate without external effects and damage beyond those specified below.

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

There shall be neither permanent arcing, ejection of flames nor flashover sufficient to cause the fine wire fuse to melt.

8.7 Verification of I^2t characteristics and overcurrent discrimination

8.7.3 Verification of compliance for fuse-links at 0,01 s

Six fuse-links shall be submitted for I^2t testing.

a) Three samples shall be subjected individually to a pulse of 0,01 s corresponding to the I^2t_{min} value in Table 604. No fuse-link shall operate.

b) Three samples shall be subjected individually to a pulse of 0,01 s corresponding to the I^2t_{max} value in Table 604. All fuse-links shall operate.

8.10 Verification of non-deterioration of contacts

The fuse-links produced to this standard are intended to be mounted direct within plugs and not in conventional fuse-bases. Appropriate tests on contacts in the plugs are made by the plug manufacturers.

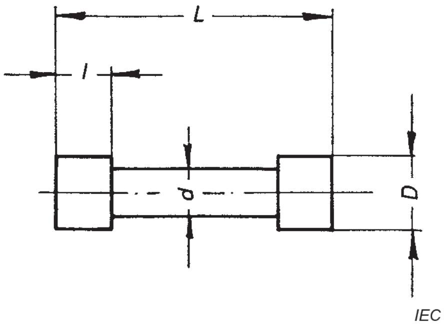
Consequently, no test for the non-deterioration of contacts is appropriate for inclusion in this specification for fuse-links.

8.11.1 Mechanical strength

Three fuse-links, selected as shown in Table 605, shall be tested in a tumbling barrel according to IEC 60068-2-31 but with 20 mm thick hardwood (hornbeam) ends and a height of fall of 350 mm. Alternatively, with the consent of the manufacturer, a tumbling barrel with a steel base which has a greater dropping distance may be used (i.e. that used for testing plugs).

Only one fuse-link is tested at a time. The barrel is rotated at five revolutions per minute and the fuse-link subjected to 50 falls, i.e. 25 revolutions of the barrel.

After the test, the body shall not be broken, filling shall not have come out, and the end caps shall remain tight when tested by hand.



Length L mm	Dimension l of end cap mm	Diameter D of end cap mm
$25{,}4\ ^{+0{,}8}_{-0{,}4}$	5,5 ± 0,8	$6{,}3\ ^{+0{,}2}_{-0{,}05}$

The maximum diameter d of the cartridge between the end caps shall be less than the diameter D of the end caps.

NOTE This figure was previously Figure 33 in IEC 60269-3-1:2004, Section IV.

Figure 601 – Dimensions for cylindrical fuse-links (primarily used in plugs)

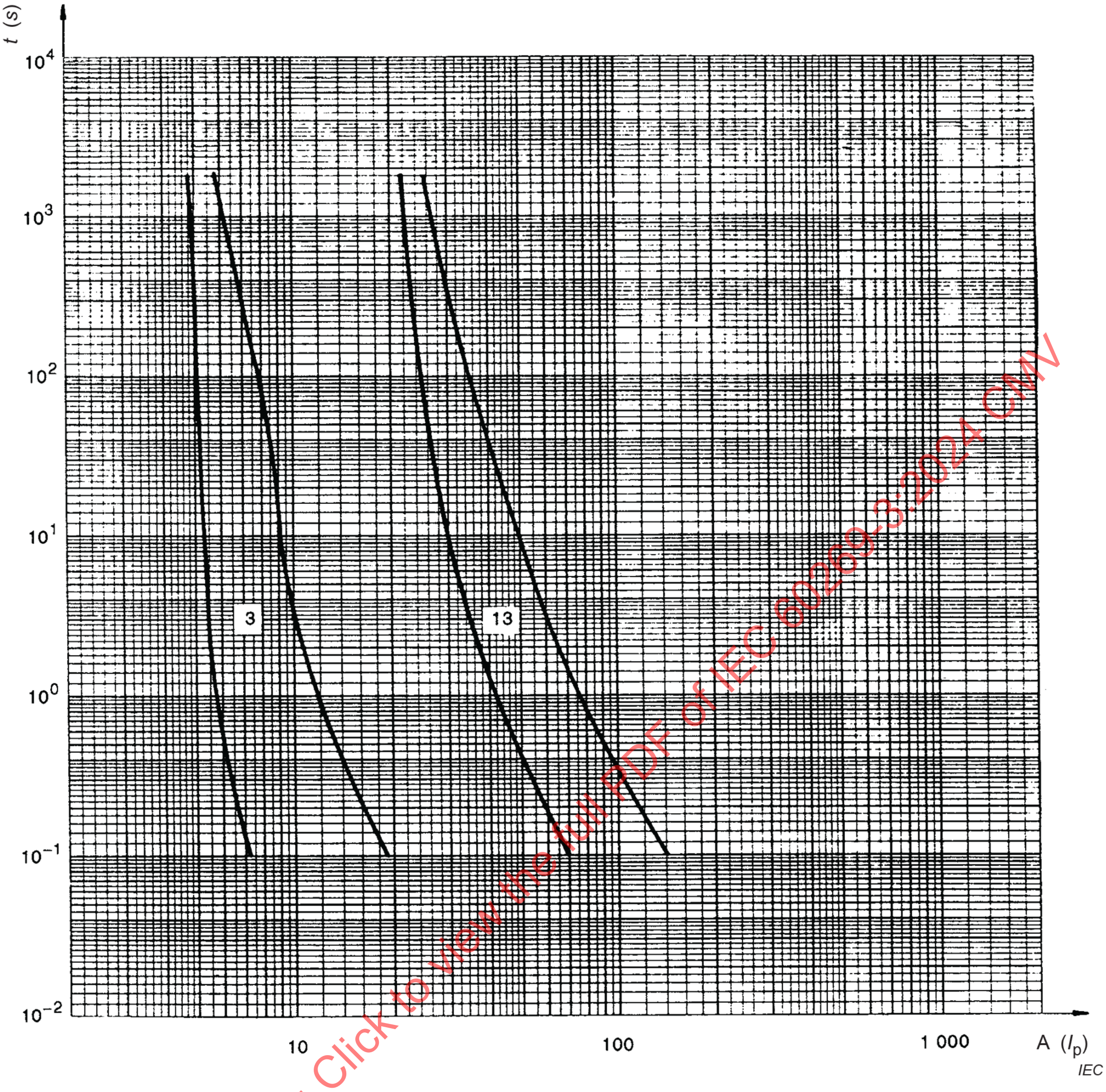
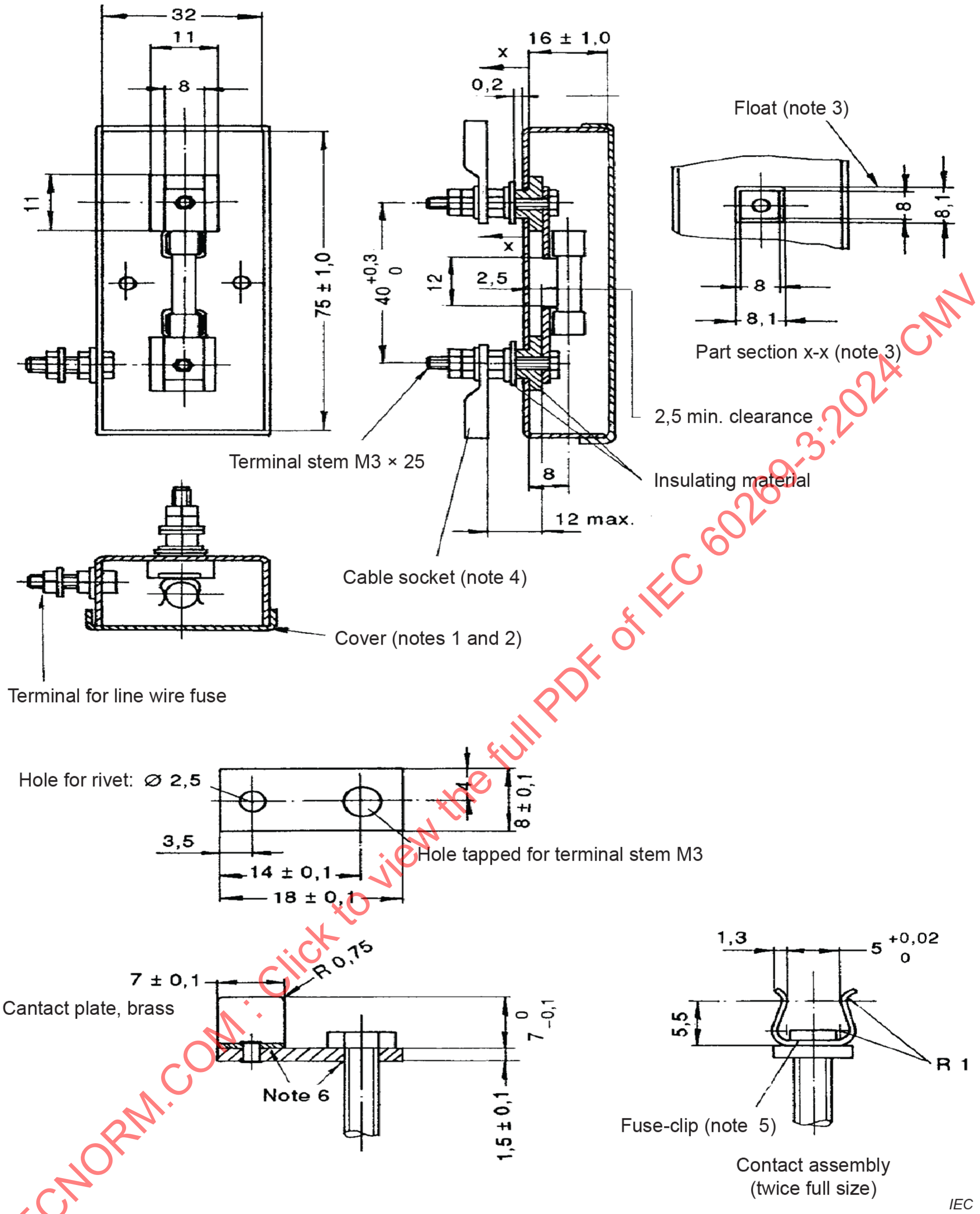


Figure 602 – Time-current zones for "gG" fuse-links

Dimensions in millimetres



NOTE 1 Box and cover should be made from 1,25 mm brass sheet, clean natural finish.

NOTE 2 The over should be a push fit on box and should not be rigidly attached.

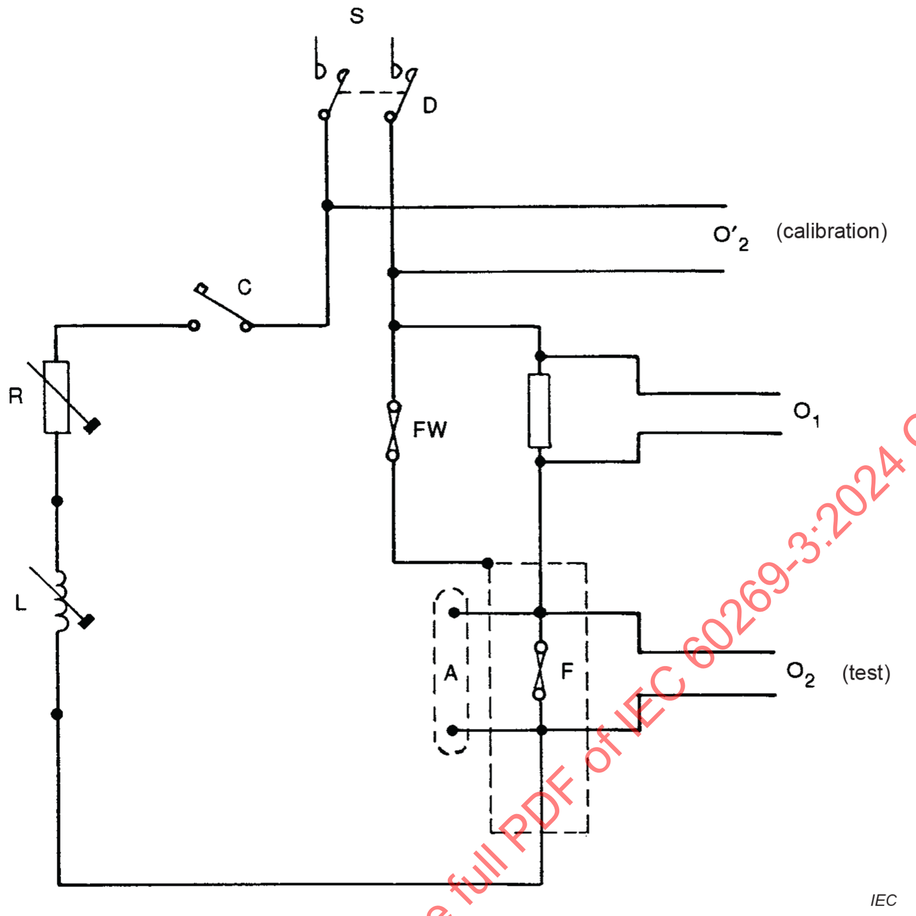
NOTE 3 The end float and clearance between the insulation and the box is to allow the contacts to be self-aligning.

NOTE 4 Cable sockets for 2,5 mm^2 cable for power-loss test. (Replaced by copper bar for breaking-capacity test, see 8.5.1.)

NOTE 5 Fuse-clip. Made from beryllium copper 0,45 mm thick and heat treated (170 HV min.). Base of clip should be flat; finish, silver-plated.

NOTE 6 Joints between clip, contact plate and terminal stem should be soldered.

Figure 603 – Test fuse-base



Key

A	removable link used for the calibration test
C	apparatus for closing the circuit
D	circuit-breaker or other apparatus for the protection of the source
F	fuse on test
FW	fine wire fuse
L	adjustance inductor
O_1	measuring circuit for recording the current
O_2	measuring circuit for recording the voltage during the test
O'_2	measuring circuit for recording the voltage during calibration
R	adjustable resistor
S	source of energy

Figure 604 – Typical diagram of the circuit used for breaking-capacity tests

Annex BB
(informative)
(for all fuse systems) –

Alternative tests for tests No. 1 and No. 2 of Table 20 of IEC 60269-1:2024

BB.1 Test method

In order to verify that the fuse satisfies the conditions of 7.5 of IEC 60269-1:2024, tests in accordance with Table 20 of IEC 60269-1:2024 shall be made. As an alternative to tests 1 and 2 of Table 20 for fuse-links with constant I^2t values at times less than 0,01s, the following test methods may be employed to achieve the test criteria for tests 1 and 2.

BB.2 Test No. 1

This test shall be performed on three samples at rated breaking capacity. As a guide the instant of making for all tests may be taken from Figure BB.1, provided that the angle of initiation of arcing complies with the requirements of IEC 60269-1.

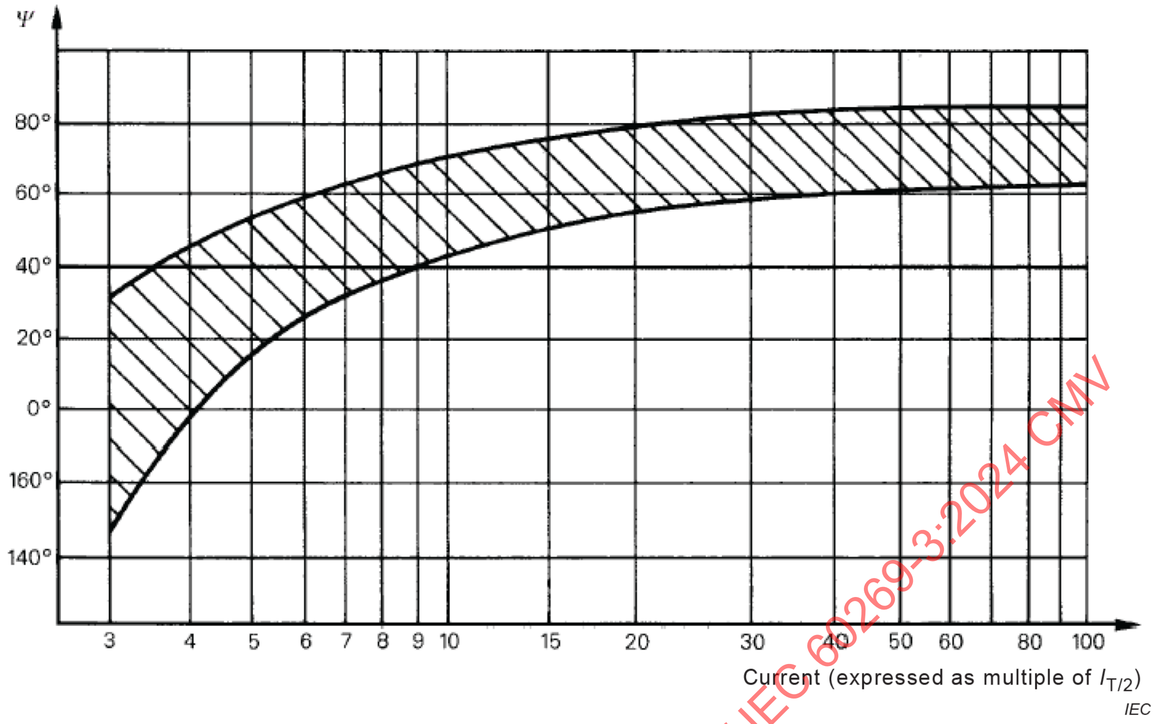
BB.3 Test No. 2

This test shall be performed on three samples. As a guide the prospective currents are indicated in Table BB.1.

Table BB.1 – Approximate values of prospective currents for breaking capacity test No. 2

Rated current of the fuse-link A	Prospective current A
≤ 2	100
> 2 ≤ 4	160
> 4 ≤ 6	315
> 6 ≤ 10	500
> 10 ≤ 16	630
> 16 ≤ 20	800
> 20 ≤ 25	1 000
> 25 ≤ 32	1 250
> 32 ≤ 40	1 600
> 40 ≤ 50	2 000
> 50 ≤ 63	2 500
> 63 ≤ 80	3 150
> 80 ≤ 100	5 000

NOTE In case of doubt, the definition of I_2 of IEC 60269-1 applies (see IEC 60269-1:2024, Table 20).



where

$I_{T/2}$ is the symmetrical current (RMS value) which causes the fuse-element to melt in the time of one half-cycle;

ψ is the making angle after the supply voltage zero.

Figure BB.1 – Instant of making for Test No. 1

Annex CC
(informative)

Recommendations for future designs of fuses (for all fuse systems)

CC.1 Overview

This standard is based on the present state of the art, i.e. well-established fuse systems used in many countries over many years.

Increasing safety requirements go in parallel with technical progress. For new fuse-designs it is recommended that attention should be paid to such features of fuses where improvement seems to be required. This applies in particular to the CC.2 and CC.3.

CC.2 Fuse contacts

The contact force should be independent of the user's skill in handling the fuse.

CC.3 Protection against electric shock

The degree of protection against electric shock during the period of replacing a fuse-link should be at least IP2X.

Bibliography

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60269-6, *Low-voltage fuses – Part 6: Supplementary requirements for fuse-links for the protection of solar photovoltaic energy systems*

ISO 228-1, *Pipe threads where pressure-tight joints are not made on the threads – Part 1: Dimensions, tolerances and designation*

ISO 228-2, *Pipe threads where pressure-tight joints are not made on the threads – Part 2: Verification by means of limit gauges*

ISO 965-1, *ISO general-purpose metric screw threads – Tolerances – Part 1: Principles and basic data*

ISO 1302, *Geometrical Product Specifications (GPS) – Indication of surface texture in technical product documentation*

List of comments

1 This is the first of many changes requested by the HAS consultants to ensure CENELEC compliance, when they reviewed the committee draft for vote (CDV).

If other changes are not otherwise commented then the changes were also the result of the HAS review.

The largest changes required are to the introduction and the scope.

These changes should not have changed the “spirit” of the wording.

2 This re-formatting and text is due to input from HAS consultant.

3 This re-formatting and text is due to input from HAS consultant.

4 For a number of standards referred to the publication dates are updated to reflect the latest date, unless the later version is not relevant and this standard specifically refers to a previous edition.

5 This additional definition is added.

6 The deleted text is considered to be not required.

7 This test is not deemed to add value to the standard, so is deleted.

8 In the case a base is not unidirectional and may be used on DC, this clarification is added.

9 This test is deemed not to add value and is also not acceptable to the HAS consultant.

10 This is clarification required by HAS consultant.

11 This modification clarifies the text.

12 This clarifies the purpose of the gauge piece.

13 Note 2 is no longer required.

14 Additions to tables in IEC 60269-1:2024 means this edition has to be specified.

15 This adds clarity as to the method.

16 This makes the statement specific.

17 Shall is preferred over must.

18 This clarifies the method.

19 The text is added in the event the fuse-bases are not capable of bidirectional current.

20 This method is no longer used.

21 These are clarifications and requested by HAS consultants.

22 See comments in Fuse systems A and B (comment 8 on page 20, comment 19 on page 71).

23 See comment in Fuse systems A, B and C (comment 8 on page 20, comment 19 on page 71, comment 22 on page 93).

IEC 60269-3

Edition 5.0 2024-08

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Low- voltage fuses –
Part 3: Supplementary requirements for fuses for operation by unskilled persons (fuses mainly for household or similar applications) – Examples of standardized systems of fuses A to F

Fusibles basse tension –
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IEC 60269-3:2024-08(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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LOW-VOLTAGE FUSES –

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

FOREWORD

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

This fifth edition cancels and replaces the fourth edition published in 2010, Amendment 1:2013 and Amendment 2:2019. This edition constitutes a technical revision.

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

a) Introduction and general scope fully updated;
b) Normative references updated and editorial changes;

c) Terms “ordinary person”, “operation" and “non-interchangeability” defined;
d) In System A: Parts defined for removal;
e) In System A: Marking of fuse-bases added for direction of current flow;
f) In System A: Clarifications added for connection;
g) In System A: Clarification of construction of fuse-carrier and fuse-link;
h) In System A: Clarification of voltage drop measurement.

The text of this International Standard is based on the following documents:

Draft	Report on voting
32B/745/FDIS	32B/754/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This part is to be used in conjunction with IEC 60269-1:2024, *Low-voltage fuses – Part 1: General requirements.*

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 document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

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 applications) – 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*

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 this document 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 document 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

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 part of IEC 60269 is divided into four fuse systems, each dealing with a specific example of standardized fuses for use by unskilled persons.

All systems provide their own mechanical solution to avoid the use of a fuse-link with higher current rating (non-interchangeability) to ensure the protection of cables and lines. The applicant is required to take care to replace a fuse-link by the same type.

Fuse system	Principles of non-interchangeability
Fuse system A: D type fuse system 1)	Diameter and shape at bottom side of the fuse-links differs, fuse bases require gauge-pieces
Fuse system B: Cylindrical fuses (NF cylindrical fuse system) 2)	Fuse-links and suitable fuse-holders (fuse-carriers) provide unique dimensions
Fuse system C: Cylindrical fuses (BS cylindrical fuse system) 2)	Fuse-links and suitable fuse-holders (fuse-carriers) provide unique dimensions
Fuse system F: Cylindrical fuse-links for use in plugs (BS plugtop fuse system) 1)	Fuse-links and suitable fuse-holders (fuse-carriers) provide unique dimensions

NOTE 1 Applicants of system A and F may have fuse-bases in their installation not providing degree of protection IP2X all the time. The degree of protection may temporarily be reduced to IP1X, when replacing the fuse-link. 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. For future designs Annex CC recommends that the degree of protection against electric shock during the period of replacing a fuse-link should be at least IP2X.

NOTE 2 Fuse-links are not to be interchanged with fuse-links of the same dimension but with different characteristics (e. g. aM).

It is important for safety and therefore strictly forbidden to mix components of different fuse-systems such as fuse-links, fuse-holders and fuse-bases.

LOW-VOLTAGE FUSES –

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

1 General Scope

This part of IEC 60269 is divided into four fuse systems, each dealing with a specific example of standardized fuses for use by unskilled persons.

This part applies to “gG” fuses only.

Unskilled persons do not have technical knowledge or sufficient experience. To avoid dangers, which electricity may create, the relevant part of the fuse standard shall provide requirements for maximum safety in service. IEC 60269-3 provides four systems for use by unskilled persons. Instructions for the safe operation of fuse-links are provided in the manufacturer’s literature.

All systems provide their own mechanical solution to avoid the use of a fuse-link with higher current rating (non-interchangeability) whereas the protection of cables and lines is ensured. The applicant is required to take care to replace a fuse-link by the same type.

Fuse system	Principles of non-interchangeability
Fuse system A: D type fuse system 1)	Diameter and shape at bottom side of the fuse-links differs, fuse bases require gauge-pieces
Fuse system B: Cylindrical fuses (NF cylindrical fuse system) 2)	Fuse-links and suitable fuse-holders (fuse-carriers) provide unique dimensions
Fuse system C: Cylindrical fuses (BS cylindrical fuse system) 2)	Fuse-links and suitable fuse-holders (fuse-carriers) provide unique dimensions
Fuse system F: Cylindrical fuse-links for use in plugs (BS plugtop fuse system) 1)	Fuse-links and suitable fuse-holders (fuse-carriers) provide unique dimensions

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60269-1:2024, *Low-voltage fuses – Part 1: General requirements*

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

IEC 60898-1:2015, *Electrical accessories – Circuit-breakers for overcurrent protection for household and similar installations – Part 1: Circuit-breakers for AC operation*
IEC 60898-1:2015/AMD1:2019

IEC 60999-1:1999, *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 61439-1, *Low-voltage switchgear and controlgear assemblies – Part 1: General rules*

IEC 61439-3:2012, *Low-voltage switchgear and controlgear assemblies – Part 3: Distribution boards intended to be operated by ordinary persons (DBO)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60269-1:2024 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.1
ordinary person
person who is neither a skilled person nor an instructed person

3.2
operation
operation is defined for this standard as the exchange of the fuse-link

3.3
non interchangeability
limitations on shape and/or dimensions with the object of avoiding in a specific fuse-base the inadvertent use of fuse-links having electrical properties other than those ensuring the desired degree of protection

[SOURCE: IEC 60050-441:1984, 441-18-33]

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 AC and 500 V DC.

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 with the following additions.

2.1.13

Defined parts which can be removed from a fuse: fuse carrier and fuse-link.

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 AC, the standard values of rated voltages are 400 V for size D01, D02 and D03[1] and 500 V for size DII, DIII and DIV.

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

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

5.3.1 Rated current of the fuse-link

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

5.3.2 Rated current of the fuse-holder

The rated currents of the fuse-carriers are given in Figure 112, Figure 113 and Figure 114. The rated currents of the fuse-bases are given in Figure 118, Figure 119 and Figure 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 In A	Maximum power dissipation W	
	D01 to D03	DII to 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	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

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 Figure 101, Figure 102, Figure 103 and Figure 127. 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 101, Figure 102, Figure 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	Conventional time	Conventional current	
A	h	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 AC

– 8 kA DC

6 Markings

6.1 General

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".

6.2 Marking of fuse-bases

If the fuse-bases are not capable of bidirectional current flow, they shall be marked with the current flow direction at front or lateral side. For this, preferentially, the symbol 5107A in accordance with IEC 60417 should be used. The arrows may be covered in the installed state of the fuse-base.

In the case of fuse-bases for busbar mounting, the marking with the current flow direction is not required.

6.3 Marking of the gauge-pieces

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

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

IEC 60269-1 applies with the following additions and changes.

7.1.2 Connections including terminals

Mounting of all fuse bases and the wiring must be done by authorized/skilled person.

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 mm^2 (size DII); 16 mm^2 (size DIII) and 35 mm^2 (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
Size	I_n	
	A	mm^2
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

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 Figure 121, Figure 122, Figure 123 and Figure 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.

Defined according to Figure 112 for fuse-carrier D0 and Figure 113 for D Type fuses-carrier and for the fuse-links in Figure 110 for D0 and Figure 111 for D-Type fuse-links.

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 Figure 112, Figure 113, Figure 114, Figure 115 and Figure 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 without a tool.

A fuse-link has no interchangeable parts. Only the Gauge piece ensures the non-interchangeability. It is not possible to interchange a fuse-link with a higher rating.

In case the fuse-link 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 Figure 110 and Figure 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 Figure 115, Figure 117, Figure 118, Figure 119, Figure 120 and Figure 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 to DIV**	**D01 to 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
Clearance mm	**DII to DIV**	**D01 to 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
Distance mm	**DII to DIV**	**D01 to 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 The standard test finger referred to in this table is that specified in IEC 60529.		

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

Instead of Table 5 of IEC 60269-1:2024, 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 of IEC 60269-1:2024, 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 60269-1:2024, the pre-arcing I^2t values given in Table 107 apply.

Table 107 – 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	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 document and of Table 7 of IEC 60269-1:2024 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 60269-1:2024.

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 I^2t values given in Table 108 shall be followed.

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

I_n A	I^2t_{min} A^2s	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 shall be measured (e.g. 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 Figure 112, Figure 113, Figure 114, Figure 118, Figure 119 and Figure 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.

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 toTable 109 and Table 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 are 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 60269-1:2024. The fuse-holder shall be submitted to the test voltage given in Table 15 of IEC 60269-1:2024.

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 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. 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 of IEC 60269-1:2024 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 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 Figure 105 and Figure 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 ± 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 60269-1:2024, 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 60269-1:2024 and Table 102 of this document. The fuse-links shall not operate within the conventional time shown in Table 2 of IEC 60269-1:2024 and Table 102 of this document.

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 60269-1:2024 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 document.

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 V ± 5 V and the test current shall be 2 × $I_f\ {}^{+20}_{0}$ %.

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 DC current, Table 21 of IEC 60269-1:2024 applies, with the exception given in Table 112.

Table 112 – Test according to 8.5.5.1

	No. 1, No. 2	No. 3, No. 4, No. 5
Time constant	$15\ {}^{+5}_{0}$ ms [a]	≤3 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 60269-1:2024, tests in accordance with Table 20 of IEC 60269-1:2024 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 60269-1:2024, 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 AC test voltage is: $\frac{1{,}1 \times U_{\text{n}}}{\sqrt{3}}$

The other characteristics of the test circuit are the same as for the breaking-capacity test No. 2 (see Table 20 of IEC 60269-1:2006).

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 RMS	I^2t_{min} A²s	Prospective I_{max} kA RMS	I^2t_{max} A²s	
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	1:1,6
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	
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 60269-1:2024, 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 °C ± 5 °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 °C ± 5 °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.

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 60269-1:2024, 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 °C ± 5 °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 shall 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 60269-1:2024 applies.

8.10.1 Arrangement of the fuse

Subclause 8.10.1 of IEC 60269-1:2024 applies, with the following addition.

The dummy fuse-link is given in Figure 104 of this document.

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 of IEC 60269-1:2024.

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 60269-1:2024. 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 of IEC 60269-1:2024 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 voltage drop measurement shall be made after 250 cycles and, if equation (1) of 8.10.3 is not met, the measurement must be repeated after 750 cycles (see equation (2) of 8.10.3).

The voltage drop of the contacts is measured after 50, 250 and 750 cycles at direct current of I_m = (0,05 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 µV.

The tolerance of I_m during the measurement shall not be greater than $^{+10}_{\ 0}$ %. 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.

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

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

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, 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, Figure 113 or Figure 114, which is screwed into a fuse-base complying with Figure 118, Figure 119 or Figure 120, a gauge-piece complying with Figure 121, Figure 122 or Figure 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 document. 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.

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
≤ 2,6	0,4
> 2,6 ≤ 3,0	0,5
> 3,0 ≤ 3,5	0,8
> 3,5 ≤ 4,0	1,2
> 4,0 ≤ 5,0	2,0
> 5,0 ≤ 6,0	2,5
> 6,0 ≤ 8,0	5,5
> 8,0 ≤ 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 °C ± 5 °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 °C ± 5 °C.

A complete fuse shall be exposed for 1 h to a temperature of 150 °C ± 5 °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 60269-1:2024. 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 60269-1:2024, 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 60269-1:2024 and 7.1.8. of this document shall be verified by measuring and comparing the dimensions of fuse-links with the related dimensions of the other parts of the fuse.

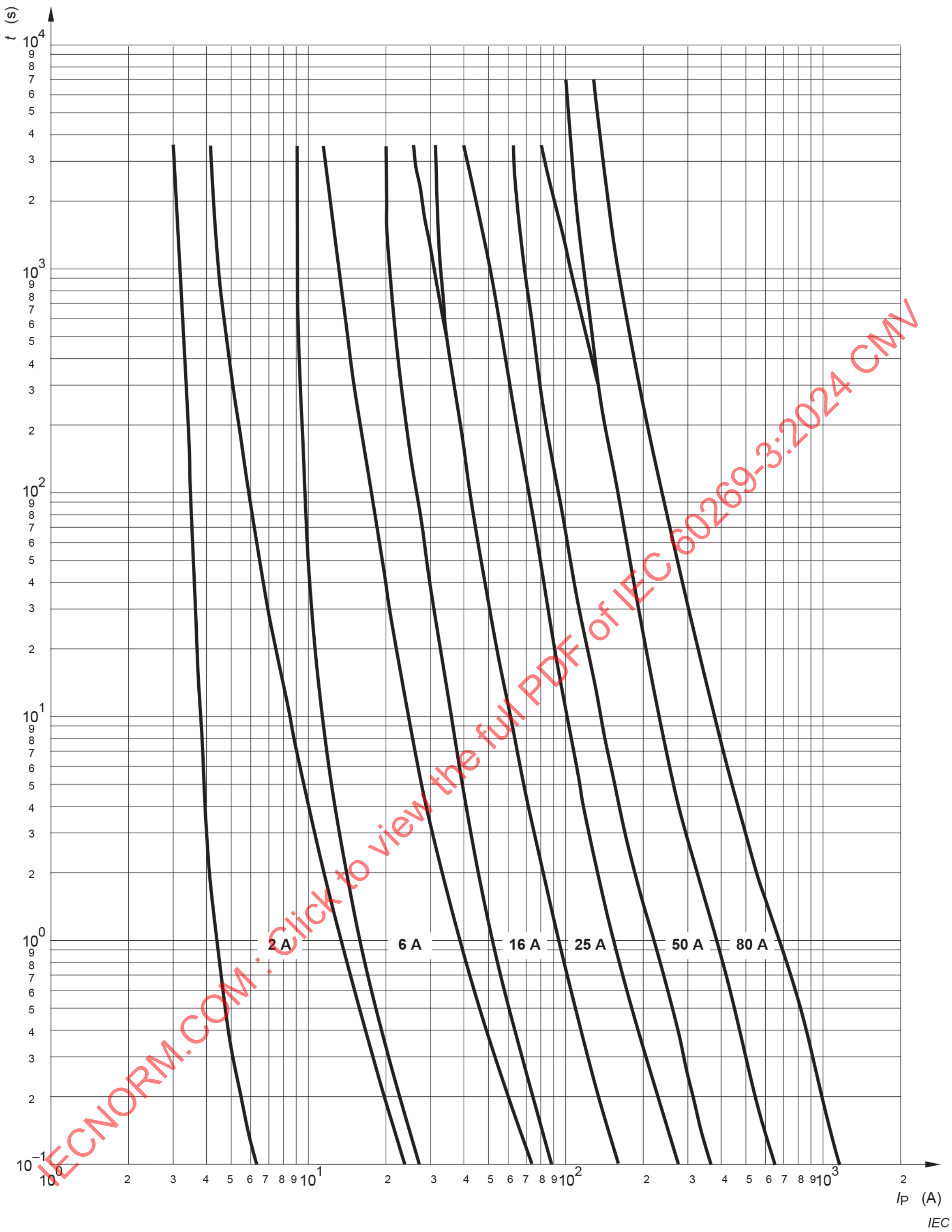


Figure 101 – Time-current zones for "gG" fuse-links

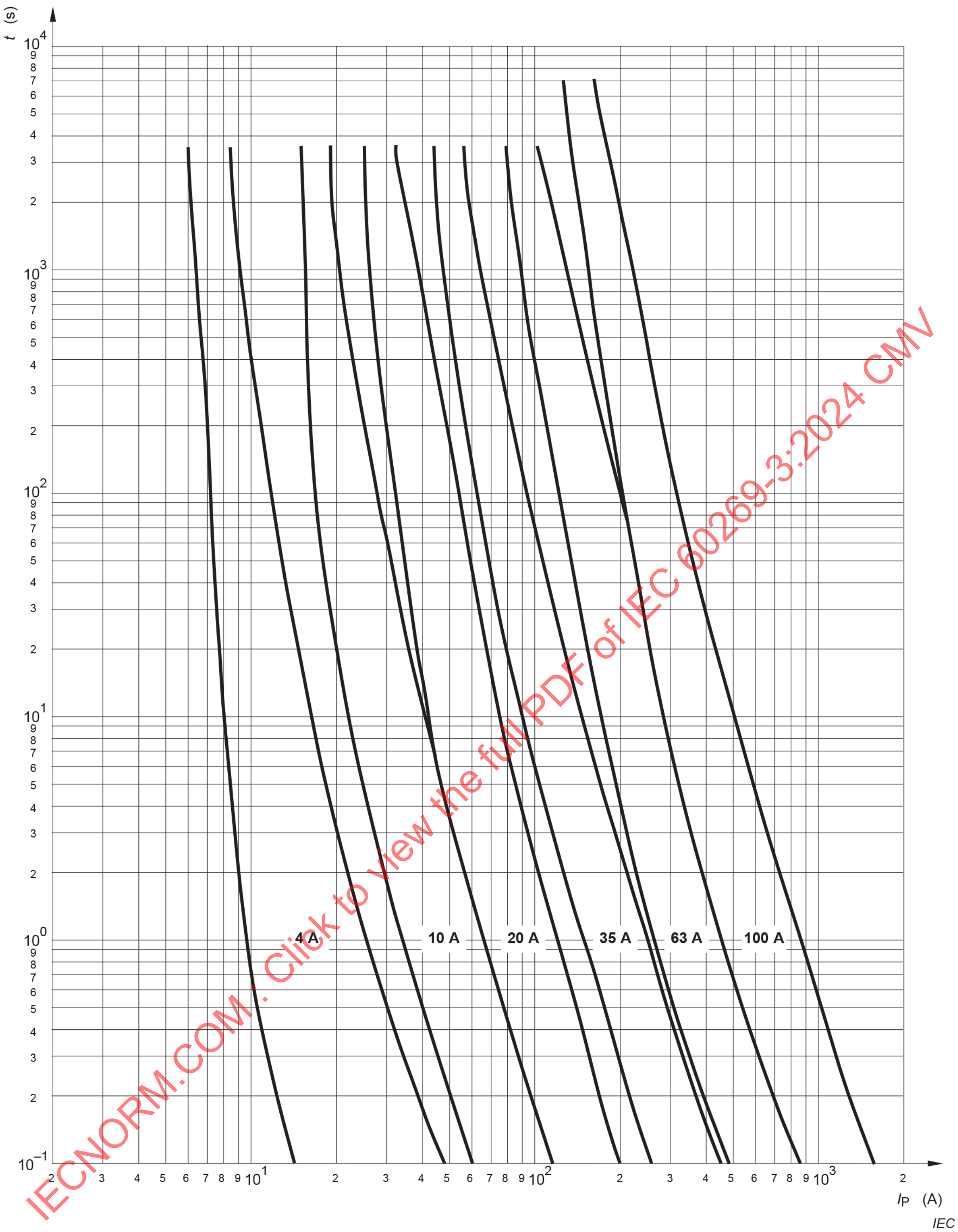


Figure 102 – Time-current zones for "gG" fuse-links

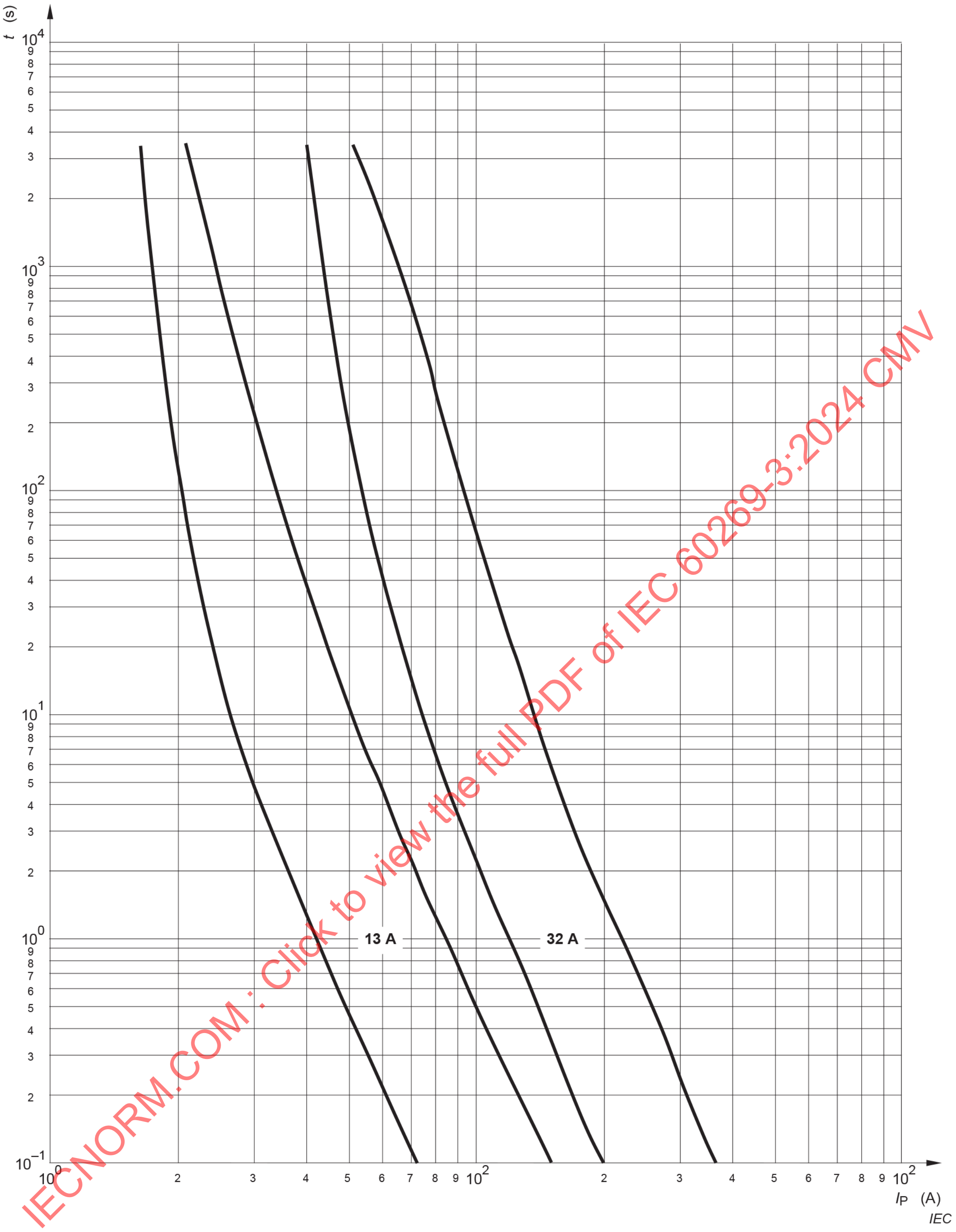
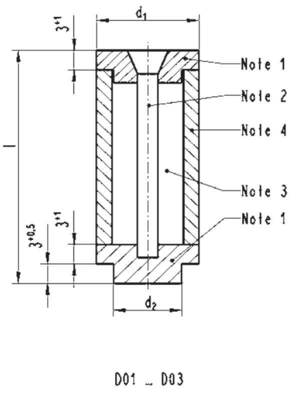
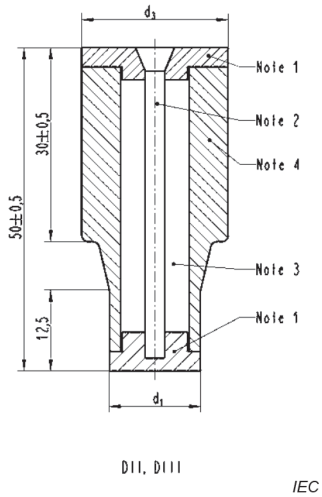


Figure 103 – Time-current zone for "gG" fuse-links 13 A and 32 A

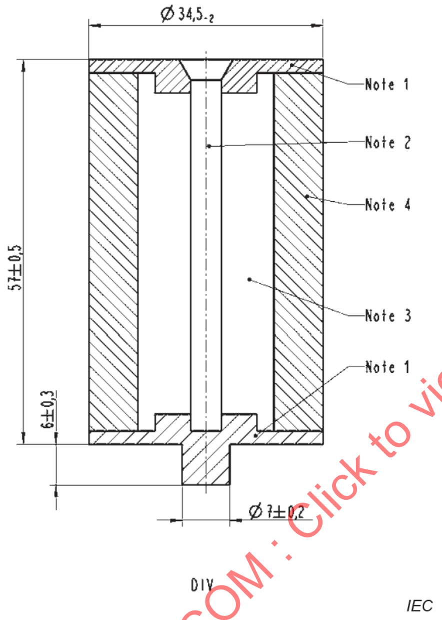




Dimensions in millimetres

Size	$d_{1}\ ^{0}_{-0,5}$	$d_{2}\ ^{0}_{-0,5}$	$l \pm 0,5$
D01	10,5	6	36
D02	15	10	36
D03	22	18	43

Size	$d_{1}\ ^{+0,2}_{-0,4}$	$d_{3}\ ^{0}_{-1,5}$
DII	14	22,5
DIII	20	28



NOTE 1 Contact CuZn, silver-plated.

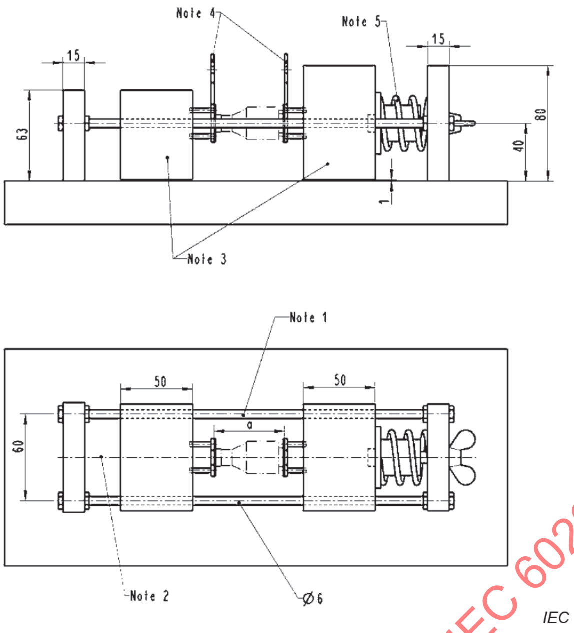
NOTE 2 Cu56Ni44 or an equivalent material with similar values of specific resistance and temperature coefficient.

NOTE 3 Quartz sand.

NOTE 4 Ceramic body.

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.

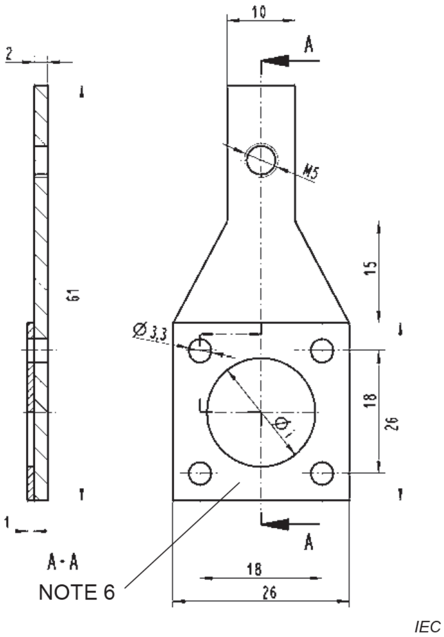
Figure 105 – Test rigs for fuse-links

Size	Dimensions		Contact force
	a [a] mm	∅ i mm	 N
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 %

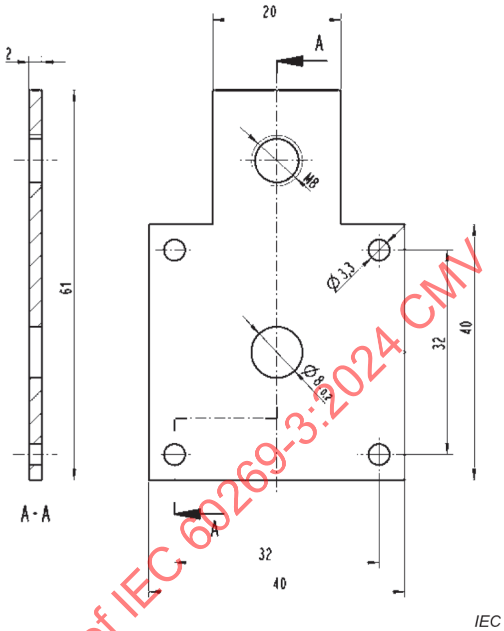
[a] See Figure 105.

Dimensions in millimetres

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



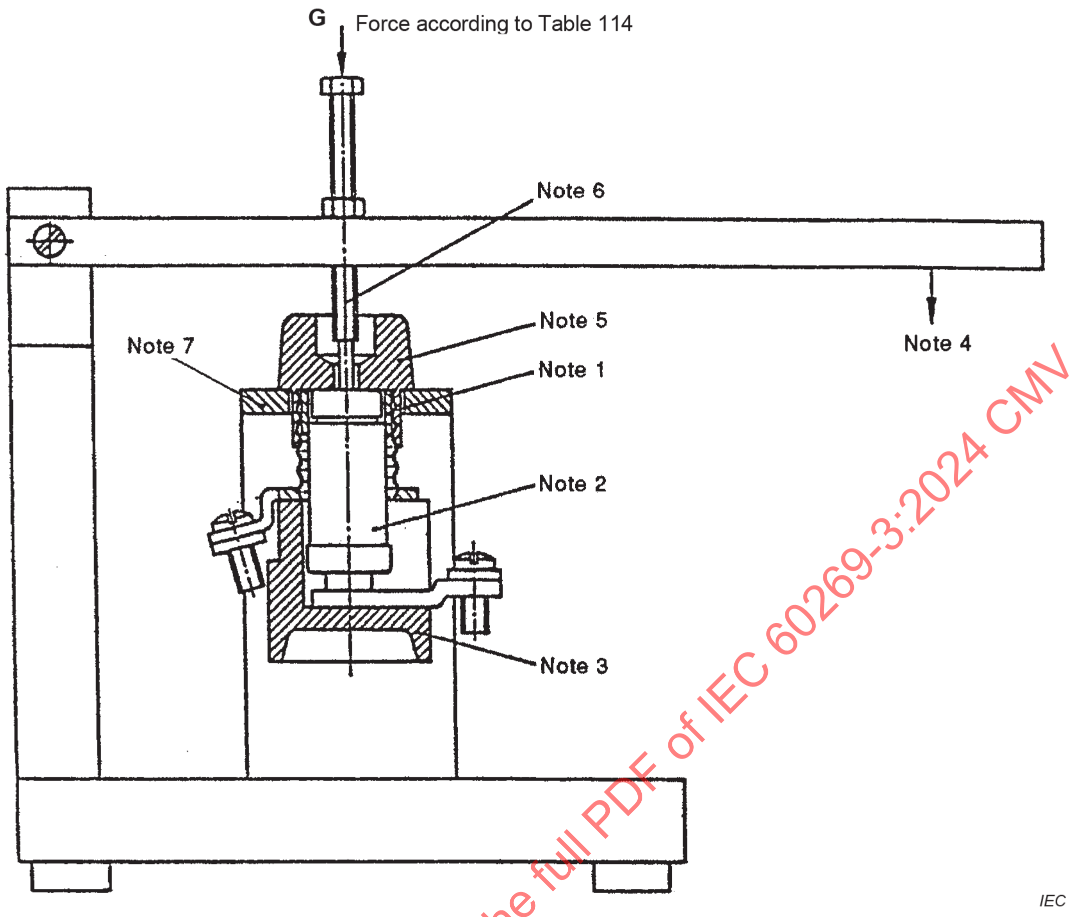
Sizes D01 to D03 and DII, DIII



Size DIV

NOTE 6 Centring plate of insulating material.

Figure 106 – Test rigs for fuse-links



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

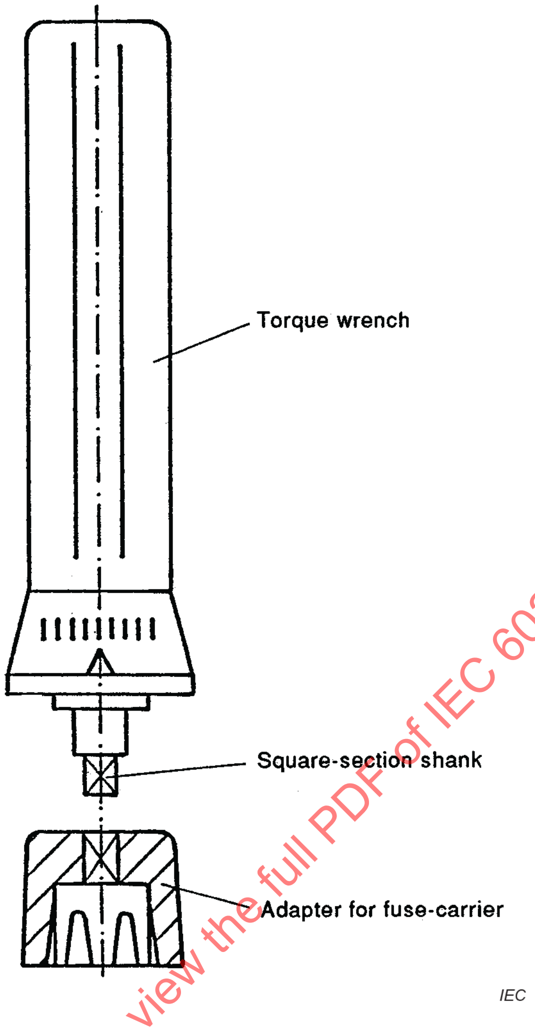


Figure 108 – Example of a torque wrench according to 8.9.2

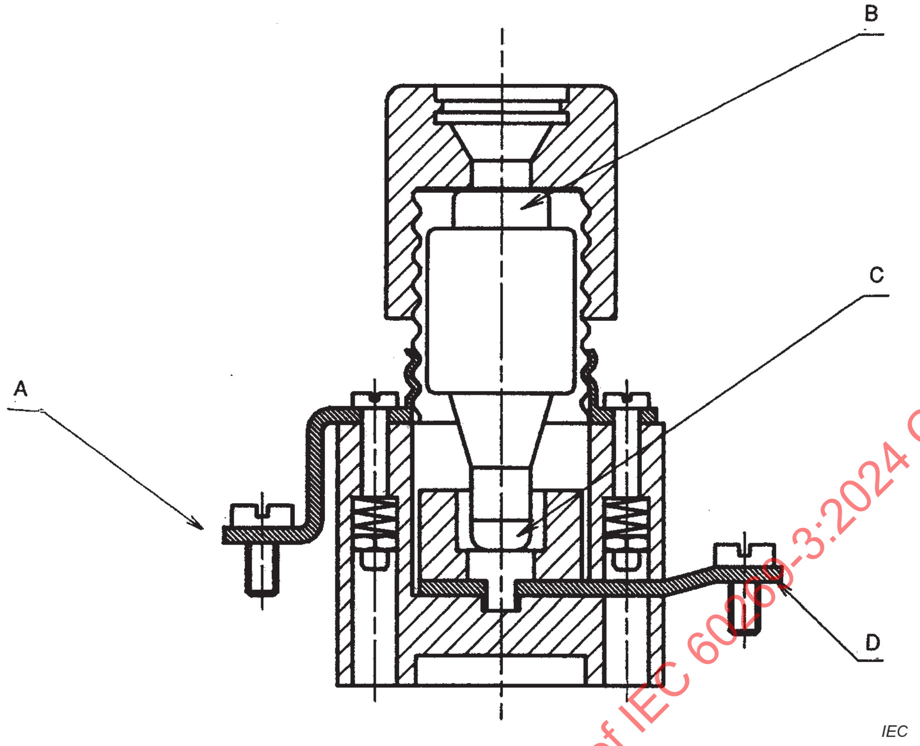
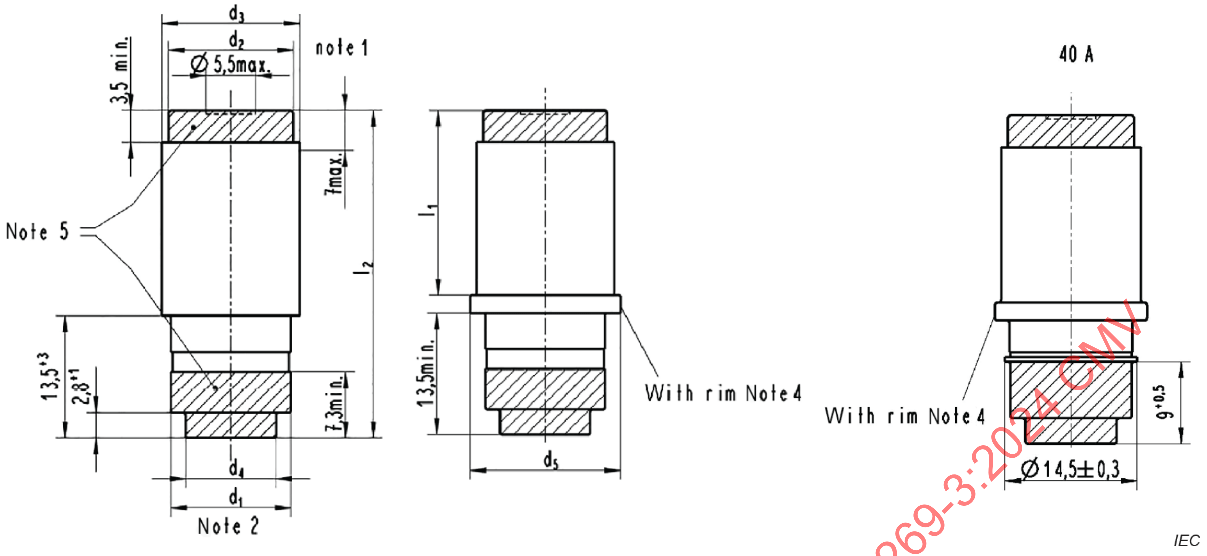


Figure 109 – Measuring points according to 8.3.3, 8.3.4.1 and 8.10.2 of fuse system A

Dimensions in millimetres



	I_n A	d_1 (note 2) ± 0,3 mm	d_2 (min.) mm	d_3 mm	d_4 (max.) mm	d_5 (note 4) mm	l_1 (note 4) mm	l_2 ± 1 mm	r (max.) mm
D01	2 4 6 10 13 16	7,3 7,3 7,3 8,5 8,5 9,7	9,8	$11^{0}_{-0,7}$	6	–	–	36	1
D02	20 25 32 35 40 50 (note 4) 63	10,9 12,1 13,3 13,3 13,3 14,5 15,9	13,8	$15,3^{0}_{-0,8}$	10	16,7 (max) 16,7 max.) 16,7 (max) 16,7 (max) 16,7 (max) $16,7^{0}_{-1,3}$ 16,7 (max.)	18,5	36	1
D03	80 (note 4) 100	22 25	20,6	$22,5^{0}_{-1}$	18	$25,6^{0}_{-2,3}$ 25,6 (max.)	22,5	43	1,6

NOTE 1 Diameter of fuse-indicator.

NOTE 2 The maximum value of d_1 shall not be exceeded within a range of 13,5 mm.

NOTE 4 Choice of manufacturer, obligatory for 50 A and 80 A. The rim is necessary for the 50 A and 80 A rating to ensure correct insertion. The rim may be used for other ratings in sizes D02 and D03.

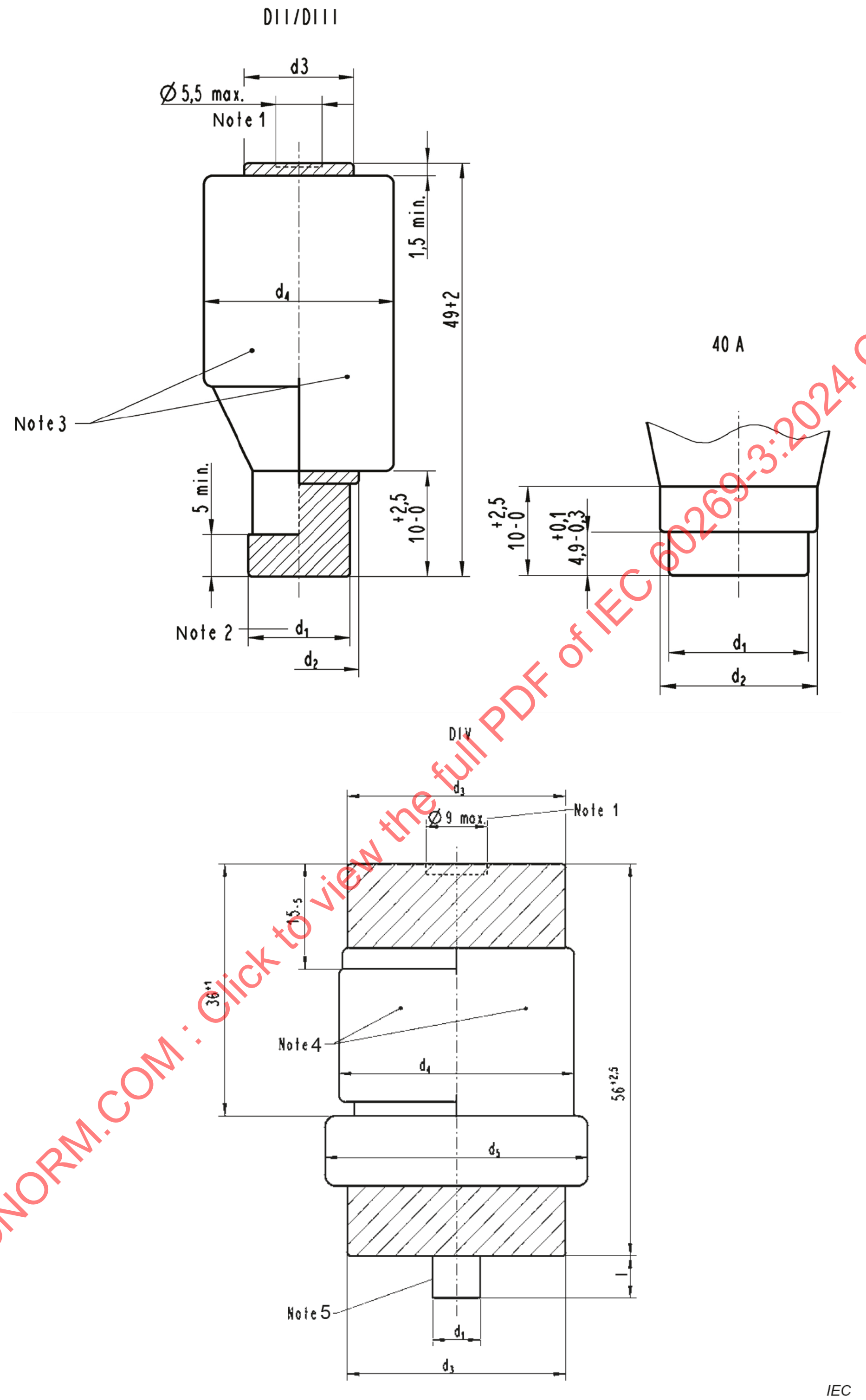
NOTE 5 Hatched areas specify contact areas.

Body of the fuse-link of ceramic material.

NOTE 6 The sketches are not intended to govern the design except as regards the dimensions shown.

Figure 110 – Fuse-link, D-type. Sizes D01-D03

Dimensions in millimetres



The sketches are not intended to govern the design except as regards the dimensions shown.

Hatched areas specify contact areas.

Body of the fuse-link of ceramic material.

	I_n A	d_1 (note 2) mm		d_2 (max.) mm	d_3 mm	d_4 mm	d_5 $^{0}_{-2}$ mm	l ±0,3 mm
DII	2	6	$^{+0,2}_{-0,4}$	14,2	11 min	22,5 $^{0}_{-1,5}$	–	–
	4							
	6							
	10	8						
	13							
	16	10			13 min			
	20	12						
	25	14						
DIII	32	16	$^{+0,2}_{-0,4}$	20,2	15 min	28 $^{0}_{-2}$	–	–
	35	16	$^{+0,2}_{-0,4}$	20,2	15 min	28 $^{0}_{-2}$	–	–
	40	16	±0,2	18,2	15 min	28 $^{0}_{-2}$	–	–
	50	18	$^{+0,2}_{-0,4}$	20,2	15 min	28 $^{0}_{-2}$	–	–
	63	20	$^{+0,2}_{-0,4}$	20,2	15 min	28 $^{0}_{-2}$	–	–
DIV	80 (6)	5	±0,2	–	32 $^{0}_{-8}$	34,5 $^{0}_{-2}$	38,5	6
	100	7						

I_n A	Colour of fuse-indicator
2	Pink
4	Brown
6	Green
10	Red
13	Black
16	Grey
20	Blue
25	Yellow
32	Violet
35	Black
40	Green
50	White
63	Copper
80	Silver
100	Red

NOTE 1 Diameter of fuse-indicator.

NOTE 2 The maximum value of d_1 shall not be exceeded within a range of 10 mm for fuse-links DII and DIII measured from the bottom contact.

NOTE 3 Alternative shape.

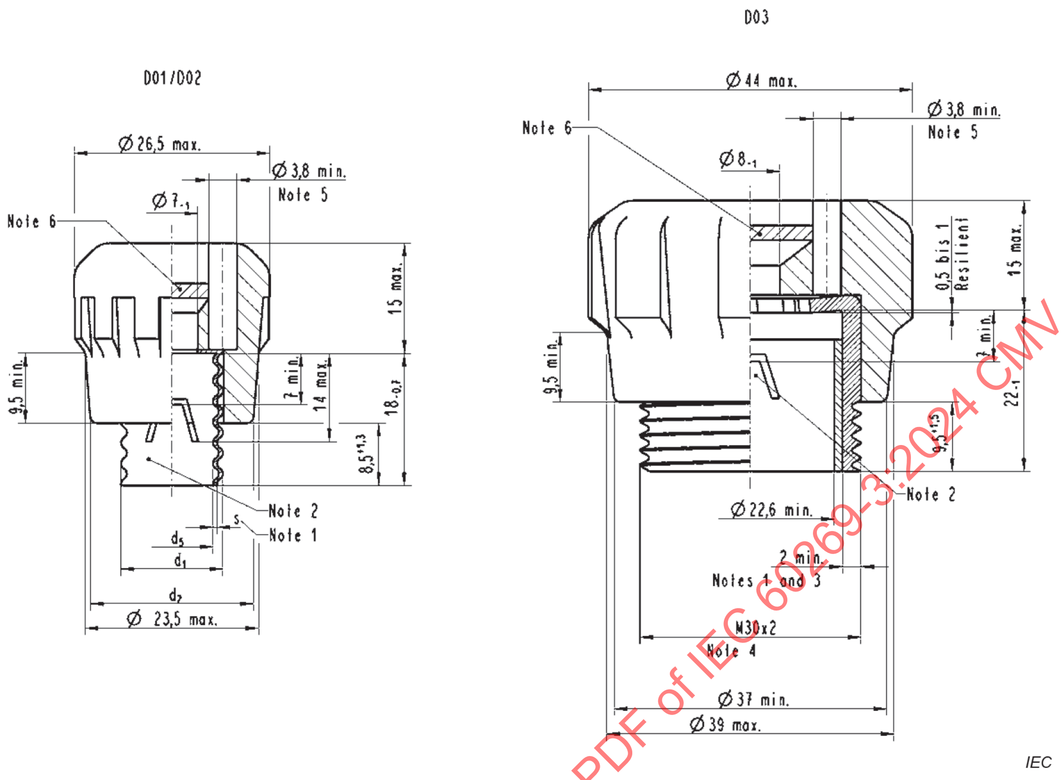
NOTE 4 Optional metal cover.

NOTE 5 The gauge-pin is not mandatory for fuse-links with rated current 80 A.

The use of these colours is mandatory also for sizes D01-D03.

Figure 111 – Fuse-link, D-type. Sizes DII-DIV

Dimensions in millimetres



The sketches are not intended to govern the design except as regards the dimensions shown.

Insulating parts of ceramic or other sufficiently heat-resistant material.

	I_n A	d_1 mm	d_2 **(min.)** mm	d_5 **(max.)** mm	s **(note 1)** **(min.)** mm
D01	16	E14	18	11,1	0,27
D02	63	E18	22	15,4	0,37

NOTE 1 Mean value.

NOTE 2 Retaining clip, other retaining means are allowed.

NOTE 3 Tolerance in the first turn of the thread $^{0}_{-0,25}$.

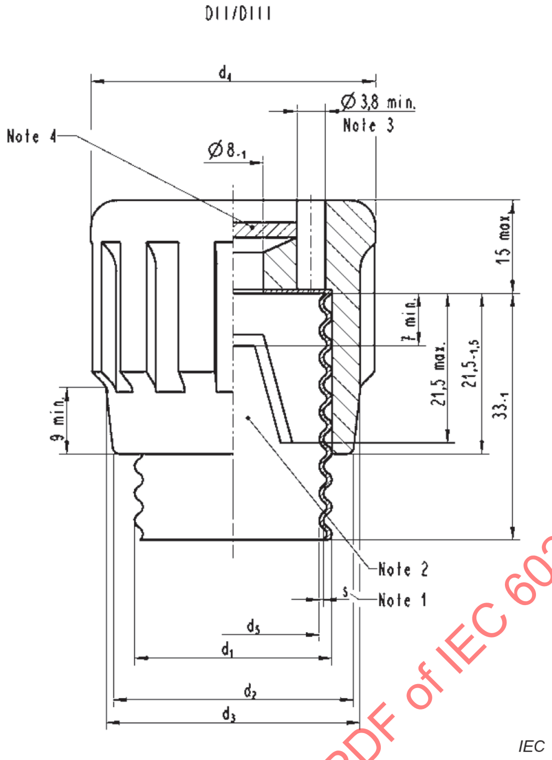
NOTE 4 Thread according to ISO 965-1, class designation 8g.

NOTE 5 The hole for the voltage tester is optional.

NOTE 6 Material: glass or other suitable transparent material.

Figure 112 – Fuse-carrier, D-type. Sizes D01-D03

Dimensions in millimetres



The sketches are not intended to govern the design except as regards the dimensions shown.

Insulating parts of ceramic or other sufficiently heat-resistant material.

	I_n A	d_1 mm	d_2 (min.) mm	d_3 (max.) mm	d_4 (max.) mm	d_5 (min.) mm	s (note 1) (min.) mm
DII	25	E27	32	34	38	22,6	0,27
DIII	63	E33	40	43	48	28,1	0,37

NOTE 1 Mean value.

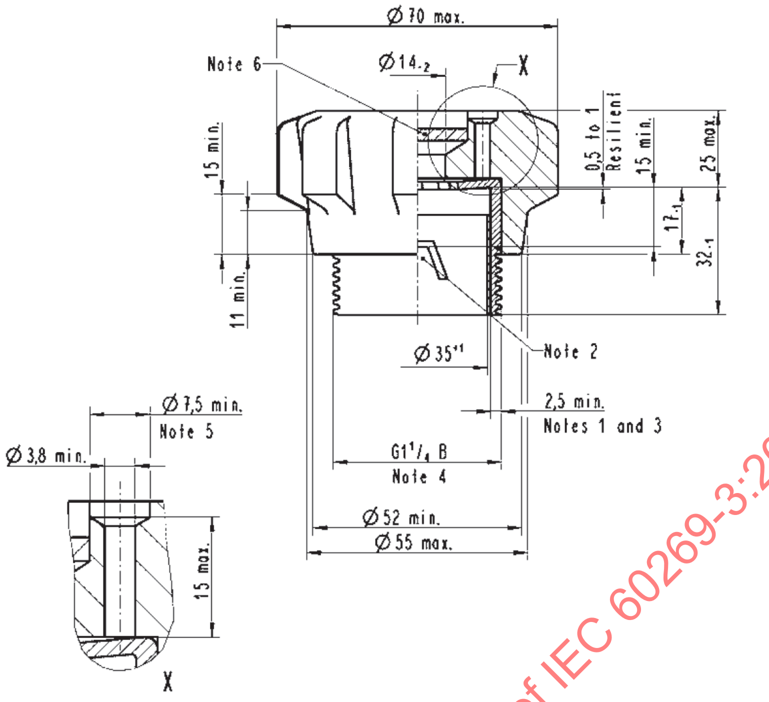
NOTE 2 Retaining clip, other retaining means are allowed.

NOTE 3 The hole for the voltage tester is optional.

NOTE 4 Material glass or other suitable transparent material.

Figure 113 – Fuse-carrier, D-type. Sizes DII-DIII

Dimensions in millimetres



The sketches are not intended to govern the design except as regards the dimensions shown.

NOTE 1 Mean value.

NOTE 2 Retaining clip, other retaining means are allowed.

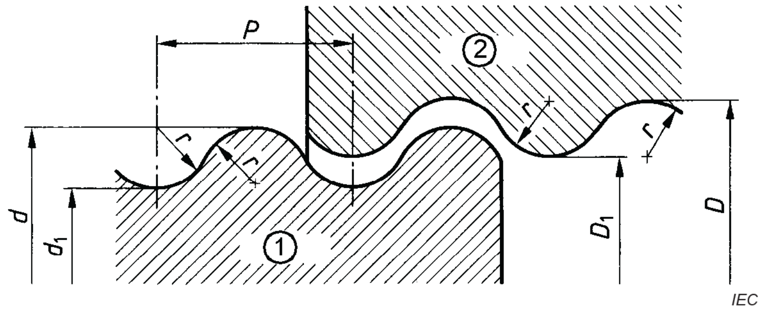
NOTE 3 Tolerance in the first turn of the thread $^{0}_{-0,5}$.

NOTE 4 Thread according to ISO 228-1; limit gauges according to ISO 228-2.

NOTE 5 The hole for the voltage tester is optional.

NOTE 6 Material: glass or other suitable transparent material.

Figure 114 – Fuse-carrier, D-type. Size DIV



Key

1 Bolt

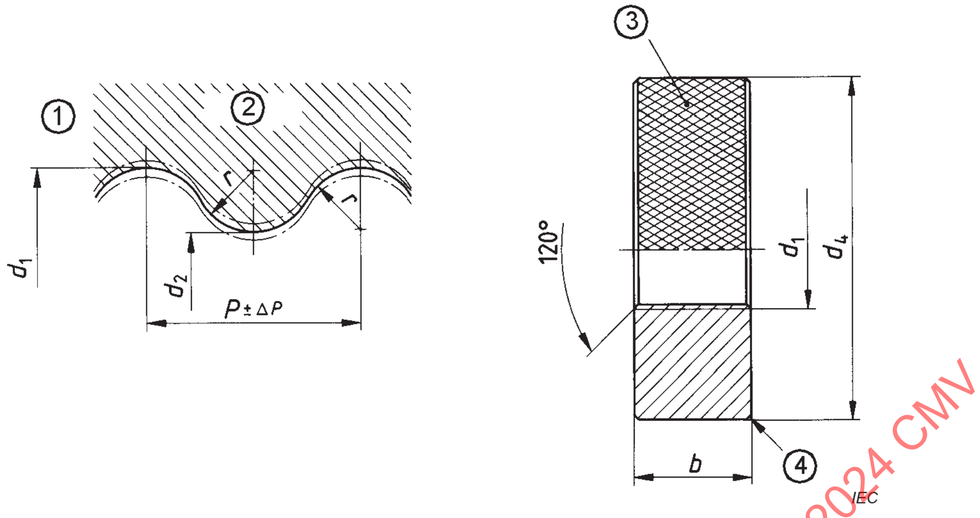
2 Nut

Dimensions in millimetres

Abbreviation	Bolt				Nut			
	External diameter d		Core diameter d_1		External diameter D		Core diameter D_1	
	Max.	Min.	Max.	Min.	Min.	Max.	Min.	Max.
E 14	13,89	13,7	12,29	12,1	13,97	14,16	12,37	12,56
E 18	18,5	18,25	16,8	16,55	18,6	18,85	16,9	17,15
E 27	26,45	26,15	24,26	23,96	26,55	26,85	24,36	24,66
E 33	33,05	32,65	30,45	30,05	33,15	33,55	30,55	30,95

Abbreviation	Threads per 25,4 mm z	Pitch P	Rounding r
E 14	9	2,822	0,822
E 18	≈ 8,5	3	0,875
E 27	7	3,629	1,025
E 33	6	4,233	1,187

Figure 115 – Edison thread for D-type fuses; limit dimensions



Key

1 Thread profile

2 Gauge

3 (Reference removed)

4 Chamfered or rounded

Material: steel, parts exposed to wear shall be hardened.

Dimensions in millimetres

Ring gauge	*b*	d_1 [a] mm	d_2 [b] mm	d_4 mm	*P*	*r*	Torques *M* Nm
E 14-D	16	13,89	12,29	38	2,822	0,822	1
E 18-D	20	18,5	16,8	45	3	0,875	1
E 27-D	24	26,45	24,26	63	3,629	1,025	1
E 33-D	32	33,05	30,45	71	4,233	1,187	1,5

[a] Maximum value of the external diameter of the bolt thread according to Figure 115.

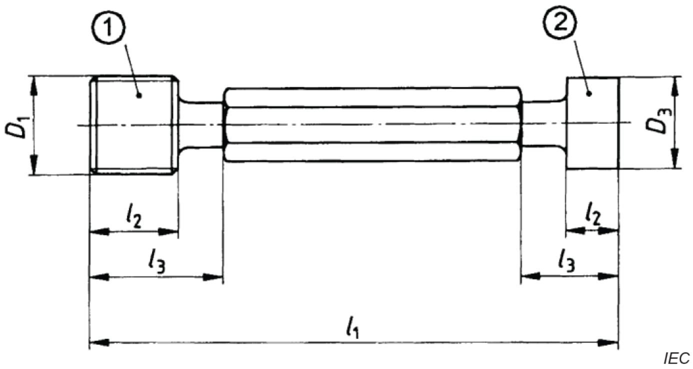
[b] Maximum value of the core diameter of the bolt thread according to Figure 115.

Ring gauge	Manufacturing tolerance for d_1 and d_2	Permissible wear for d_1 and d_2	Tolerance for the pitch T_p [c]
E 14-D	0 –0,025	+0,02 0	±0,01
E 18-D	0 –0,025	+0,02 0	±0,01
E 27-D	0 –0,03	+0,03 0	±0,01
E 33-D	0 –0,03	+0,04 0	±0,01

[c] The tolerance for the pitch is valid for any number of threads within the length of thread of the ring gauge.

It shall be possible to screw the go gauge on the whole length of the thread with the maximum torque M.

Figure 116 – Gauges for Edison thread for D-type fuses for screwed shells of fuse-carrier go ring gauges



Key

1 Thread plug gauge go

2 Thread plug gauge not-go

For details, see the drawing on the next page.

Material: steel, parts exposed to wear shall be hardened.

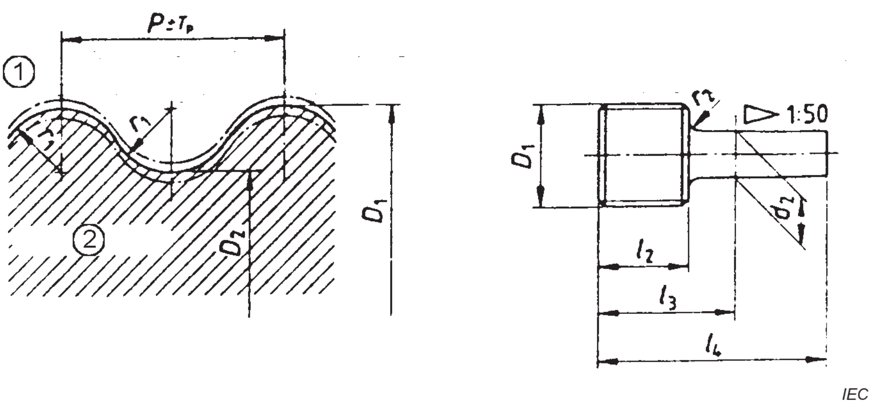
Dimensions in millimetres

Plug gauge	D_1 [a]	D_3 [b]	l_1 [c]	l_2		l_3	
				Thread go gauge $^{0}_{-0,3}$	Not go gauge $^{0}_{-0,3}$	Thread go gauge	Not go gauge
E 14-D-Gd	13,97	$12,56^{+0}_{-0,025}$	103	16	8	24	16
E 18-D-Gd	18,6	$17,15^{+0}_{-0,025}$	120	20	10	30	20
E 27-D-Gd	26,55	$24,66^{+0}_{-0,03}$	142	24	14	36	26
E 33-D-Gd	33,15	$30,95^{+0}_{-0,03}$	167	32	15	47	30

a See the following table.

b Maximum value of the core diameter of the nut thread according to Figure 115.

c The total length l_1 is an approximate dimension.



Key

1 Thread profile

2 Plug gauge

Dimensions in millimetres

Go plug gauge	D_1 [a]	D_2 [b]	d_2 ±0,01 mm	l_2 $^{0}_{-0,3}$	l_3 min.	l_4	P	r_1	r_2
E 14-D-Gk	13,97	12,37	7	16	24	44	2,822	0,822	2
E 18-D-Gk	18,6	16,9	12	20	30	52	3	0,875	2,5
E 27-D-Gk	26,55	24,36	12	24	36	60	3,629	1,025	2,5
E 33-D-Gk	33,15	30,55	16	32	47	72	4,233	1,187	4

[a] Lower limit of the external diameter of the nut thread according to Figure 115.

[b] Lower limit of the core diameter of the nut thread according to Figure 115.

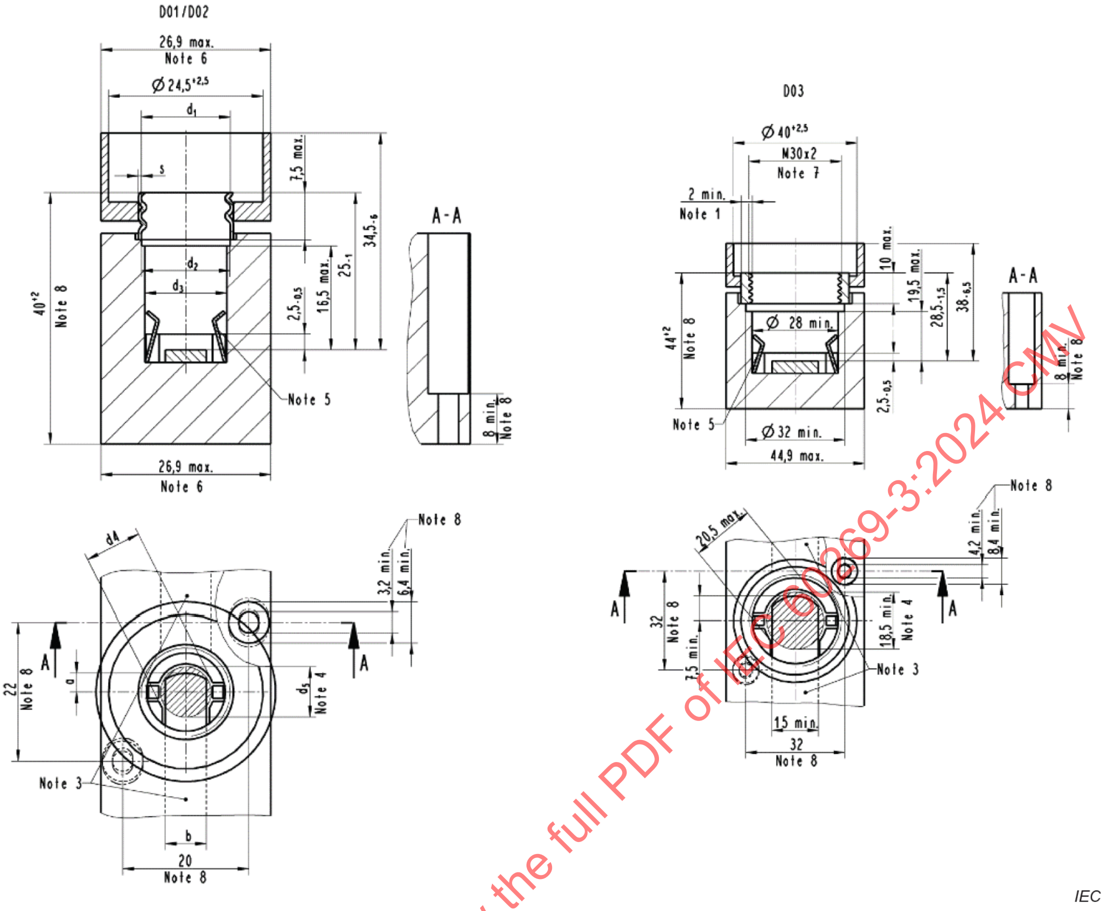
Go plug gauge	Manufacturing tolerance for D_1 and D_2	Permissible wear for D_1 and D_2	Tolerance for the pitch T_p [c]	Torque M Nm
E 14-D-Gk	+0,025 0	0 –0,02	±0,01	1
E 18-D-Gk	+0,025 0	0 –0,02	±0,01	1
E 27-D-Gk	+0,03 0	0 –0,03	±0,01	1
E 33-D-Gk	+0,03 0	0 –0,04	±0,01	1,5

[c] The tolerance for the pitch T_p is valid for any number of the thread being within the length of thread.

It shall be possible to screw the go gauge home at least with the maximum torque M. The not- go gauge shall not engage under its own weight.

Figure 117 – Gauges for Edison thread, D-type fuses, go and not-go plug gauges for screwed shells of fuse-bases

Dimensions in millimetres



	I_n	*a* (min.)	*b* (min.)	d_1	d_2 (min.)	d_3 (min.)	d_4	D_6 (min.)	*s* (min.)		*Q* (note 3) (min.)
	A	mm	mm	mm	mm	mm	mm	mm	mm	Tolerance (note 1)	mm²
D01	16	2,5	5	E14	15	13	9,7 max.	6,5	0,3	–0,05	10
D02	63	4	6	E18	19,5	17	13,7 max.	10,5	0,65	–0,15	30
D03	100	See sketch								–0,25	60

NOTE 1 Tolerance in first turn of the thread.

NOTE 2 Preferred value – for fuse-bases for rail-mounting, this value refers to the top edge of the mounting rail.

NOTE 3 Cross-sectional area of the connecting strips at least *Q* mm². The cross-sectional area of the connecting strips may be reduced in the region of their own fixing means and in the region of terminals. The cross-sectional area of the connecting strips is calculated for an alloy containing at least 62 % copper. Connecting strips made of pure copper or other materials with better conductivity than that of the calculated copper alloy may have corresponding lower cross-sectional areas.

NOTE 4 Within the hatched circle area no projection is allowed above the contact area.

NOTE 5 Resilient grip for gauge-piece. A conductive connection between the grip and live parts is not allowed.

NOTE 6 For multiple fuse-bases, the multiple value is relevant.

NOTE 7 Thread according to ISO 965-1, class designation 7H.

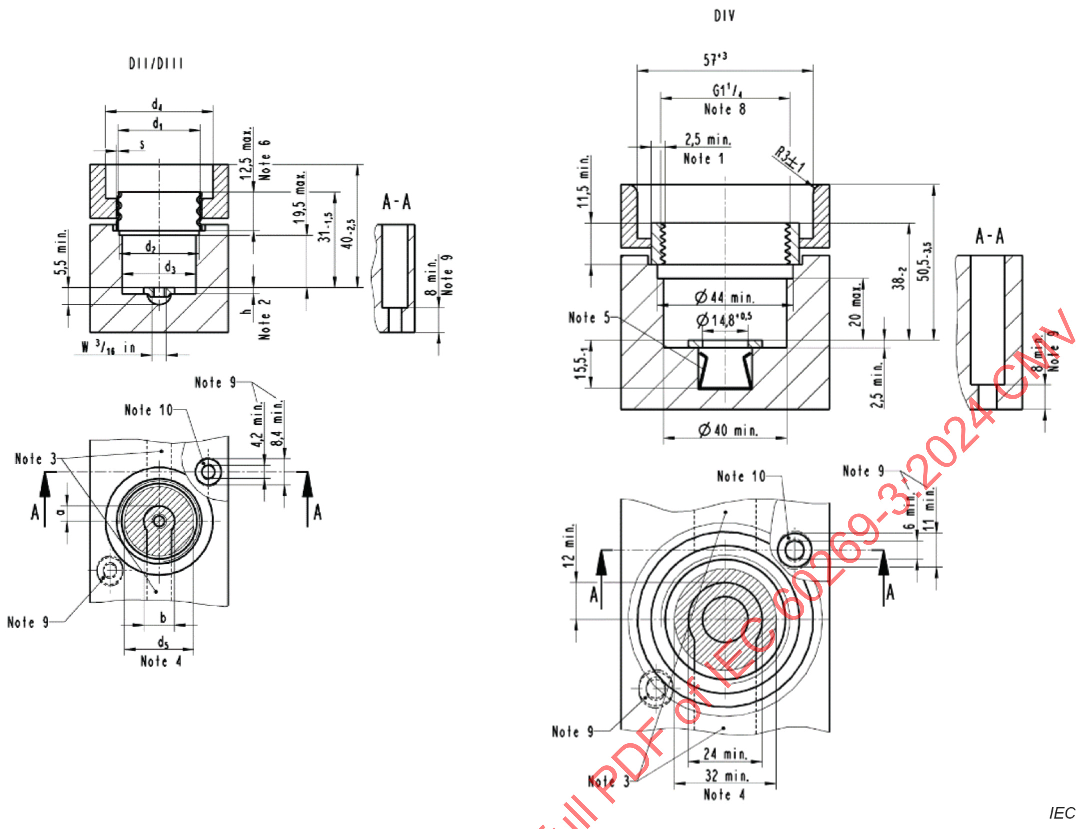
NOTE 8 Not applicable for fuse-bases for busbar mounting.

Insulating parts of ceramic or other sufficiently heat resistant material.

The sketches are not intended to govern the design except as regards the dimensions shown.

Figure 118 – Fuse-base, D-type. Sizes D01-D03

Dimensions in millimetres



The sketches are not intended to govern the design except as regards the dimensions shown.

Insulating parts of ceramic or other sufficiently heat-resistant material.

	I_n	a (min.)	b (min.)	d_1	d_2 (min.)	d_3 (min.)	d_4 (note 7)	d_5 (min.)	h (note 2) (min.)	s (min.)		Q (note 3) (min.)
	A	mm	mm	mm	mm	mm	mm	mm	mm	mm	Tolerance (note 1)	mm²
DII	25	5	10	E27	27	25,5	$35\ ^{+2}_{0}$	24,5	2	0,5	–0,1	15
DIII	63	6	12	E33	33,5	31,5	$45\ ^{+2,5}_{0}$	30,5	2,5	0,65	–0,15	30
DIV	100	See sketch									–0,5	60

NOTE 1 Tolerance in first turn of the thread.

NOTE 2 Only the thickness of the bottom of the connecting strip, minimum effective length of thread in connecting strip: 2,2 mm (DII) and 3,2 mm (DIII) for W3/16 in.

NOTE 3 Cross-sectional area of the connecting strip at least Q mm². The cross-sectional area of the connecting strips may be reduced in the region of their own fixing means and in the region of terminals. The cross-sectional area of the connecting strips is calculated for an alloy, containing at least 62 % copper. Connecting strips, made of pure copper or other materials with improved electrical and thermal conductivity than the calculated copper alloy may have corresponding lower cross-sectional areas.

NOTE 4 Within the hatched circle area no projection is allowed above the contact area.

NOTE 5 Resilient grip for gauge-piece.

NOTE 6 Effective thread length at least 7 mm from the top of the screwed shell.

NOTE 7 When fuse-bases of size DIII are used in assemblies (for example, consumer units) the tolerance of the diameter d_4 of the corresponding protection covers may be reduced to $45\ ^{0}_{-1,5}$.

NOTE 8 Thread according to ISO 228-1; limit gauges according to ISO 228-2.

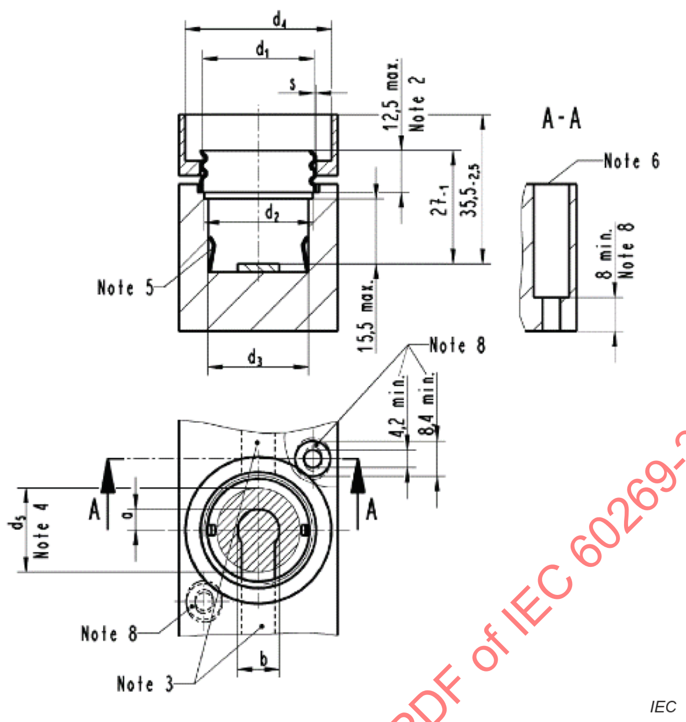
NOTE 9 Not applicable for fuse-bases for busbar mounting.

NOTE 10 Alternatively closed or open, oval holes permitted.

Figure 119 – Fuse-base, D-type. Sizes DII-DIV

The sketches are not intended to govern design except as regards the dimensions shown.

Dimensions in millimetres



Dimensions in millimetres

	I_n	*a* (min.)	*b* (min.)	d_1	d_2 (min.)	d_3 (min.)	d_4 (note 7)	d_5 (min.)	*s* (min.)		*Q* (note 3) (min.)
	A	mm	mm	mm	mm	mm	mm	mm	mm	Tolerance (note 1)	mm²
DII	25	5	10	E27	27	25,5	35^{+2}_{0}	24,5	0,5	–0,1	15
DIII	63	6	12	E33	33,5	31,5	$45^{+2,5}_{0}$ (7)	30,5	0,65	–0,15	30

Insulating parts of ceramic or other sufficiently heat-resistant material.

Current-carrying parts of copper or copper alloy.

NOTE 1 Tolerance in first turn of the thread: $^{0}_{-0,1}$ (E27)

$^{0}_{-0,15}$ (E33).

NOTE 2 Effective thread length at least 7 mm from the top of the screwed shell.

NOTE 3 Cross-sectional area of the connecting strips: at least Q mm². The cross-sectional area of the connecting strips may be reduced in the region of their own fixing means and in the region of terminals. The cross-sectional area of the connecting strips is calculated for an alloy, containing at least 62 % copper. Connecting strips, made of pure copper or other material with improved electrical and thermal conductivity than the calculated copper alloy may have corresponding lower cross-sectional areas.

NOTE 4 Within the hatched circle area, no projection is allowed above the contact area.

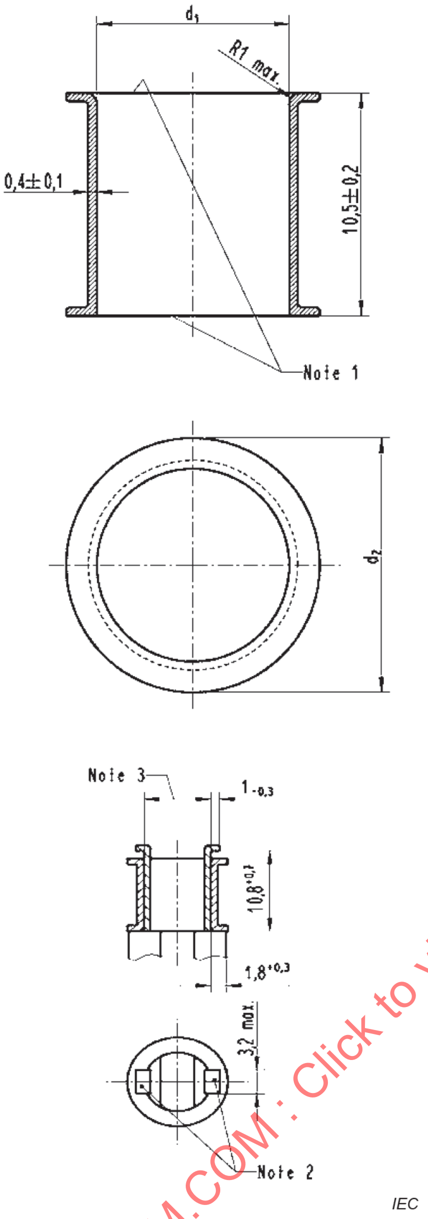
NOTE 5 Resilient grip for gauge-piece.

NOTE 6 Alternatively closed or open, oval holes permitted.

NOTE 7 When fuse-bases size DIII are used in assemblies (for example, consumer units), the tolerance of the diameter d_4 of corresponding protection covers may be reduced to $45^{\ 0}_{-1,5}$ mm.

NOTE 8 Not applicable for fuse-bases for busbar mounting.

Figure 120 – Fuse-base, D-type for push-in gauge pieces. Size DII-DIII



	I_n A	d_1 ±0,1	d_2 ±0,1
D01	2	7,9	12
	4	7,9	
	6	7,9	
	10	9,1	
	13	9,1	
	16	(note 4)	(note 4)
D02	20	11,5	16,6
	25	12,7	
	32	13,9	
	40	15,1	
	35	13,9	
	50	15,1	
	63	(note 4)	(note 4)
D03	80	23	27
	100	(note 4)	(note 4)

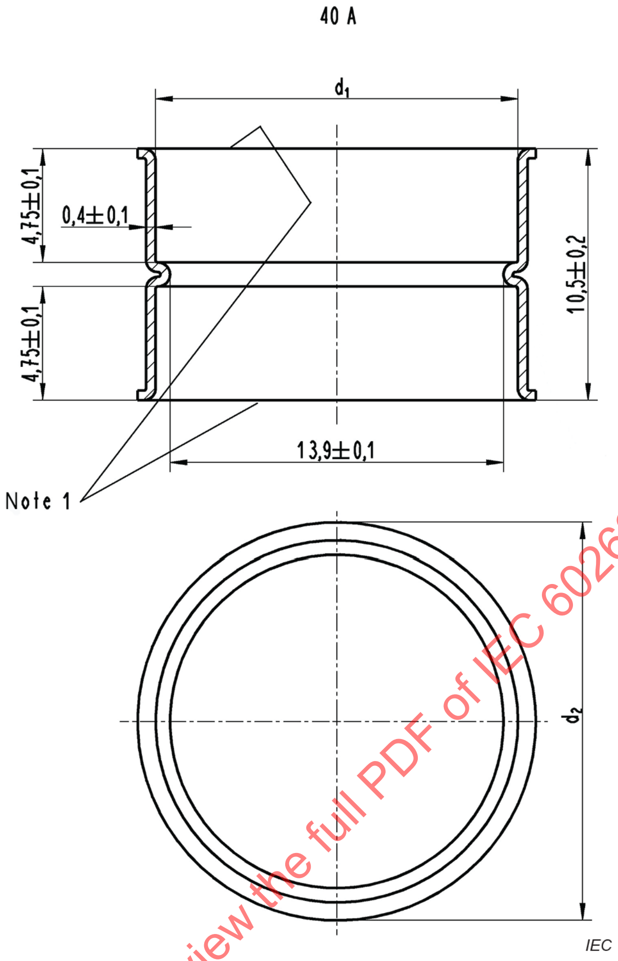
NOTE 1 Coloured according to Figure 111 (table).

NOTE 2 Grip of the working head.

NOTE 3 Resilient between 5 mm and 24 mm.

NOTE 4 Gauge-pieces do not apply to the maximum rating.

Dimensions in millimetres



Gauge-piece 40A

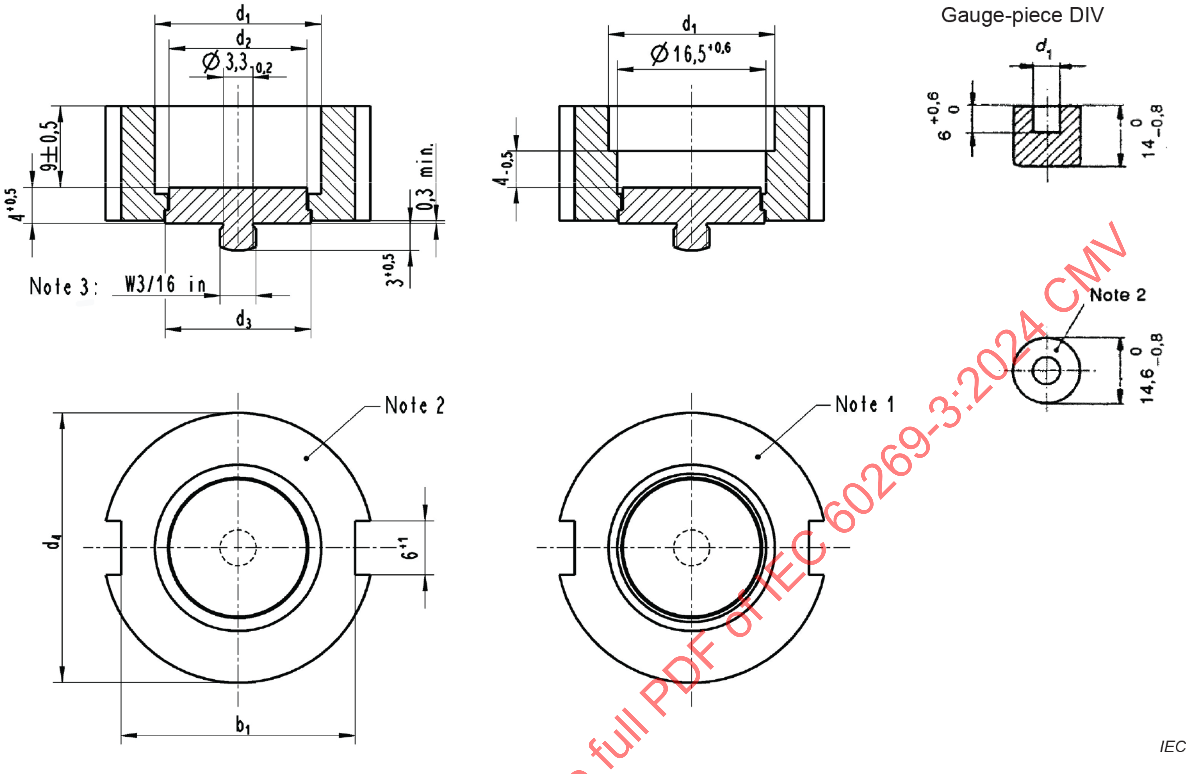
The sketches are not intended to govern design except as regards the dimensions shown.

Figure 121 – Gauge-piece and hand-key, D-type. Sizes D01-D03

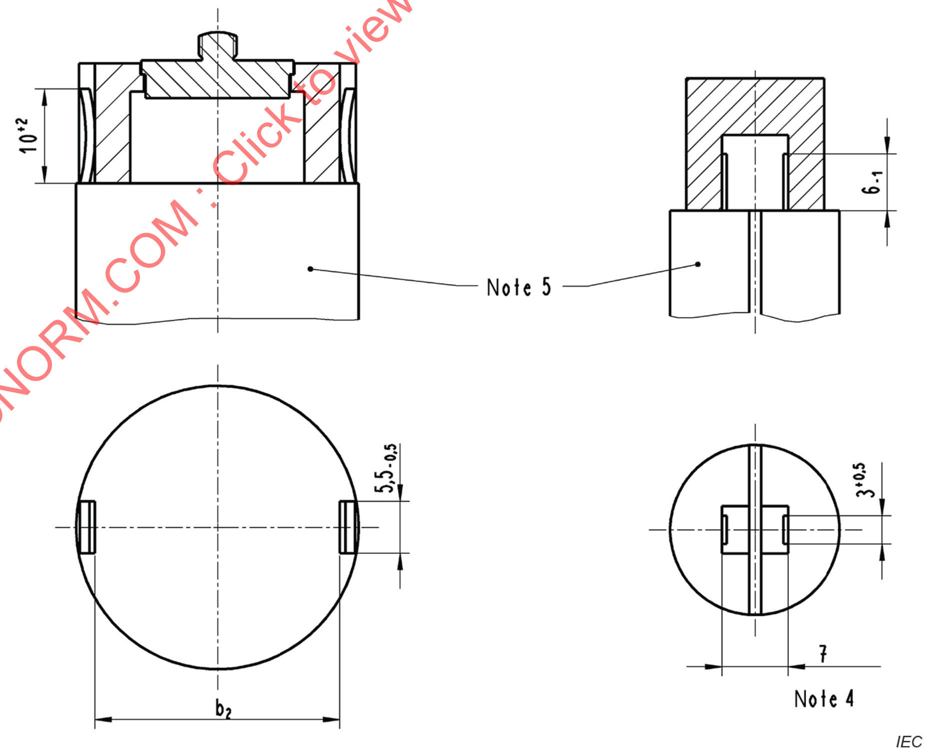
Dimensions in millimetres

Screw-in gauge piece

40A



Insulating part of ceramic material



The sketches are not intended to govern design except as regards the dimensions shown.

<table>
<tr><th></th><th>I_n
A</th><th>d_1
mm</th><th></th><th>d_2
(min.)
mm</th><th>d_3
(min.)
mm</th><th>d_4
0
−1,5
mm</th><th>b_1
(min.)
0
−1,5
mm</th><th>b_2
(max.)
mm</th></tr>
<tr><td rowspan="8">DII</td><td>2</td><td>6,5</td><td rowspan="8">+0,8
0</td><td rowspan="3">4,5</td><td rowspan="5">6,5</td><td rowspan="8">24</td><td rowspan="8">20</td><td rowspan="8">19
(note 6)</td></tr>
<tr><td>4</td><td>6,5</td></tr>
<tr><td>6</td><td>6,5</td></tr>
<tr><td>10</td><td>8,5</td><td rowspan="2">6,5</td></tr>
<tr><td>13</td><td>8,5</td></tr>
<tr><td>16</td><td>10,5</td><td>8,5</td><td>8,5</td></tr>
<tr><td>20</td><td>12,5</td><td rowspan="2">9,5</td><td rowspan="2">9,5</td></tr>
<tr><td>25</td><td>14,5</td></tr>
<tr><td rowspan="5">DIII</td><td>32</td><td>16,5</td><td rowspan="2">+0,8
0</td><td rowspan="2">15</td><td rowspan="2">15</td><td rowspan="2">30</td><td rowspan="2">26</td><td rowspan="2">25
(note 7)</td></tr>
<tr><td>35</td><td>16,5</td></tr>
<tr><td>40</td><td>18,5</td><td>+0,6
0</td><td>15</td><td>15</td><td>30</td><td>26</td><td>25
(note 7)</td></tr>
<tr><td>50</td><td>18,5</td><td>+0,8
0</td><td>15</td><td>15</td><td>30</td><td>26</td><td>25
(note 7)</td></tr>
<tr><td>63</td><td>20,5</td><td>+0,8
0</td><td>15</td><td>15</td><td>30</td><td>26</td><td>25
(note 7)</td></tr>
<tr><td rowspan="2">DIV</td><td>80</td><td>6</td><td rowspan="2">±0,5</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>100</td><td>8</td><td>–</td><td>–</td><td>–</td><td>–</td><td>–</td></tr>
</table>

NOTE 2 Coloured according to Figure 111 (table).

NOTE 3 Effective thread length at least 2,5 mm.

NOTE 4 Resilient between 5 mm and 9 mm.

NOTE 5 Insulating material.

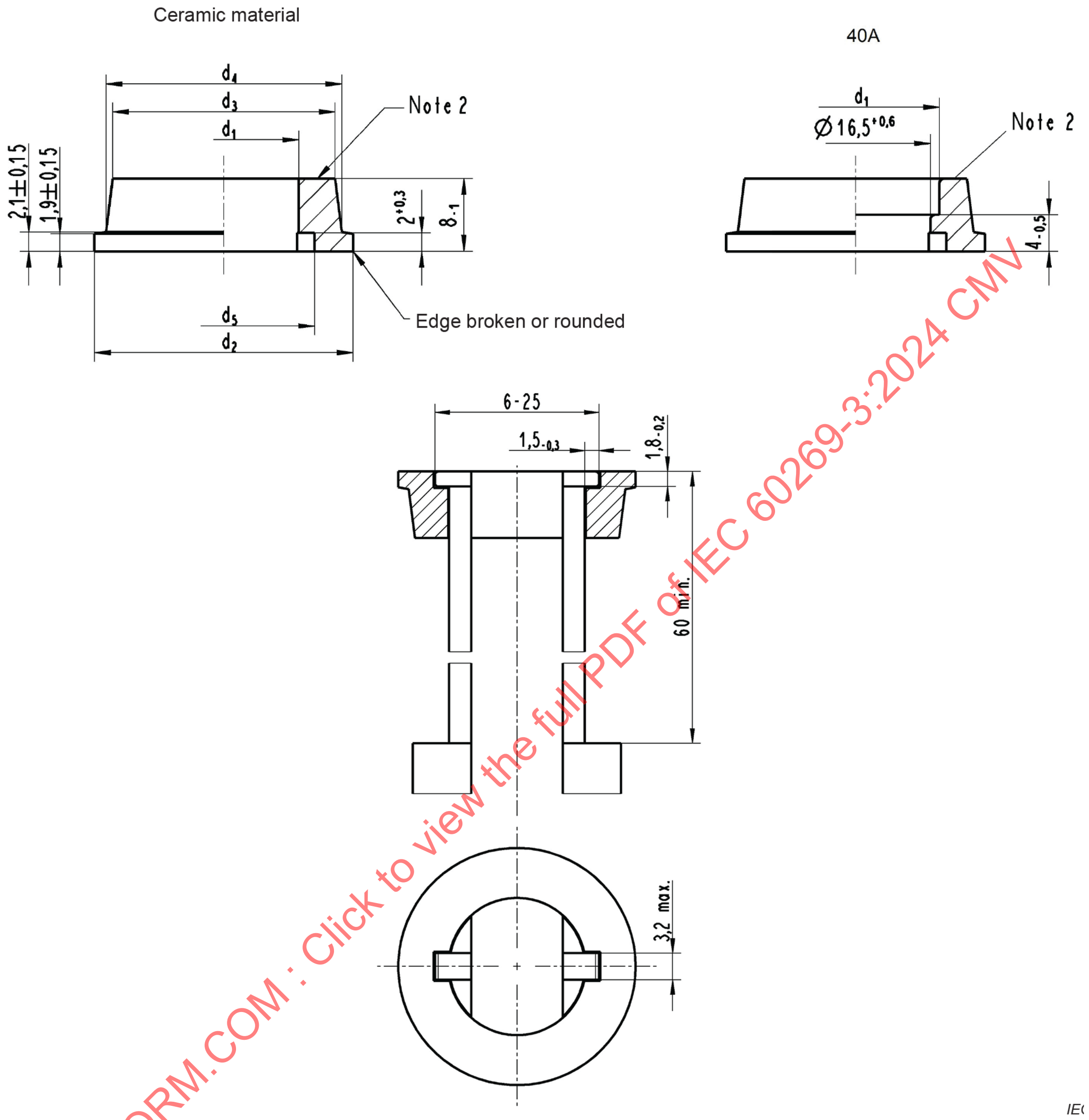
NOTE 6 Resilient between 18 mm and 20,5 mm.

NOTE 7 Resilient between 24 mm and 26,5 mm.

Figure 122 – Gauge-piece and hand-key, D-type. Sizes DII-DIV

Gauge-piece DII/DIII

Dimensions in millimetres



The sketches are not intended to govern design except as regards the dimensions shown

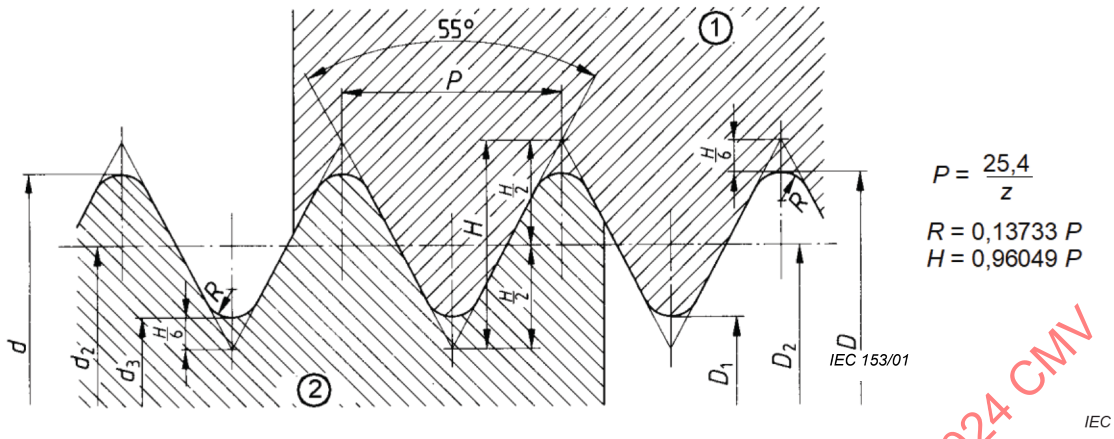
	I_n A	d_1 +0,8 mm	d_2 ±0,5 mm	d_3 ±0,5 mm	d_4 ±0,5 mm	d_5 (min.) mm	**Colour of the front surface**
	2						Pink
	4	6,5				10	Brown
	6						Green
DII	10	8,5	22,5	18,5	20,5	12	Red
	16	10,5				14	Grey
	20	12,5				15,5	Blue
	25	(see Note 3)					
	2						Pink
	4	6,5				10	Brown
	6						Green
	10	8,5				12	Red
	16	10,5				14	Grey
DIII	20	12,5	28,5	24,5	26,5	16	Blue
	25	14,5				18	Yellow
	32	16,5				20	Violet
	35	16,5				20	Black
	40			See Figure			Green
	50	18,5				21,5	White
	63	(see Note 3)					

NOTE 2 Coloured surface.

NOTE 3 Gauge-pieces do not apply to the maximum ratings.

Figure 123 – Gauge-piece and hand-key, D-type push-in gauge rings. Size DII-DIII

Dimensions in millimetres



Key

1 Nut

2 Bolt

Nominal sizes

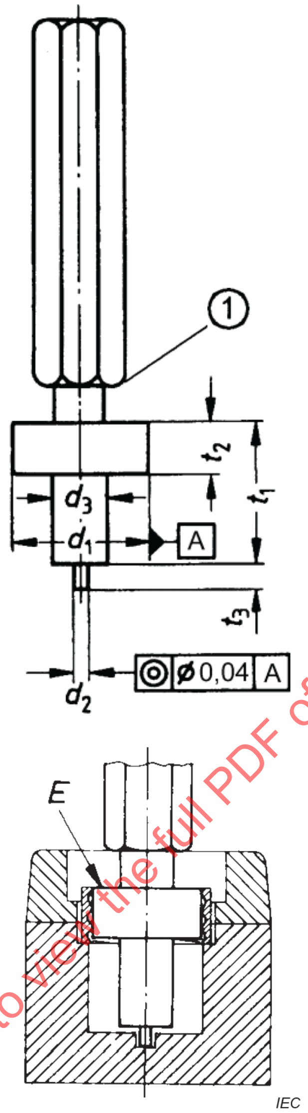
Abbreviation	Full thread $d = D$	Threads per 25,4 mm z	Pitch P	Thread-pitch diameter $d_2 = D_2$	Core diameter $d_3 = D_1$	Core cross-section mm^2
W3/16	4,762	24	1,058	4,084	3,406	9,1

Thread limits

Abbreviation	Bolt thread						Nut thread				
	External diameter		Thread-pitch diameter		Core diameter		External diameter	Thread-pitch diameter		Core diameter	
	d		d_2		d_3		D	D_2		D_1	
	mm		mm		mm						
	Max.	Min.	Max.	Min.	Max.	Min.	Min.	Max.	Min.	Max.	Min.
W3/16	4,732	4,593	4,054	3,965	3,376	3,183	4,762	4,216	4,084	3,744	3,406

Figure 124 – Whitworth thread W 3/16 for screw-in gauge rings and corresponding fuse-bases of sizes DII and DIII

Dimensions in millimetres



Key

1 Slightly rounded edge

Size	d_1		d_2		d_3	t_1		t_2		t_3		Gauge
	Max.	Min.	Max.	Min.		Max.	Min.	Max.	Min.	Max.	Min.	
DII	24,3	24,2	3	2,9	12	31	30,5	11,5	11	5	4,5	C 17 A
DIII	30,5	30,4	3	2,9	12	31	30,5	11,5	11	5	4,5	C 17 B
DIV	38,9	38,8	14,4	14,3	24	38	37,5	17	16,5	14	13,5	C 17 C
D01	12,3	12,2	6,2	6,1	10	22	21,75	7	6,5	3	2,75	C 17 E
D02	16,85	16,75	10,2	10,1	14	22	21,75	7	6,5	3	2,75	C 17 F
D03	27,7	27,6	18,2	18,1	22	25,5	25,25	9,5	9	3	2,75	C 17 G

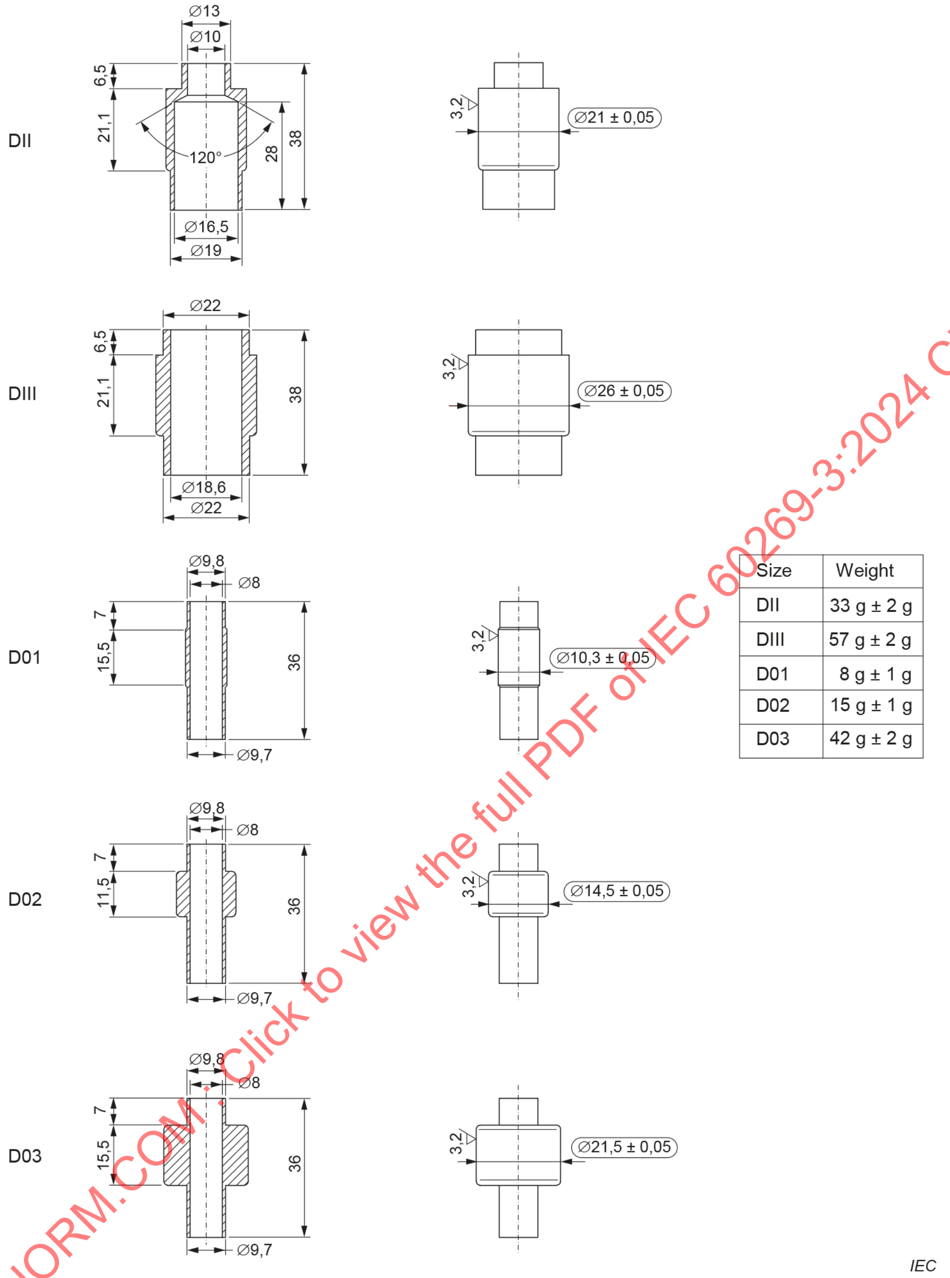
The gauges are intended for checking that the hole for the gauge-piece in the bottom contact (sizes DII to DIV) or that the hollow space (sizes D01 to D03) is concentric with the thread of the screwed shell.

It shall be possible to introduce the gauge without undue force into the fuse-base so that the surface E is approximately level with the upper edge of the screwed shell.

Material: steel.

Figure 125 – Gauges C 17 for concentricity of fuse-bases

Dimensions in millimetres
Undimensioned radiuses R0,6



Size	Weight
DII	33 g ± 2 g
DIII	57 g ± 2 g
D01	8 g ± 1 g
D02	15 g ± 1 g
D03	42 g ± 2 g

Material: hardened steel

Surface quality in the cylindrical area Ra = 3,2µm

NOTE The dimension "21,1" has ben corrected in DII.

Figure 126 – Test dummies DII, DIII, D01, D02 and D03 for fuse-carrier test

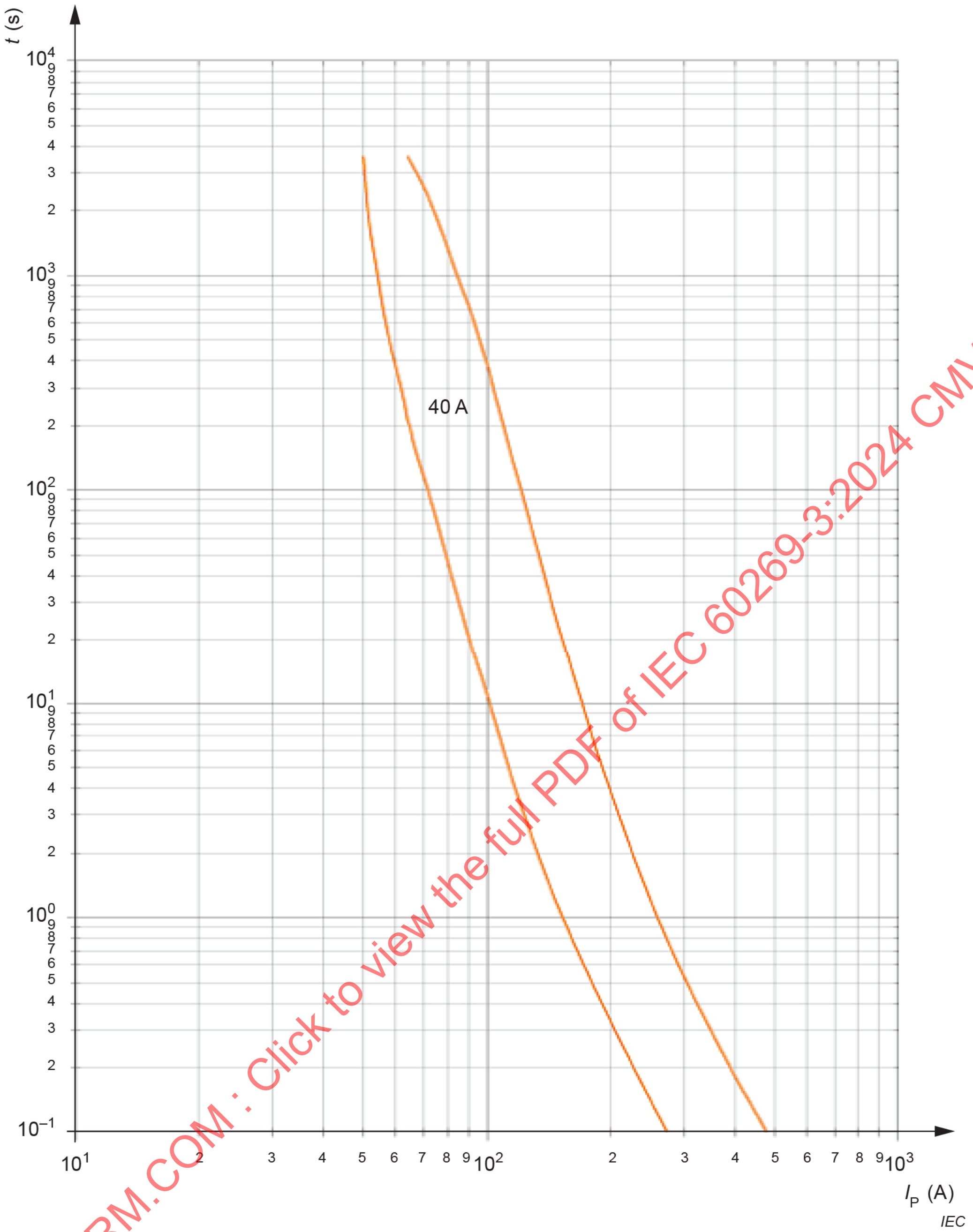


Figure 127 – Time-current zone for "gG" fuse-links 40 A

Annex AA
(informative)

Special test for cable overload protection[2] (for fuse system A)

Fuses with I_n > 10 A shall be tested as follows.

AA.1 Arrangement of the fuse

One fuse comprising fuse-base, fuse-carrier, gauge-piece, cover and the relevant fuse-link is submitted to the test.

The test arrangement is that specified in 8.3.1 of IEC 60269-1:2006. The test shall be carried out at an ambient air temperature of 30^{+5}_{0} °C.

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

AA.2 Test method and acceptability of test results

A test current equal to 1,13 I_n flows through the fuse during the conventional time as given in Table 2 of IEC 60269-1:2024. The fuse-link shall not operate. The test current is then raised without interruption within 5 s to I_t = 1,45 I_n. The fuse-link shall operate within the conventional time.

2 See note to 8.4.3.5.

Fuse system B –
Cylindrical fuses
(NF cylindrical 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 having fuse-links, satisfying the dimensional requirements given in Figure 201 of this fuse system. Their rated current does not exceed 63 A and their rated voltages are 230 V or 400 V AC.

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 with the following supplementary requirements.

Definitions concerning terminals are given in IEC 60999-1.

For the purpose of this fuse system, the following terms and definitions apply.

2.1.201
screw-type terminal
terminal for the connection and subsequent disconnection of a conductor or the interconnection of the two or more conductors capable of being dismantled, the connection being made, directly or indirectly, by means of screws or nuts of any kind

2.1.202
pillar terminal
terminal with screw-clamping in which the conductor is inserted into a hole or cavity, where it is clamped under the shank of the screw(s)

Note 1 to entry: The clamping pressure may be applied direct by the shank of the screw or through an intermediate clamping member to which pressure is applied by the shank of the screw.

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 shall be 230 V or 400 V AC.

5.3.1 Rated current of the fuse-link

The maximum rated currents of fuse-links are given in the table of Figure 201.

5.3.2 Rated current of the fuse-holder

The rated currents of the fuse-holders are the same as the maximum values of the fuse-links (see 5.3.1 of this fuse system).

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 of the fuse-links and the rated acceptable power dissipation of the fuse-holders are given in Table 201.

Table 201 – Maximum values of rated power dissipation and values of rated acceptable power dissipation

Dimensions mm	Rated current I_n A	Rated voltage U_n V	Power dissipation / acceptable power dissipation W
6,3 × 23	6	230	1,0
8,5 × 23	10	230	1,3
10,3 × 25,8	16	230	2,3
8,5 × 31,5	20	400	2,6
10,3 × 31,5	25	400	3,2
10 × 38	32	400	3,2
16,7 × 35	63	400	6,8

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 202.

Table 202 – Conventional times and currents for "gG" fuse-links

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
$16 \leq I_n \leq 63$	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 203 apply.

Table 203 – Gates for specified pre-arcing times of "gG" fuse-links with rated currents 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
6	11,0	28,0	26,0	72,0
10	22,0	46,5	47,0	110,0

5.7.2 Rated breaking capacity

The minimum breaking capacities are specified in Table 204.

Table 204 – Minimum rated breaking capacities

Rated voltage V	Minimum rated breaking capacity kA
230	6
400	20

6 Markings

IEC 60269-1 applies.

If the fuse-bases are not capable of bidirectional current flow, they shall be marked with the current flow direction at front or lateral side.

For this, preferentially, the symbol 5107A in accordance with IEC 60417 should be used. The arrows may be covered in the installed state of the fuse-base.

In the case of fuse-bases for busbar mounting, the marking with the current flow direction is not required.

7 Standard conditions for construction

IEC 60269-1 applies with the following supplementary requirements.

7.1 Mechanical design

The dimensions of the cartridge shall be in accordance with Figure 201.

7.1.2 Connections including terminals

See IEC 60269-1 and IEC 60999-1.

Within the framework of this document, only those terminals intended for receiving external copper conductors are included.

The base shall be fitted with terminals designed to receive copper conductors of cross-sectional area and current rating as in the following table.

Table 205 – Nominal section of copper conductors that the terminals shall accept

Rated current of fuse-base A	Flexible conductors (note 1) mm^2	Rigid conductors of solid core or cables (note 2) mm^2
6	0,5 to 1	0,75 to 1,5
10	0,75 to 1,5	1 to 2,5
16	1 to 2,5	1,5 to 4
20	1,5 to 4	1,5 to 4
25	1,5 to 4	2,5 to 6
32	2,5 to 6 (NOTE 1)	4 to 10
63	6 to 16	10 to 25

NOTE 1 Attention is drawn to the fact that, for certain applications, more space is necessary.

NOTE 2 It is admitted that for conductors sizes 1 mm^2 to 6 mm^2, the terminals are intended only for clamping rigid solid conductors.

Verification is to be carried out by measurement and by the insertion of conductors of the smallest and largest section successively.

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.

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.

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.

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.

7.2 Insulating properties and suitability for isolation

As described in 7.2 of IEC 60269-1:2024 and pending the application of the requirements of the IEC 60664 series, the clearances and creepage distances given in Table 206 shall be respected.

The verification of this prescription is made by measurements. The measurements are performed on a sample without conductors, or on a sample fitted with conductors of the maximum cross-sectional area specified in Table 205.

The requirements stated above do not apply to metal covers and enclosures, if these are isolated with an internal insulating sheet.

If an enclosure of insulating material is covered internally by a metal sheet, this is in any case considered as an accessible metal part.

The thickness of the filling material exceeding a groove is not to be taken into account for evaluation of creepage distance.

The verification of this condition is made by examination.

Table 206 – Creepage distances and clearances

		Minimum creepage distances and clearances	mm
1		Between live parts of the same polarity separated during breaking operation:	3
2		Between live parts of different polarities:	3
3		Between live parts and:	
	a)	metallic accessible parts not listed in 5, decorative parts and metallic covers, parts of mechanism, if these are isolated from live parts,	
	b)	screws of fixing means for surface mounting base of devices	3
	c)	screws or fixing means for the base of devices in flush-mounting housings,	
	d)	screws of covers or cover sheets,	
	e)	conduits entering the apparatus:	
4		Between metallic parts of the mechanism and the accessible metallic parts, including frame-works used as support to flush-mounting device bases if an insulation is required:	3
5		Between live parts other than terminals for one part, and for the other part, metallic enclosures, or cases as well as the supporting surface of the bases:	4
6		Between terminals and the metallic enclosures or cases, as well as the supporting surface of the bases:	6
		Shortest distance	mm
7		Between live parts covered by minimum 2 mm of sealing compound and the supporting surface of the bases:	3
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 is ignored in computing the total clearance.			

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

Instead of Table 5 of IEC 60269-1:2024, Table 207 applies.

Table 207 – 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 of IEC 60269-1:2024, 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 60269-1:2024, the pre-arcing I^2t values given in Table 208 apply.

Table 208 – 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
6	24,00	225,00
10	100,00	576,00

7.7.2 Operating I^2t values

The maximum pre-arcing I^2t values given above are considered as the maximum operating I^2t values. For fuse-links with rated currents greater than 16 A, the maximum pre-arcing I^2t values of Table 7 of IEC 60269-1:2024 are considered as the maximum operating I^2t values.

7.8 Overcurrent discrimination of "gG" fuse-links

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

7.9 Protection against electric shock

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

As specified in 7.9 of IEC 60269-1:2024, the following details are given with regard to this subclause:

a) the fuses shall be so designed that no contact can be made between different poles with fuse-carriers and fuse-links;

b) it shall be possible to replace easily a fuse-link without touching the live parts;

c) the live parts of devices protected against direct contact shall not be accessible when the fuse-base is installed and connected with conductors as in normal use, either fitted with its fuse-link or not, the fuse-carrier being in place;

NOTE In case of a fuse unprotected against direct contact and intended to be incorporated in appliances, this requirement does not apply to parts for which the protection should be provided by screens or by construction in the appliance itself.

d) when the fuse-carrier is withdrawn, the accessibility to the live parts shall be possible only after a deliberate action.

These requirements are verified by the test according to 8.8 of this fuse system.

8 Tests

IEC 60269-1 applies with the following supplementary requirements.

8.1.5.1 Complete tests

The following additional test is required according to Table 209.

Table 209 – Survey of tests on fuse-link

Test according to subclause	Number of test samples			
	1	1	1	1
8.7.4 Verification of overcurrent discrimination	x	x	x	x

8.1.6 Testing of fuse-holders

The following additional test is required according to Table 210.

Table 210 – Survey of tests on fuse-holder and number of fuse-holders to be tested

Test according to subclause		Number of test samples
		1
8.12	Verification of the reliability of terminals	x

8.2.2.3.1 This test shall be performed immediately after the humidity treatment described in 8.2.2.3.2 of IEC 60269-1:2024.

The fuse-holder shall be submitted to the test voltage given in Table 15 of IEC 60269-1:2024.

8.3.1 Arrangement of the fuse

The screws of the screw terminals shall be tightened with a torque of two-thirds the torque given in Table 211.

Table 211 – Screw-thread diameters and applied torques

Nominal diameter of thread				Torque		
mm				Nm		
				I	II	III
		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
Over	4,1	up to and including	4,7	0,8	1,8	1,8
Over	4,7	up to and including	5,3	0,8	2,0	2,0
Over	5,3	up to and including	6,0	1,2	2,5	3,0
Over	6,0	up to and including	8,0	2,5	3,5	6,0
Over	8,0	up to and including	10,0	–	4,0	10,0
Over	10,0	up to and including	12,0		(Under consideration)	
Over	12,0	up to and including	15,0		(Under consideration)	

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 other screws, which are tightened by means of a screwdriver.

Column III applies to screws and nuts, which are tightened by means other than a screwdriver.

8.3.3 Measurement of the power dissipation of the fuse-link

The fuse-links are tested in open air, in a vertical position in one of the test rigs according to Figure 203 and Figure 204, according to the indications given in Table 212.

The sliding pin shall be well guided.

The ferrules and other parts of the fuse-base shall be made from brass with 58 % to 70 % copper, except springs, screws for connections, and the test piece used as specified in the following subclauses for measuring the contact resistance. Furthermore, the ferrules shall be silver-plated.

After each test, it is necessary to verify the good condition of the contact surface.

Table 212 – Values concerning the choice and the adjustment of the test base

Cartridge Rated current A	No. of the base (see Figure 203)	No. of the ferrule (see Figure 203)	Distance *b* mm	Contact force N
6	1	1	48	6 to 8
10	1	2	48	6 to 8
16	2	3	56	14 to 17
20	2	3	62	14 to 17
25	2	3	62	14 to 17
32	2	3	68	18 to 22
63	3	4	80	38 to 42

8.3.4.1 Temperature rise of the fuse-holder

The dummy fuse-link shall have the maximum power dissipation given in Table 201 and the dimensions in accordance with Figure 202.

8.4 Verification of operation

8.4.1 Arrangement of the fuse

The fuse-links are tested in one of the test-rigs according to Figure 203, chosen from the indications given in Table 212. The cartridge is placed under a housing in polyacryl resin according to Figure 205. Before each test, it is necessary to verify the good condition of the ferrule surface.

8.4.3.6 Operation of indicating devices and strikers, if any

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

If the tests are performed at reduced voltages, the test circuit voltage shall be 100 V ± 5 V.

8.5 Verification of the breaking capacity

8.5.1 Arrangement of the fuse

The fuse-links are tested in a test-base according to Figure 206 adjusted according to indications given in Table 213. The contact ferrules are of silver-plated brass.

Before beginning the test, it is necessary to verify the good condition of the ferrule surfaces.

Table 213 – Values for adjustment of the test base

Cartridge rated current A	No. of the ferrule	Distance *b* mm	Contact force N
6	5	70	8 to 10
10	5	70	8 to 10
16	6	73	14 to 16
20	5	79	14 to 16
25	6	79	14 to 16
32	6	85	22 to 24
63	7	85	38 to 42

8.5.5 Test method

8.5.5.1 In order to verify that the fuse satisfies the conditions of 7.5 of IEC 60269-1:2024, tests in accordance with Table 20 of IEC 60269-1:2024 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

Subclause 8.5.8 of IEC 60269-1:2024 applies, under the following restrictions. The following is permissible:

– malfunction of the indicating device;

– any crack of the cartridge which does not prevent its withdrawal without a tool;

– small blisters, localized bumps on the ferrules also small holes, provided that these are not sufficient to damage the fuse-base or the fuse-carrier.

8.7.4 Verification of overcurrent discrimination

To verify the requirements specified in 7.7.1 and 7.7.2 of this fuse system, four supplementary samples are tested, two to verify the minimum pre-arcing I^2t values and the other two to verify the total I^2t values.

The samples are arranged as for the breaking capacity test according to 8.5 of IEC 60269-1:2024.

The test voltage to verify the operating I^2t values shall be

$$\frac{1,1 \times 400\ \text{V}}{\sqrt{3}}$$

for 400 V fuses and 1,1 × 230 V for 230 V fuses.

8.8 Verification of the degree of protection of enclosures

8.8.1 Verification of protection against electric shock

To verify the requirements given in 7.9, the procedure is as follows:

– requirement b) is verified by examination;

– requirement c) is verified by means of the test finger shown in Figure 9 of IEC 60898-1:2002;

– requirement d) is verified by means of the test finger shown in Figure 9 of IEC 60898-1:2002.

In the case of the protecting screen or of parts intended to be knocked out, the test finger is applied with a 20 N force.

8.9 Verification of resistance to heat

The following two tests are performed.

a) Test in a heating cabinet

This test is performed with the specimen being kept in a heating cabinet at a temperature of 100 °C ± 5 °C for 1 h.

At the end of this test, significant deteriorations shall not be observed, and live parts protected with sealing compound shall not become exposed.

NOTE Slight displacement of the sealing compound is permitted.

b) Ball pressure test

External parts of insulating material other than ceramic are, furthermore, submitted to a ball pressure test by means of the apparatus shown in Figure 16 of IEC 60898-1:2002.

A steel ball of 5 mm diameter is pressed with a force of 20 N against one part of the external surface placed horizontally. The test is performed in a heating cabinet at a temperature of 125 °C ± 5 °C. After 1 h in the heating cabinet, the pressure is released, the ball is removed and after 5 min, the diameter of the impression is measured, which shall not exceed 2 mm.

Following these tests, the fuse-carrier is (without fuse-link) withdrawn and inserted by hand 50 times.

After this operation, it is verified that the force to withdraw the cover from the fuse-base, exerted in a direction perpendicular to the mounting plane of the fuse-base, is higher than 1,5 N.

The force is exerted without jerks by means of a mass of 150 g. The cover shall not be separated from the fuse-base.

8.10 Verification of non-deterioration of contacts

8.10.1 Arrangement of the fuse

A dummy fuse-link with its maximum power dissipation and its dimensions is given in 8.3.4.1 of this fuse system and Figure 202. A typical fuse-base with its spring-loaded contact pieces is given in Figure 204.

Torques to be applied to the screws of the terminals are specified in 8.3.1 of this fuse system.

In addition, 7.3 of this fuse system and 8.3.1 of IEC 60269-1:2024 apply.

8.10.2 Test method

The load period is 75 % of the conventional time.

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

The test current is the non-fusing current.

The conventional time, as well as the non-fusing current, is stated in Table 2 of IEC 60269-1:2024.

A lower test voltage may be used.

8.10.3 Acceptability of test results

After 250 cycles, the measured temperature rise values of terminals shall not exceed the temperature rise measured at the beginning of the test (first cycle) by more than 15 K.

After 750 cycles, if necessary, the temperature rise values of terminals shall not exceed the values measured at the beginning of the tests (first cycle) by more than 20 K.

8.11.1.1 Mechanical strength of the fuse-holder

To verify that a fuse has satisfied the requirements of 7.11 of IEC 60269-1:2024 it is submitted to the following tests.

8.11.1.1.1 Verification of resistance to shock

The verification is made by means of the apparatus described in 8.11.1.1.1.1 of this fuse system. The test conditions are given in 8.11.1.1.1.2 of this fuse system.

8.11.1.1.1.1 Test apparatus

The test apparatus, according to Figure 10 of IEC 60898-1:2002, consists of an arm swinging round an axis and fitted at its lower part with a hammer.

The arm is made with a steel tube of 9 mm external diameter and 8 mm internal diameter and includes

– on its higher part, a device fitted with a swinging axis, the distance of which to the frame of the apparatus is adjustable, so that the pendulum can move only in a vertical plane perpendicular to the supporting side of the frame;
– on its lower part, a device designed to hold one of the hammers described below.

The length of the tube is such that the distance between the swinging axis of the pendulum and the hammer axis mounted on the pendulum arm is equal to 1 m.

The hammer has, as applicable, such a mass as, fixed on the tube by means of the device shown in Figure 11 of IEC 60898-1:2002, the vertical force to apply in the axis of the hammer to maintain the pendulum arm horizontal, is:

– 2 N in case of type a, hammer so-called "of 150 g" shown in Figure 11 of IEC 60898-1:2002.

According to dimensions, the apparatus is fixed on one support shown in Figure 12 of IEC 60898-1:2002.

The support is so arranged that it is possible

– to place the apparatus so that the target is in the vertical plane passing by the pendulum swinging axis;
– to turn the apparatus round one vertical axis;
– to displace the apparatus horizontally, in parallel to the pendulum swinging axis.

8.11.1.1.1.2 Test procedure

The enclosure is fixed on the support as in normal use; the conductor apertures are left open and the cover screws are tightened with a torque equal to two-thirds of that given in Table 211.

Enclosures intended for flush mounting are placed in the recessed portion of a block of plywood so that the edge of the enclosure box, if any, is flush with the surface of the block.

The enclosure box is tested separately and maintained against the support, its front side being directed towards the hammer.

By acting on the position of the support and that of the swinging axis of the pendulum, the enclosure is placed in such a way that the target is in the vertical plane passing by the pendulum axis and the hammer is allowed to fall down from the prescribed height, measured vertically between the target on the enclosure and the strike point of the hammer at its free fall point.

NOTE The blows are not applied to the knock-out holes.

The hammer to be used and the height of fall according to the enclosure classification with regard to the resistance to shocks are indicated in Table 214.

Table 214 – Hammer and height of fall for test for verification of resistance to shocks

Type of apparatus	Type of hammer	Height of fall
		cm
Ordinary enclosure	a	15

The apparatus is subjected to 10 blows, evenly distributed over the enclosure and if any, over the cover sheet.

The first series of five blows is applied as follows:

– in the case of flush-fitting enclosures, one blow on the centre, one blow on each end of the cover sheet and the two remaining at about half-distance;
– in the case of other types, one blow on the centre, one blow on each lateral side and the two remaining blows on intermediary positions, the enclosure being turned after each blow, with the appropriate angle but not more than 60°, around a vertical axis.

The second series of five blows is then applied in the same way but after having turned the enclosure to 90° around its perpendicular axis to the support.

If there are cable entries, the two lines of targets on the specimens are chosen to be at the mid-way of the cable entries.

After the test, the enclosure shall show no damage that could decrease its protective function. It shall neither show any cracks nor deformations that could impair the operating characteristics, or alter the guaranteed qualities of the specimens.

Small cracks, which do not alter the protection against direct contact, may be neglected.

Fracture of the external cover sheet is permissible provided that this sheet is double and the second one satisfies the test, the live parts not being exposed.

8.11.1.1.2 Verification of the constructional requirements

The fuse-carriers shall comprise a device intended to maintain the fuse-link in place during the withdrawal of the fuse-carrier.

The efficiency of this device is verified by using a fuse-base corresponding to the fuse-carrier under test.

The fuse-carrier is equipped with a gauge-piece, the dimensions of which are in accordance with those given in Figure 207 for the rated current of the fuse considered, and fitted together with the fuse-base as in normal use.

The fuse-carrier is then withdrawn from the fuse-base and, where an elastic device (for example, a spring clip) is used to hold the fuse-link, the fuse-carrier is kept in its most unfavourable position during about 10 s.

The test-piece shall not fall out from the fuse-carrier under the effect of its own weight.

In the case of the screw-type fuse-carrier, the threaded sleeve shall be fixed securely and shall not present a rough surface on the live surface of contact.

The verification of these conditions is made by examination and by the following test.

The fuse-carrier of a fuse-link having the maximum dimensions is screwed in fully and unscrewed 50 times consecutively as in normal use, by exerting during each screwing stroke a torque as indicated in Table 215.

Table 215 – Torque to be applied to the fuse-carrier

Rated current of the fuse-base A	Torque Nm
6	0,6
10	0,6
16	1,0
20	1,0
25	1,0
32	1,0
63	1,7

8.11.1.4 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 10 times in the case of non-metallic thread by means of a suitable test spanner or screwdriver, applying a torque as indicated in Table 216.

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 216 – Mechanical strength of screw-thread

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

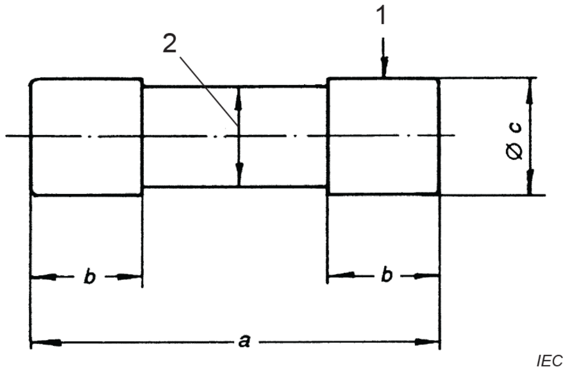
During the test, no change impairing the further use of the screwed connection shall occur.

8.11.2.6 Dimensions and non-interchangeability

Compliance with 8.1.4 of IEC 60269-1:2024 and 7.1.8. of this fuse system shall be verified by measuring and comparing the dimensions of fuse-links with the related dimensions of the other parts of the fuse.

8.12 Verification of the reliability of terminals

Follow the tests described in IEC 60999-1:1990, Clause 8.



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

2) The diameter of the cartridge between the end caps shall not exceed diameter *c*.

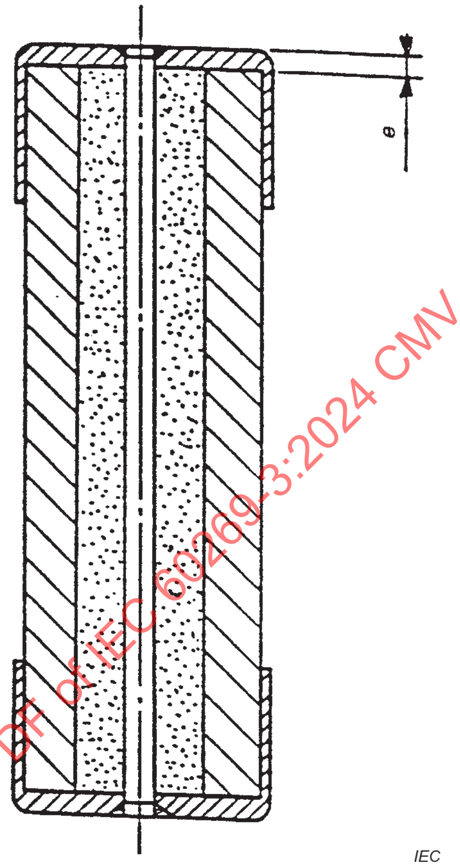
Dimensions in millimetres

230 V/400 V					
Dimensions	$I_{n\ max}$ A	U_n V	*a*	*b*	*c*
6,3 × 23	6	230	$23{,}0\ ^{0}_{-0{,}8}$	$5{,}0\ ^{+0{,}2}_{-0{,}6}$	6,3 ± 0,1
8,5 × 23	10	230	$23{,}0\ ^{0}_{-0{,}8}$	$5{,}0\ ^{+0{,}2}_{-0{,}6}$	8,5 ± 0,1
10,3 × 25,8	16	230	25,8 ± 0,4	6,3 ± 0,4	10,3 ± 0,1
8,5 × 31,5	20	400	31,5 ± 0,5	6,3 ± 0,4	8,5 ± 0,1
10,3 × 31,5	25	400	31,5 ± 0,5	6,3 ± 0,4	10,3 ± 0,1
10 × 38	32	400	$38^{+0{,}9}_{-0{,}6}$	$10{,}0\ ^{+0{,}5}_{-0{,}3}$	10,3 ± 0,1
16,7 × 35	63	400	$35{,}0\ ^{+0{,}8}_{-0{,}1}$	9,5 ± 0,5	16,7 ± 0,1

The sketch is not intended to govern the design except as regards the dimensions shown.

Figure 201 – Fuse-link

Dimension *e*	
6 A	0,5 mm
10 A	1 mm
16 A	1,5 mm
20 A	1,5 mm
25 A	1,5 mm
32 A	2 mm
63 A	2 mm



The end caps are of nickel-plated and silver-plated copper.

The body is of ceramic material.

The fuse-element is of CuNi 56/44 alloy or of an equivalent material with similar values of specific resistance and temperature coefficient and is connected to the end caps by welding or brazing.

The filling and arc extinction material is identical to that commonly used in fuse-links.

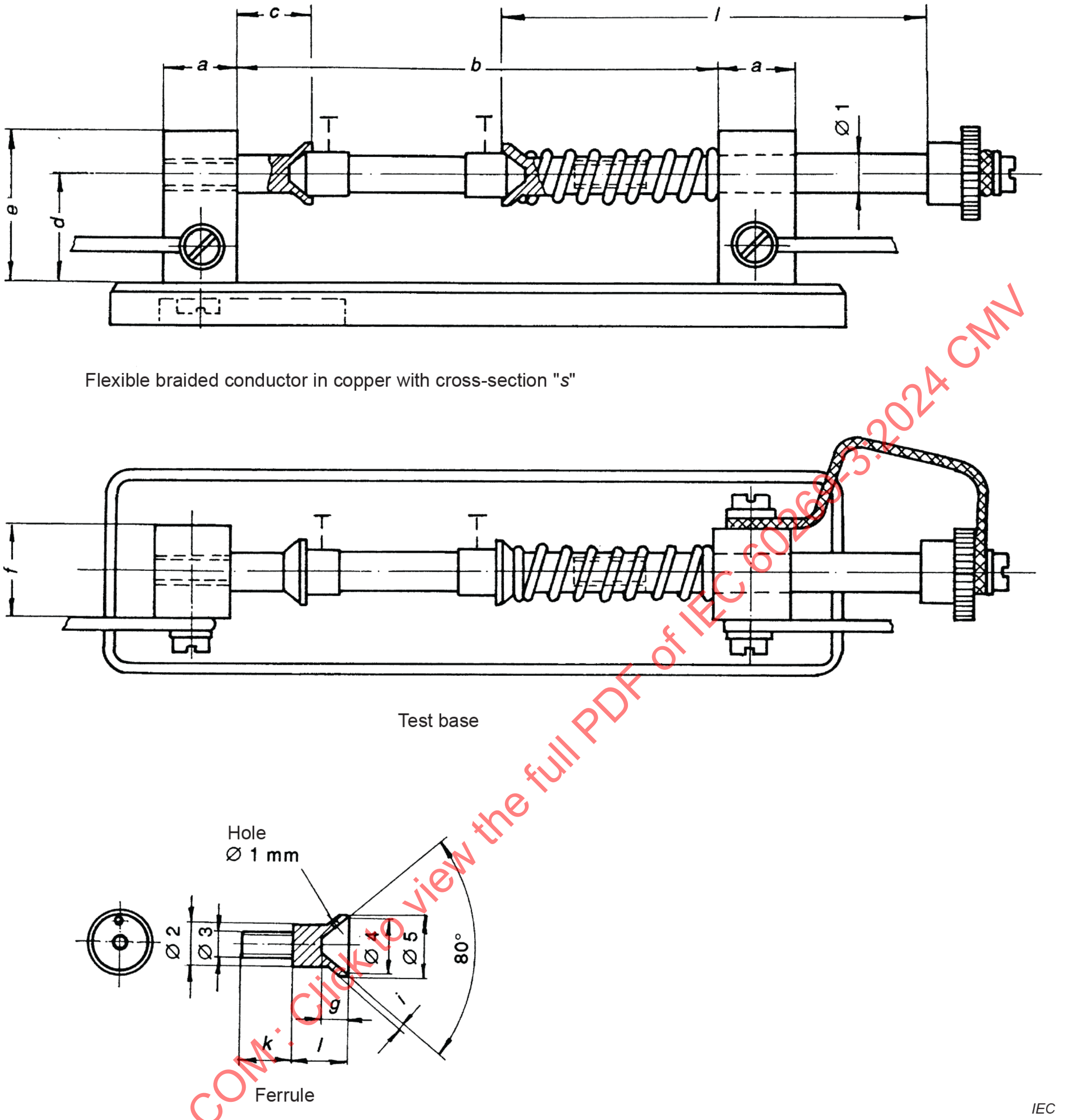
The other dimensions are indicated in Figure 201.

The values of power dissipation are indicated in Table 201 with a tolerance of $^{+5}_{0}$ %.

The sketch is not intended to govern the design except as regards the dimensions shown.

Figure 202 – Dummy fuse-link

Dimensions in millimetres



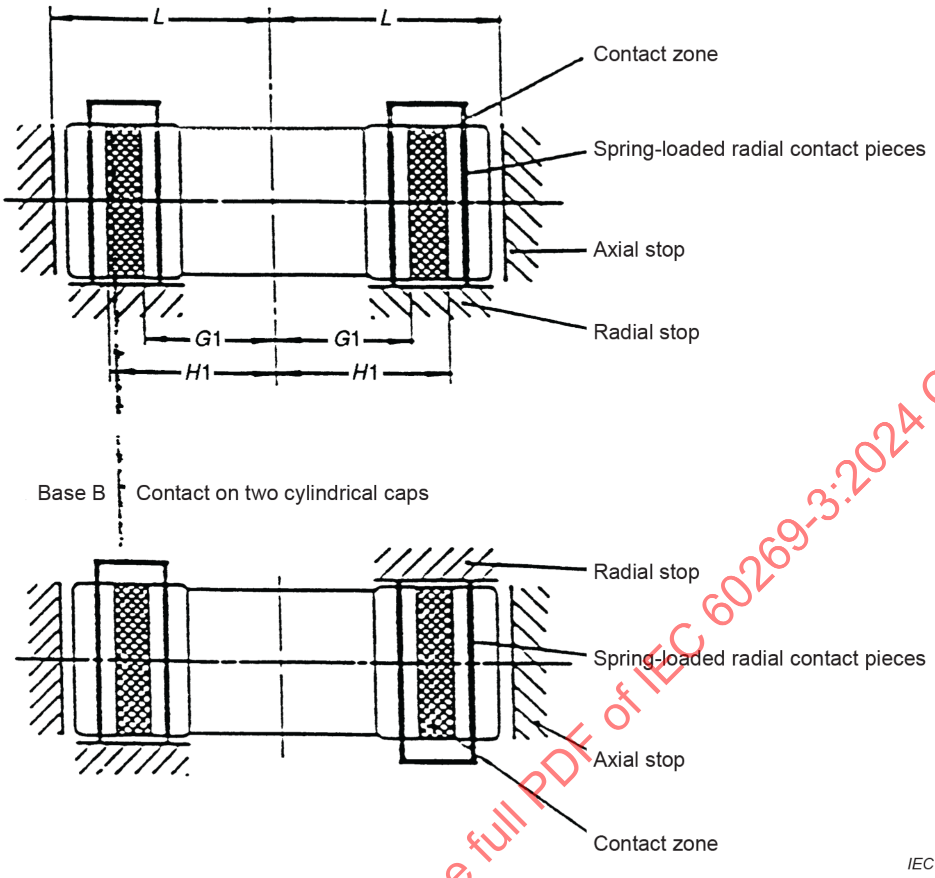
NOTE The measurement of the voltage drop should be made on the points T indicated in Figure 203.

No. of test base	*a*	*b**	*c*	*d* mm	*e*	*f*	*l*	Ø1	*s* mm^2
1	8		10	12	17,5	8	50	5	4,6
2	12		10	17,5	24	15	65	6	13
3	20		10	30	40	20	75	12	30

* This dimension is given in Table 212.

No. of the ferrule	Ø2	Ø3	Ø4	Ø5	*g*	*i*	*l*	*k*
1	5	4	9	10	4	1	10	8
2	5	4	13	14	5	1	10	8
3	10	4	15	17	6	1,5	10	8
4	12	8	21,5	24	7	2	10	18

Figure 203 – Test-rig and ferrules for the measurement of the voltage drop and the verification of operating characteristics of the cartridge



Dimensions in millimetres

Size	I_n A	G1 max.	H1 min.	*L*
6,3 × 23	6	8	9,5	$11,5\ ^{+0,8}_{0}$
8,5 × 23	10	8	10	$11,5\ ^{+0,8}_{0}$
10,3 × 25,8	16	8,5	10,5	$13,10\ ^{+0,8}_{0}$
8,5 × 31,5	20	11,5	14	$16\ ^{+0,8}_{0}$
10,3 × 31,5	25	11,5	14	$16\ ^{+0,8}_{0}$
10,3 × 38	32	12,5	15	$19,30\ ^{+0,8}_{0}$

Figure 204 – Fuse-base, A-type and B-type

Dimensions in millimetres

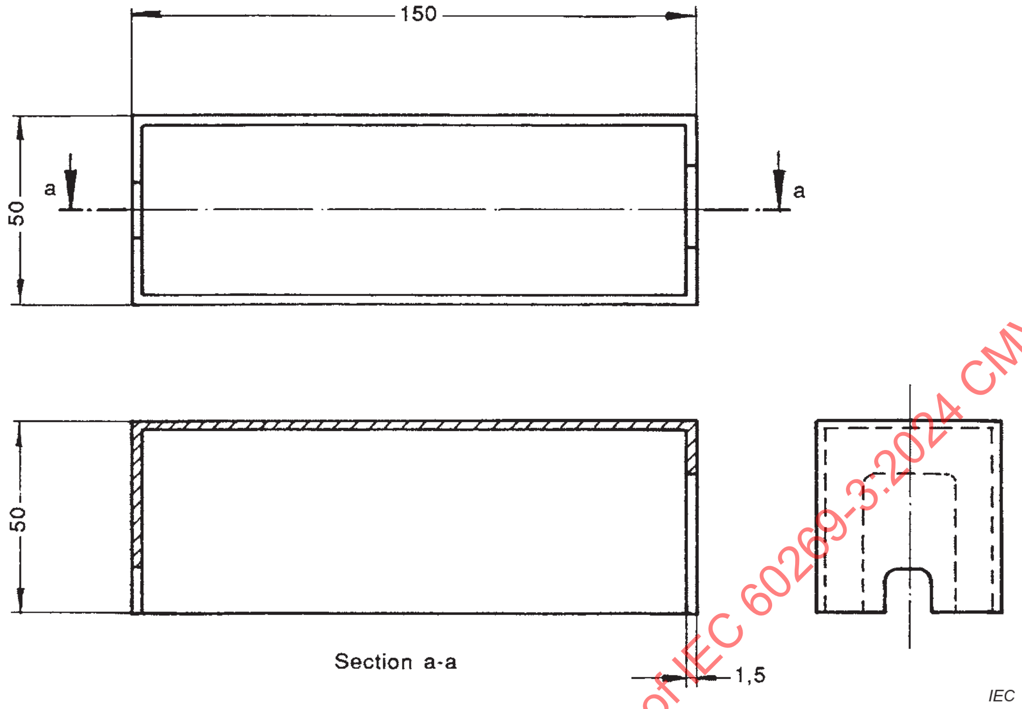
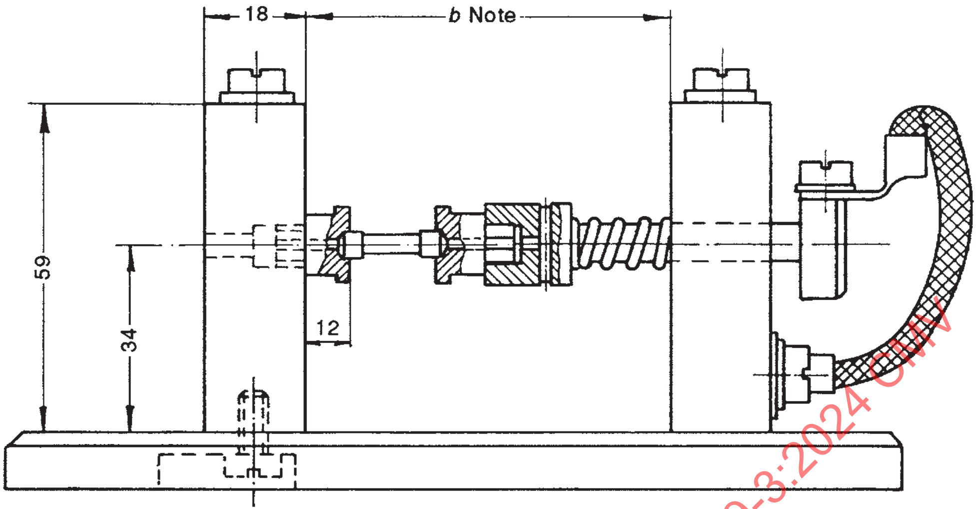
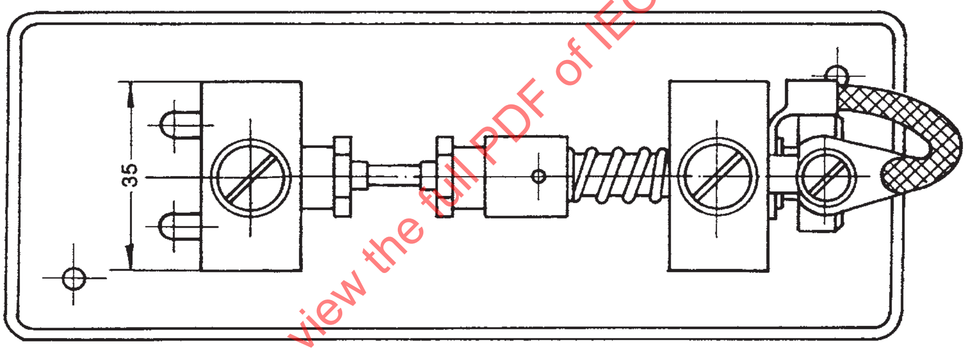


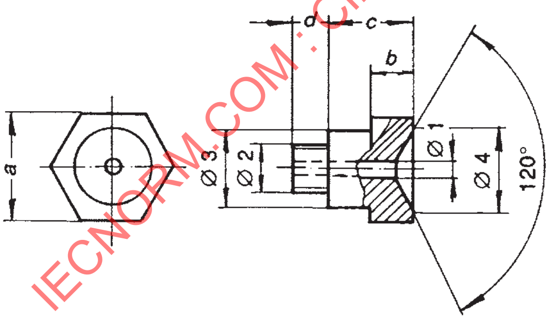
Figure 205 – Housing for verification of operation of the fuse-links with a test rig according to Figure 203

Dimensions in millimetres



NOTE This dimension is given in Table 213.



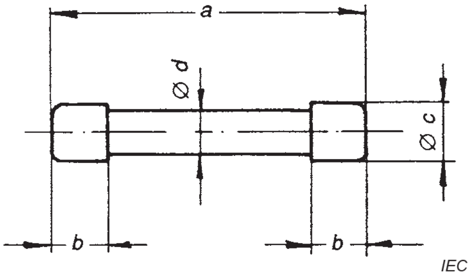


IEC

Dimensions in millimetres

No. of the ferrule	Ø 1	Ø 2	Ø 3	Ø 4	*a*	*b*	*c*	*d*
5	2,5	8	12	10	14	5	12	5
6	2,5	8	12	12	17	6	12	5
7	2,5	8	12	18,5	24	8	12	5

Figure 206 – Test rig and ferrules for verification of breaking capacity



Material: solid steel parts exposed to wear shall be hardened.

Dimensions mm	Rated current A	Rated voltage V	*a* mm	*b* mm	*c* mm	*d* mm
6,3 × 23	6	230	22,2 $^{0}_{-0,1}$	4,4 $^{+0,1}_{0}$	6,2 $^{0}_{-0,02}$	5,2 $^{0}_{-0,05}$
8,5 × 23	10	230	22,2 $^{0}_{-0,1}$	4,4 $^{+0,1}_{0}$	8,4 $^{0}_{-0,02}$	7,4 $^{0}_{-0,05}$
10,3 × 25,8	16	230	25,4 $^{0}_{-0,1}$	5,9 $^{+0,1}_{0}$	10,2 $^{0}_{-0,02}$	9,2 $^{0}_{-0,05}$
8,5 × 31,5	20	400	31,0 $^{0}_{-0,1}$	5,9 $^{+0,1}_{0}$	8,4 $^{0}_{-0,02}$	7,4 $^{0}_{-0,05}$
10,3 × 31,5	25	400	31,0 $^{0}_{-0,1}$	5,9 $^{+0,1}_{0}$	10,2 $^{0}_{-0,02}$	9,2 $^{0}_{-0,05}$
10 × 38	32	400	37,4 $^{0}_{-0,1}$	9,7 $^{+0,1}_{0}$	10,2 $^{0}_{-0,02}$	9,2 $^{0}_{-0,05}$
16,7 × 35	63	400	34,9 $^{0}_{-0,1}$	9,1 $^{+0,1}_{0}$	16,6 $^{0}_{-0,02}$	15,6 $^{0}_{-0,05}$

Figure 207 – Gauge for verification of the upholding of the cartridge in the fuse-carrier during withdrawal

Fuse system C –
Cylindrical fuses
(BS cylindrical 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 in domestic or similar applications having cylindrical fuse-links:

Type I: rated currents up to and equal 45 A AC and a rated voltage of 230 V AC.

Type II: rated currents up to and equal 100 A AC and a rated voltage of 400 V AC.

NOTE 1 These fuses are intended for use on systems employing the future standardised voltage of 230/400 V AC 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 AC and therefore these fuses will continue to be supplied and tested as 240 V AC or 415 V AC rating until such time as all supplies have evolved to the recommended values of 230 V and 400 V.

NOTE 2 For type II fuse-links, in most cases a part of the associated equipment for power supplies to buildings serves the purpose of a fuse-carrier and fuse-base.

Owing to the great variety of equipment no general rules can be given; the suitability of such equipment to serve as a fuse-carrier and fuse-base must be stated in the manufacturer’s instructions. However if separate fuse-carriers and fuse-bases are used they must comply with the appropriate requirements of IEC 60269-1 as stated in the manufacturer’s instructions.

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

The values of standardised rated voltages given in Table 1 of IEC 60269-1:2024 applicable to this document are:

Type I fuse-links – 230 V AC

Type II fuse-links – 400 V AC

(See NOTE 1 of 1.1)

5.3 Rated current

5.3.1 Rated current of the fuse-link

The maximum rated currents are shown in Figure 301.

5.3.2 Rated current of the fuse-holder

The rated currents of typical fuse-holders are shown in Figure 302 and Figure 303.

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

The maximum power dissipation of the fuse-links is given in Figure 301.

The acceptable power dissipation of the fuse-holders is given in Figure 302 and Figure 303.

5.6 Limits of time-current characteristics

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

In addition to the limits of the pre-arcing time given by the gates and the conventional time and currents, the time-current zones, excluding manufacturing tolerances, are given in Figure 304 and Figure 305. The tolerances on individual 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 301.

Table 301 – Conventional time and current for "gG" fuse-links

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

5.7 Breaking range and breaking capacity

5.7.2 Rated breaking capacity

The rated breaking capacity shall be a minimum of 16 kA for Type I fuse-links and a minimum of 31,5 kA for Type II fuse-links.

6 Markings

IEC 60269-1 applies with the addition of colour coding for designated current ratings of Type I fuse-links given in Figure 301. For all other Type I current ratings the markings shall be in black.

If the fuse-bases are not capable of bidirectional current flow, they shall be marked with the current flow direction at front or lateral side.

For this, preferentially, the symbol 5107A in accordance with IEC 60417 should be used. The arrows may be covered in the installed state of the fuse-base.

In the case of fuse-bases for busbar mounting, the marking with the current flow direction is not required.

7 Standard conditions for construction

IEC 60269-1 applies with the following supplementary requirements.

7.1 Mechanical design

7.1.2 Connections including terminals

Reference is made to IEC 60999-1:1990, Clause 7.

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.

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

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.

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 position 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.

7.2 Insulating properties and suitability for isolation

Under consideration

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

Instead of Table 5 of IEC 60269-1:2024, Table 302 applies.

Table 302 – 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 60269-1:2024, for the corresponding rated current of the fuse-base shall not exceed	65K

7.7 I^2t characteristics

The I^2t values given in IEC 60269-1 apply with the exception that the pre-arcing I^2t_{max} value of 86,0 × 10^3 for I_n = 100 A shall be deleted and replaced by 68,0 × 10^3.

7.9 Protection against electric shock

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.

8.1 General

8.1.4 Arrangement of the fuse

The dimensions of the fuse-links are given in Figure 301 and typical fuse-holders in Figure 302 and Figure 303.

8.3 Verification of temperature rise and power dissipation

8.3.1 Arrangement of the fuse

The test arrangement for the fuse-links is given in Figure 306. The test arrangement shall be mounted vertically.

8.3.3 Measurement of the power dissipation of the fuse-link

The fuse-link shall be tested in the test rig shown in Figure 306.

8.4 Verification of operation

8.4.1 Arrangement of fuse

The test arrangement for the fuse-link is specified in 8.3.1 of this fuse system.

8.5 Verification of breaking capacity

8.5.1 Arrangement of the fuse

The test arrangement of the fuse-link is given in Figure 307.

8.5.2 Characteristics of the test circuit

IEC 60269-1 applies with the exception that the power factor for test No. 1 and test No.2 shall be 0,25 to 0,35.

8.5.5 Test method

8.5.5.1 In order to verify that the fuse satisfies the conditions of 7.5 of IEC 60269-1:2024, tests in accordance with Table 20 of IEC 60269-1:2024 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

The requirements of IEC 60269-1 apply, and, in addition, fuse-links shall operate without the melting of the fine wire fuse which indicates arcing to the metal enclosure and without mechanical damage to the test rig.

8.10 Verification of non-deterioration of contacts

8.10.1 Arrangement of the fuse

The test arrangement is given in 8.3.1 of this fuse system.

The dummy fuse-links shall have dimensions that comply with Figure 301.

The power dissipation of the dummy fuse-links shall not be less than the maximum rated power dissipation given in Figure 301 when tested in the standardized power-dissipation test rig according to Figure 306.

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

8.10.2 Test method

The load period is 75 % of the conventional time.

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

The test current is the non-fusing current.

The conventional time, as well as the non-fusing current, are stated in Table 2 of IEC 60269-1:2024.

A lower test voltage may be used.

8.10.3 Acceptability of test results

After 250 cycles, the measured temperature rise values of terminals shall not exceed the temperature rise measured at the beginning of the tests (1st cycle) by more than 15 K.

After 750 cycles, if necessary, the temperature rise values of terminals shall not exceed the values measured at the beginning of the tests (1st cycle) by more than 20 K.

8.11.1.4 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 10 times in the case of non-metallic thread by means of a suitable test spanner or screwdriver, applying a torque as indicated in Table 303.

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.

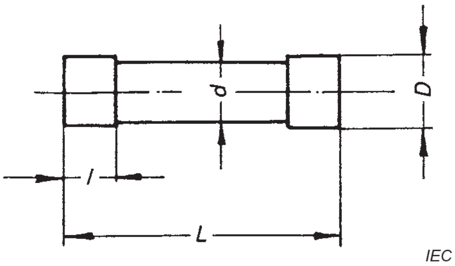
Table 303 – Mechanical strength of screw-thread

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

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

8.11.2.6 Dimensions and non-interchangeability

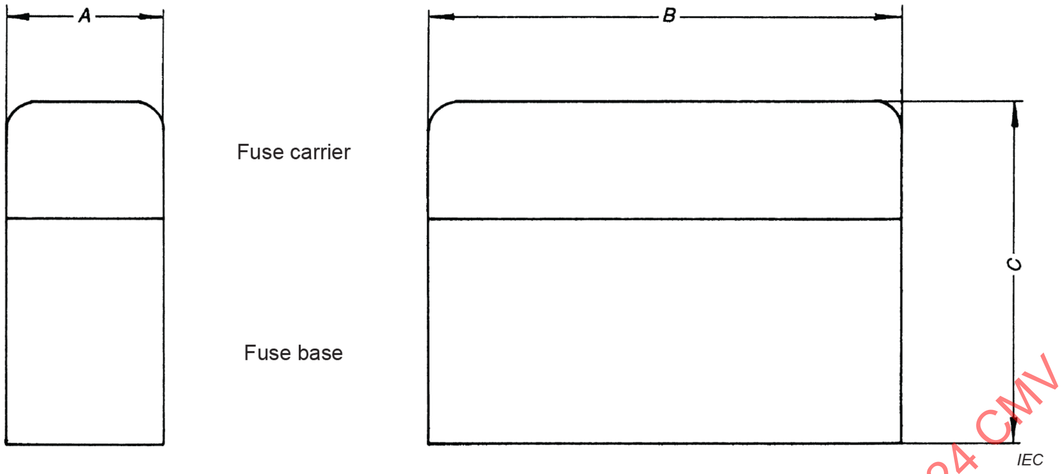
Compliance with 8.1.4 of IEC 60269-1:2024 and 7.1.8. of this document shall be verified by measuring and comparing the dimensions of fuse-links with the related dimensions of the other parts of the fuse.



Type	Maximum rated current A	Colour coding	Maximum power dissipation W	Length *L* mm	Length *l* of endcap mm	Diameter *D* of endcap mm
Ia	5	White	1,1	$23\,^{+0}_{-0,8}$	4,8 ± 0,5	6,35 ± 0,1
Ib	16 20	Blue Yellow	2,0 2,5	$26\,^{+0,2}_{-0,6}$	6,4 ± 0,5	10,32 ± 0,1
Ic	32	Red	3,0	29 ± 0,4	8,0 ± 0,5	12,7 ± 0,1
Id	45	Green	3,5	$35\,^{+0,8}_{-0,1}$	9,5 ± 0,5	16,67 ± 0,1
IIa	63 80	-	5 6	57 ± 1,0	16 ± 0,5	22,23 ± 0,1
IIb	100	-	6	57 ± 1,0	16 ± 0,5	30,16 ± 0,1

The maximum diameter (d) of the cartridge between the endcaps shall be less than the diameter D of the end caps.

Figure 301 – Details of cylindrical fuse-links



Rated current A	Fuse-link type	Acceptable power dissipation W	*A* max. mm	*B* max. mm	*C* max. mm
5	Ia	1,1	25,4	77,0	56,0
20	Ib	2,5	25,4	77,0	56,0
32	Ic	3,0	28,0	77,0	56,0
45	Id	3,5	30,0	80,0	60,0

NOTE This figure 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 302 – Typical outline dimensions of carriers and bases for 230 V cylindrical fuse-links

Under consideration

Figure 303 – Typical carrier and base for 400 V cylindrical fuse-links

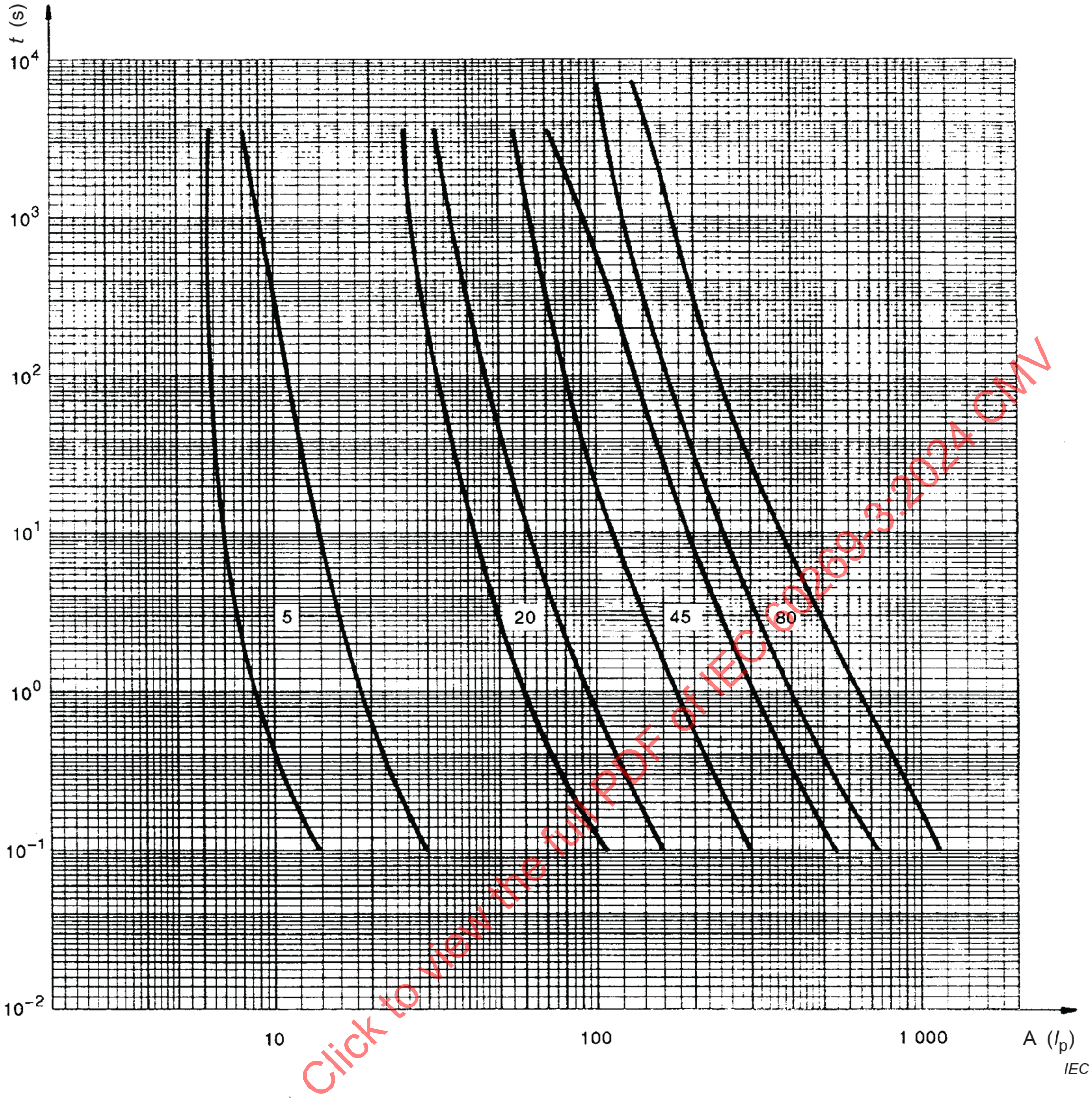


Figure 304 – Time-current zones for "gG" fuse-link

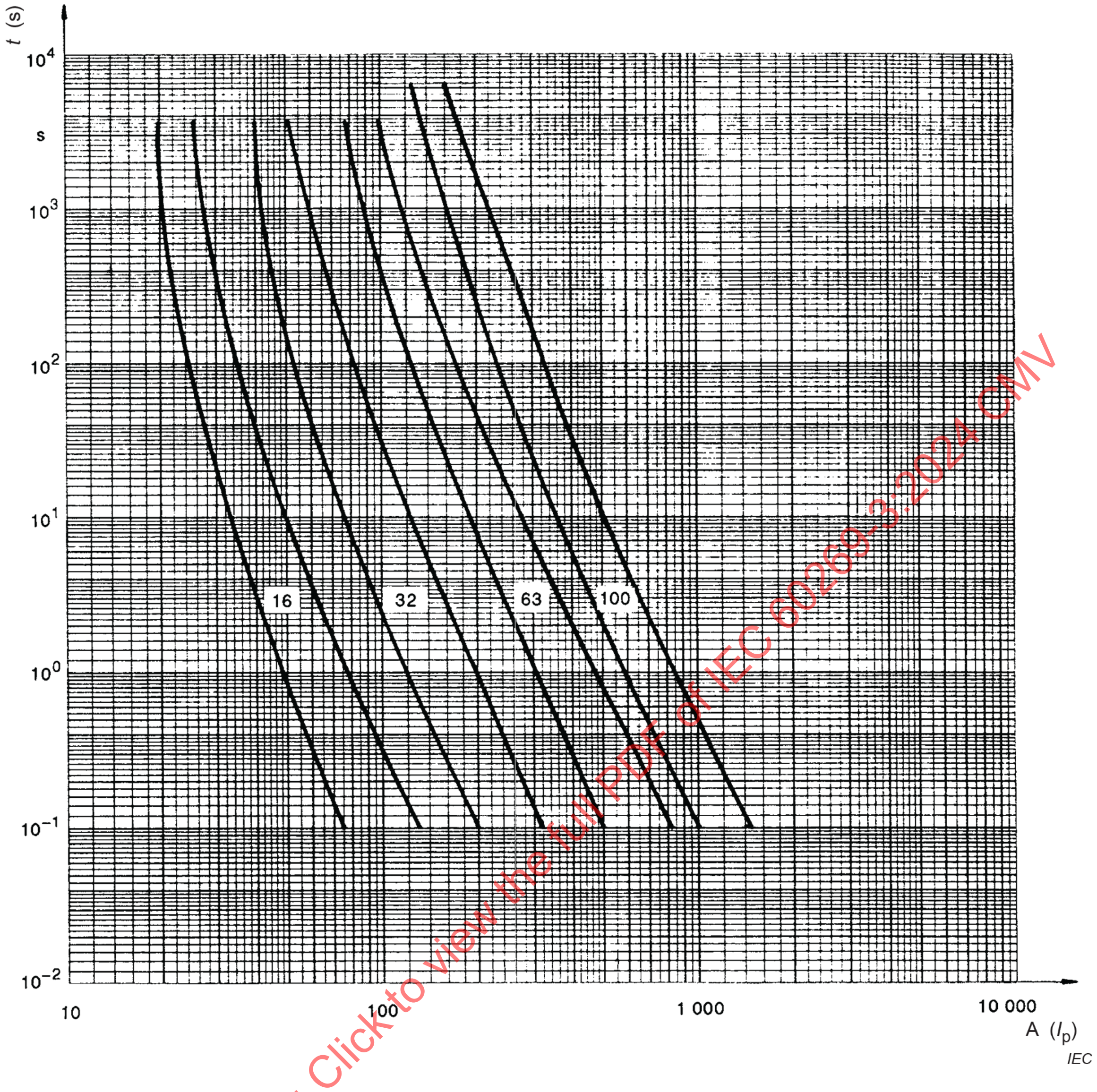
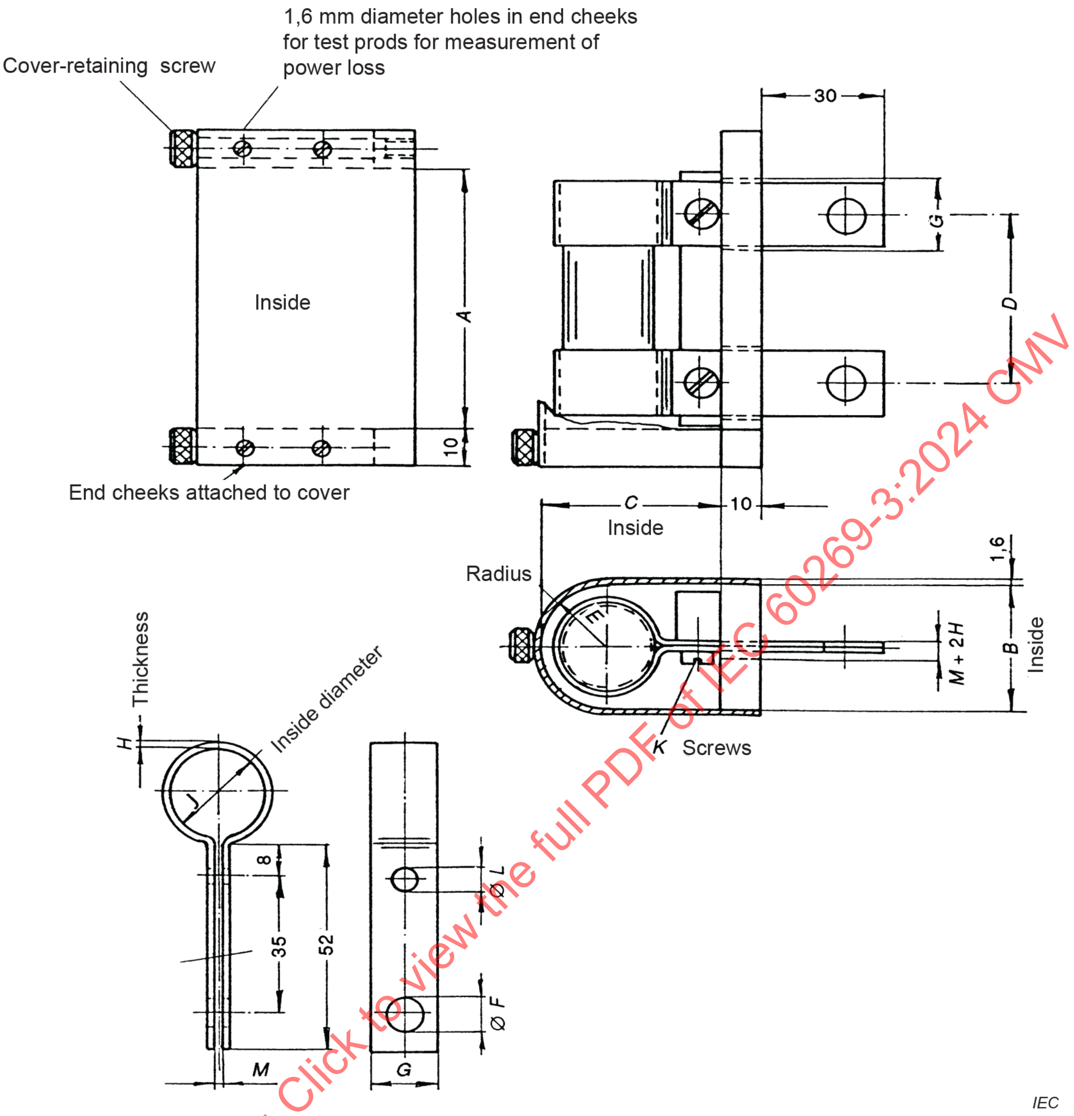


Figure 305 – Time-current zones for "gG" fuse-link

Dimensions in millimetres



Materials

Base, end cheeks and cover: insulating material

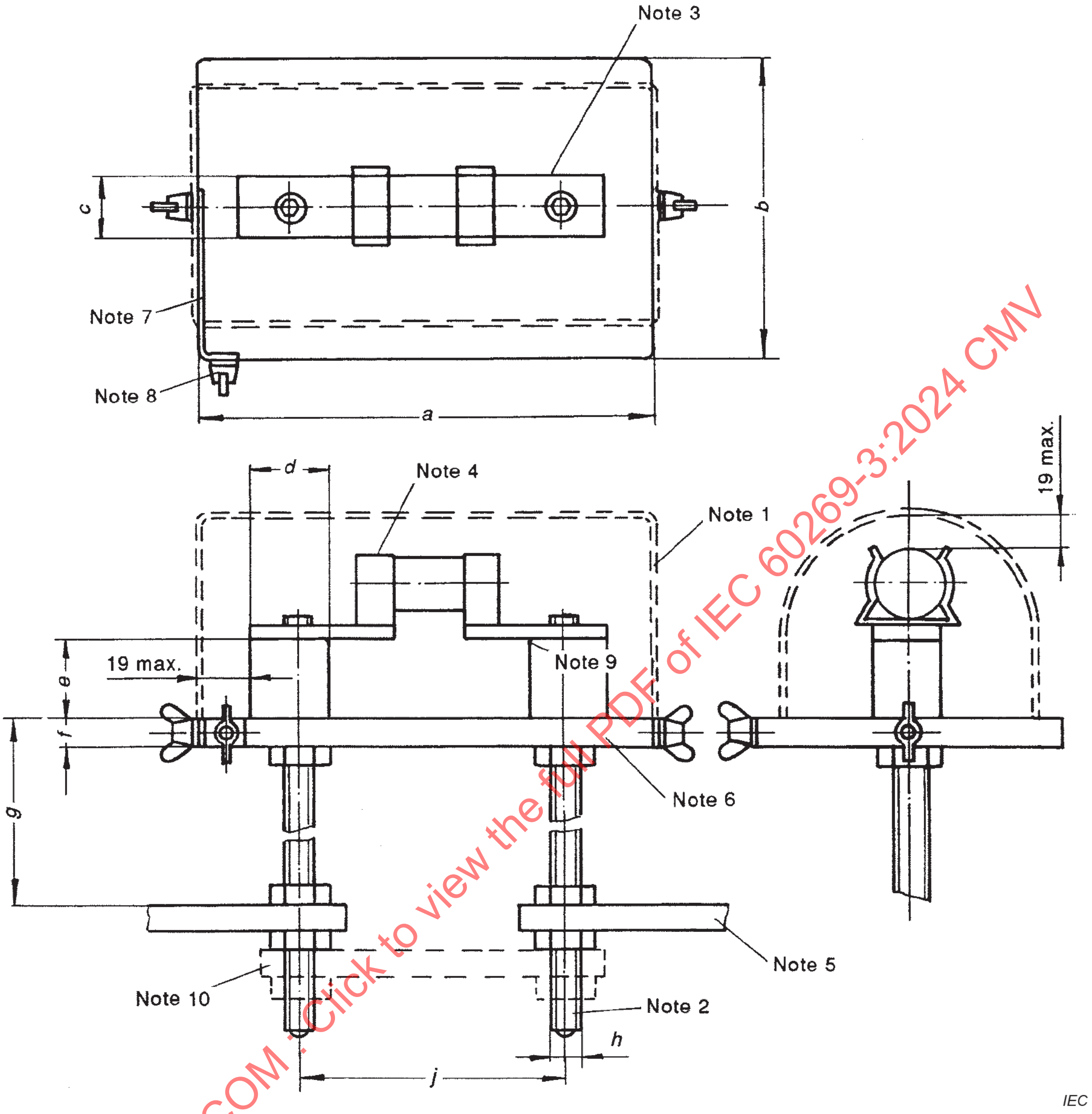
Clips: tin-plated

A (max.)	Type	*A*	*B*	*C*	*D*	*E*	*F*	*G*	*H*	*J*	*K*	*L*	*M* [a]
100	IIb	63,5	38	47,7	41,3	19	8,7	16	1,2	30,1	M5	5,2	1,6
63	IIa	63,5	30	40	41,3	15	8,7	16	1,2	22,2	M5	5,2	1,6
45	Id	42	25	34	25,5	12,5	5	10	0,6	16,7	M3,5	4	1,6
32	Ic	42	25	34	25,5	12,5	5	10	0,6	12,7	M3,5	4	1,6
20	Ib	29	19	28	19	9,5	4	6,5	0,6	10,3	M3,5	4	1,6
5	Ia	29	19	28	19	9,5	4	6,5	0,6	6,3	M3,5	4	0,8

[a] These dimensions are for guidance only. They should be adjusted to give adequate contact pressure between the clips and the fuse endcaps.

Figure 306 – Standard test rig for power-dissipation test

Dimensions in millimetres



Fuse-link reference	*a*	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*j*
Types I, IIa and IIb	187	127	25	36,5	38	12,7	114	M12	111

NOTE 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.

NOTE 2 Connecting studs of high conductivity copper.

NOTE 3 Copper adaptor plates of minimum section 25 mm × 6,3 mm length and fixing centres appropriate to the fuse-link under test.

NOTE 4 Fuse clips of a size appropriate to the fuse-links under test. Specific dimensions are pending.

NOTE 5 The arrangement of the test connections beyond the test rig is not specified (the second paragraph of 8.5.1 of IEC 60269-1:2006 does not apply).

NOTE 6 The base shall be made from insulating material and the test rig shall be of sufficient rigidity to withstand the forces encountered without applying external loads to the fuse-link under test.

NOTE 7 Copper strip.

NOTE 8 Fine wire fuse of copper wire approximately 0,1 mm diameter, with a free length of not less that 75 mm, connected between the terminal and one pole of the test supply.

NOTE 9 Chamfer.

NOTE 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 307 – Breaking-capacity test rig

Fuse system F –
Cylindrical fuse-links for use in plugs
(BS plugtop system)

1 General

IEC 60269-1 applies with the following supplementary requirements.

1.1 Scope

Special requirements for "gG" fuse-links for use by unskilled persons for domestic and similar applications, primarily for use in plugs with rated currents not exceeding 13 A and rated voltages not exceeding 240 V AC. Dimensions of these fuse-links are given in Figure 601.

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

The rated voltage shall be 240 V AC.

5.3.1 Rated current of the fuse-link

For adequate protection of flexible conductors, the preferred ratings are 3 A and 13 A. Other ratings shall be below 13 A and selected from the R10 and R20 series rounded to the nearest whole number.

5.3.2 Rated current of the fuse-holder

Fuses used in plugs may require special current ratings to protect adequately flexible conductors.

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

To ensure that the plug is maintained within acceptable temperature rise limits, the rated power dissipation of the fuse-links shall not exceed 1 W when carrying rated current under specified conditions of test.

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

The time-current zones are given in Figure 602.

5.6.2 Conventional times and currents

Conventional times and currents are given in Table 601.

Table 601 – Conventional times and conventional currents

Rated current for fuse-link I_n A	Conventional time h	Conventional currents	
		I_{nf}	I_f
≤13	0,5	1,6 I_n	1,9 I_n

5.6.3 Gates

Gates for specified pre-arcing times are given in Table 602.

Table 602 – Gates for specified pre-arcing times of "gG" fuse-links for use in plugs

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
3	5,5	9,5	7	19
13	30	55	70	140

5.7.2 Rated breaking capacity

The minimum value of the rated breaking capacity shall not be less than 6 kA AC.

6 Markings

IEC 60269-1 applies with the following supplementary requirements.

The markings on the fuse-link barrel shall be in brown for a 13 A rating and red for a 3 A rating. For all other ratings the markings shall be in black.

If the fuse-bases are not capable of bidirectional current flow, they shall be marked with the current flow direction at front or lateral side.

For this, preferentially, the symbol 5107A in accordance with IEC 60417 should be used. The arrows may be covered in the installed state of the fuse-base.

In the case of fuse-bases for busbar mounting, the marking with the current flow direction is not required.

7 Standard conditions for construction

IEC 60269-1 applies with the following supplementary requirements.

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

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.

7.2 Insulating properties and suitability for isolation

Under consideration

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

Instead of Table 5 of IEC 60269-1:2024, Table 603 applies.

Table 603 – 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 of IEC 60269-1:2024, 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

Limits are standardized for fuse-links rated at 3 A and 13 A as in Table 604.

Table 604 – 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
3	5	45
13	275	1 200

7.9 Protection against electric shock

A fuse shall be so designed that live parts are not accessible when the fuse-base is installed and wired as in normal use with gauge-piece(s), if any, fuse-link and fuse-carrier in position. Where fuse-bases have exposed live parts which are intended to be covered, when installed, by shields not forming a part of the fuse, these live parts are considered to be not accessible.

The degree of protection shall be at least IP2X when the fuse is under normal service conditions. When replacing the fuse-link, the degree of protection may temporarily be reduced to IP1X (see Annex CC).

Where a fuse-carrier is used, it shall retain the fuse-link during insertion in and removal from the fuse-base.

8 Tests

IEC 60269-1 applies with the following supplementary requirements.

8.1.4 Arrangement of the fuse-link for tests

For all electrical tests, the fuse-links shall be mounted in the test fuse-base shown in Figure 603 with the axis of the fuse-link vertical.

8.1.5 Testing of fuse-links

For each rating to be tested, 45 samples are required. All the tests are performed unless the fuse-links constitute a homogeneous series (see 8.1.5.2 of IEC 60269-1:2024), in which case the tests to be made are given in Table 605.

If the test has to be repeated for reasons other than the failure of the fuse-link, spare fuse-links, having approximately the same initial cold resistance as the original samples, shall be used for the repeated test.

Table 605 – Survey of tests on fuse-links

	Sample numbers to be tested														
Sample numbers in order of decreasing initial cold resistance	1 to 3	4 to 6	7 to 9	10 to 12	13 to 15	16 to 18	19 to 21	22 to 24	25 to 27	28 to 30	31 to 33	34 to 36	37 to 39	40 to 42	43 to 45
Tests on maximum rated current in a series	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
Tests on intermediate rated current in a series	×	×	×	*	*	*	×	×	×			*	*	×	
Tests on lowest rated current in a series	×	×	×	*	*	*	×	×	×		×	*	*	×	
Test according to subclause	Tests to be made														
8.3 Verification of temperature rise and power dissipation	×														
8.4.3.1 Conventional non-fusing current a)		×	×												
Conventional fusing current b)			×												
8.4.3.2 Verification of rated current	×														
8.4.3.3.2 Verification of gates* a) c)				×	×										
b) d)													×	×	
8.5 Breaking capacity No. 5							×								
8.5 Breaking capacity No. 4								×							
8.5 Breaking capacity No. 3									×						
8.5 Breaking capacity No. 2										×					
8.5 Breaking capacity No. 1											×				
8.7.3 * Verification of pre-arcing I^2t at 0,01 s a) I^2t_{min}						×									
b) I^2t_{max}												×			
8.11.1 Mechanical strength															×

* Notwithstanding the range submitted by a manufacturer, these tests are mandatory for 3 A and 13 A fuse-links. All ranges submitted by a manufacturer shall include 3 A and 13 A fuse-links.

Table 605 replaces Tables 11, 12 and 13 of IEC 60269-1:2024.

The initial cold resistance of the samples shall be measured when carrying not more than 10 % of the rated current. They shall then be sorted and numbered consecutively in descending order of cold resistance. These numbers are then used to determine which samples shall be used to the various tests, as indicated in Table 605.

8.1.5.2 Testing of fuse-links of a homogeneous series

In addition to IEC 60269-1, the following shall apply.

The grain size may vary between different rated currents.

8.2.4 Acceptability of test results

There shall be no failure in any of the tests.

8.3 Verification of temperature rise and power dissipation

8.3.1 Arrangement of the fuse

The connections of the test base (see 8.1.4 of this fuse system) shall be by means of single-core copper cables with PVC or similar insulation, with a length of 0,3 m ± 0,05 m and a cross-section of 2,5 mm^2. The surroundings shall be free from draughts, and the ambient air temperature, measured by a suitable thermocouple or thermometer at a horizontal distance of 1 m to 2 m from the fuse-link, shall be within the range of 15 °C to 25 °C.

8.3.4 Test method

Three fuse-links, selected in accordance with Table 605, shall be tested. After carrying rated current continuously for 1 h, the cover of the test base shall be removed. The millivolt drop shall then be measured between the end surfaces of the endcaps of the fuse-links whilst carrying rated current. Direct current is recommended for this test, but if AC is used, care should be taken to avoid errors, for example, by distorted waveform.

8.3.5 Acceptability of test results

The product of the measured millivolt drop, multiplied by the rated current, shall not exceed 1 W for any rated current.

8.4 Verification of operation

8.4.1 Arrangement of the fuse

This shall be as specified in 8.3.1 of this fuse system. The tests shall be made using AC of substantially sinusoidal waveform.

8.4.3.1 Verification of conventional non-fusing and fusing current

Six fuse-links, selected in accordance with Table 605, shall carry the conventional non-fusing current (1,6 I_n) for a conventional time of 30 min and shall not operate during this time.

Three fuse-links, selected in accordance with Table 605, shall be subjected to the conventional fusing current (1,9 I_n). They shall operate satisfactorily within the conventional time of 30 min. The recorded time to operate can be used to verify the time-current characteristics.

8.4.3.2 Verification of rated current of "gG" fuse-links

During the following tests, the current shall be maintained within ±2,5 % of the adjusted value.

Three fuse-links, selected from those used for the power-loss test of 8.3, having been allowed to cool down to approximately ambient temperature, shall be subjected to 100 cycles of the current. Each cycle shall comprise an on-period of 1 h at 1,2 I_n, followed by an off-period of 15 min. This test should be run continuously but, where unavoidable, a single interruption is permitted.

Following this, a current of 1,4 I_n shall be passed through the fuse-link for a period of 1 h.

Finally, the millivolt drop at rated current shall again be measured as in 8.3.4 and the values obtained shall not exceed those recorded in the original test by more than 10 % and the marking of the fuse-link shall still be legible.

8.5 Breaking-capacity tests

8.5.1 Arrangement of the fuse

The fuse-links shall be mounted in the enclosed fuse-base shown in Figure 603. However, the cable soldering sockets shown in this figure shall be removed and the fuse-base bolted directly to two copper bars of a cross-section of approximately 25 mm × 3 mm by means of the test terminals.

Substantial terminals shall be provided in these copper bars adjacent to the mounting terminals, so that the fuse-base can be shorted by a copper-link of negligible impedance during the calibration test.

A typical arrangement for the test-circuit connections is shown in Figure 604. The metal enclosure of the test fuse-base shall be connected to one pole of the supply through a fine wire fuse (FW) wired with a copper wire of diameter not greater than 0,1 mm and having a free length of not less than 75 mm.

8.5.2 Characteristics of the test circuit

Subclause 8.5.2 of IEC 60269-1:2024 applies, with the exception that Table 20 is to be replaced by Table 606.

Table 606 – Values for breaking-capacity tests

Breaking capacity test No.	1	2	3	4	5
Prospective current	6 000 A	Depends on rated current[a]	I_3 = 6,3 I_n	I_4 = 4 I_n	I_5 = 2,5 I_n
Tolerance on test current	$^{+10}_{\ 0}$ [b] %	±10 %			
Power factor	0,3[b] – 0,4	Not specified (see 8.5.4)			
Making angle after voltage zero	70° $^{+10°}_{-10°}$	0° $^{+20°}_{-0}$	Not specified		
Power-frequency recovery voltage (RMS)	110 $^{+5}_{\ 0}$ [b] % of the rated voltage				

a) See Table BB.1.

b) By agreement with the manufacturer, this tolerance may be exceeded.

8.5.4 Calibration of the test circuit

The power factor shall be determined as described in Annex A of IEC 60269-1:2024, preferably by using method 1.

The required current values for tests 2 to 5 (see Table 606) shall be obtained by adjustment of the series resistance only, the air-cored reactor remaining as adjusted for test 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 60269-1:2024, tests in accordance with Table 20 of IEC 60269-1:2024 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

The fuse-links shall operate without external effects and damage beyond those specified below.

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

There shall be neither permanent arcing, ejection of flames nor flashover sufficient to cause the fine wire fuse to melt.

8.7 Verification of I^2t characteristics and overcurrent discrimination

8.7.3 Verification of compliance for fuse-links at 0,01 s

Six fuse-links shall be submitted for I^2t testing.

a) Three samples shall be subjected individually to a pulse of 0,01 s corresponding to the I^2t_{min} value in Table 604. No fuse-link shall operate.

b) Three samples shall be subjected individually to a pulse of 0,01 s corresponding to the I^2t_{max} value in Table 604. All fuse-links shall operate.

8.10 Verification of non-deterioration of contacts

The fuse-links produced to this standard are intended to be mounted direct within plugs and not in conventional fuse-bases. Appropriate tests on contacts in the plugs are made by the plug manufacturers.

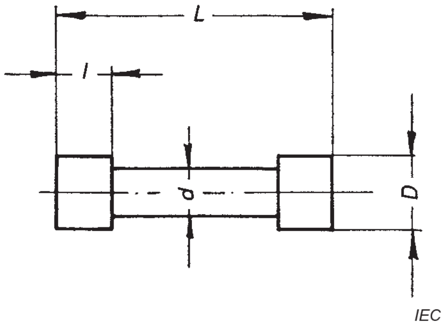
Consequently, no test for the non-deterioration of contacts is appropriate for inclusion in this specification for fuse-links.

8.11.1 Mechanical strength

Three fuse-links, selected as shown in Table 605, shall be tested in a tumbling barrel according to IEC 60068-2-31 but with 20 mm thick hardwood (hornbeam) ends and a height of fall of 350 mm. Alternatively, with the consent of the manufacturer, a tumbling barrel with a steel base which has a greater dropping distance may be used (i.e. that used for testing plugs).

Only one fuse-link is tested at a time. The barrel is rotated at five revolutions per minute and the fuse-link subjected to 50 falls, i.e. 25 revolutions of the barrel.

After the test, the body shall not be broken, filling shall not have come out, and the end caps shall remain tight when tested by hand.



Length L mm	Dimension l of end cap mm	Diameter D of end cap mm
$25,4\,^{+0,8}_{-0,4}$	5,5 ± 0,8	$6,3\,^{+0,2}_{-0,05}$

The maximum diameter d of the cartridge between the end caps shall be less than the diameter D of the end caps.

NOTE This figure was previously Figure 33 in IEC 60269-3-1:2004, Section IV.

Figure 601 – Dimensions for cylindrical fuse-links (primarily used in plugs)

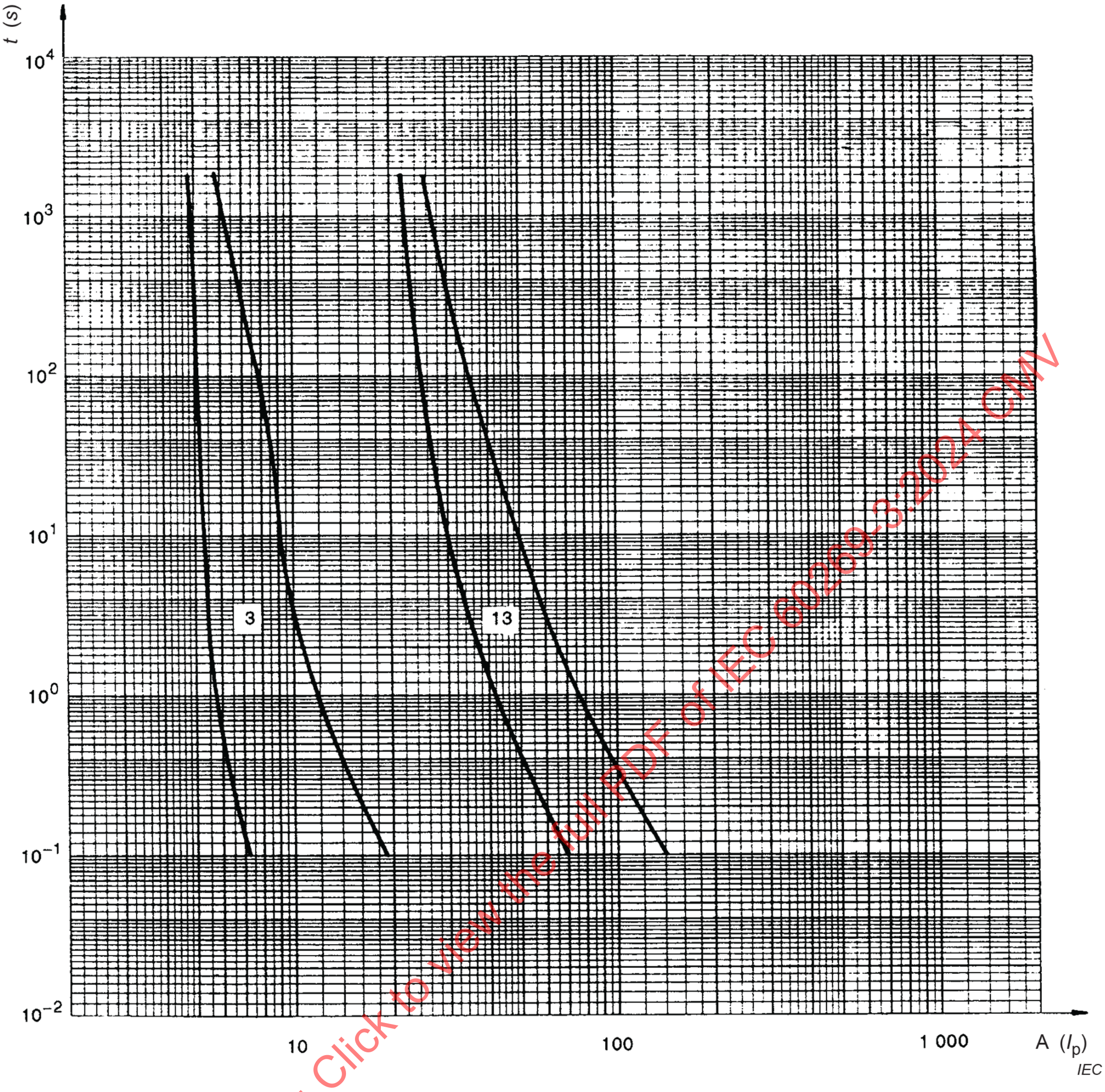
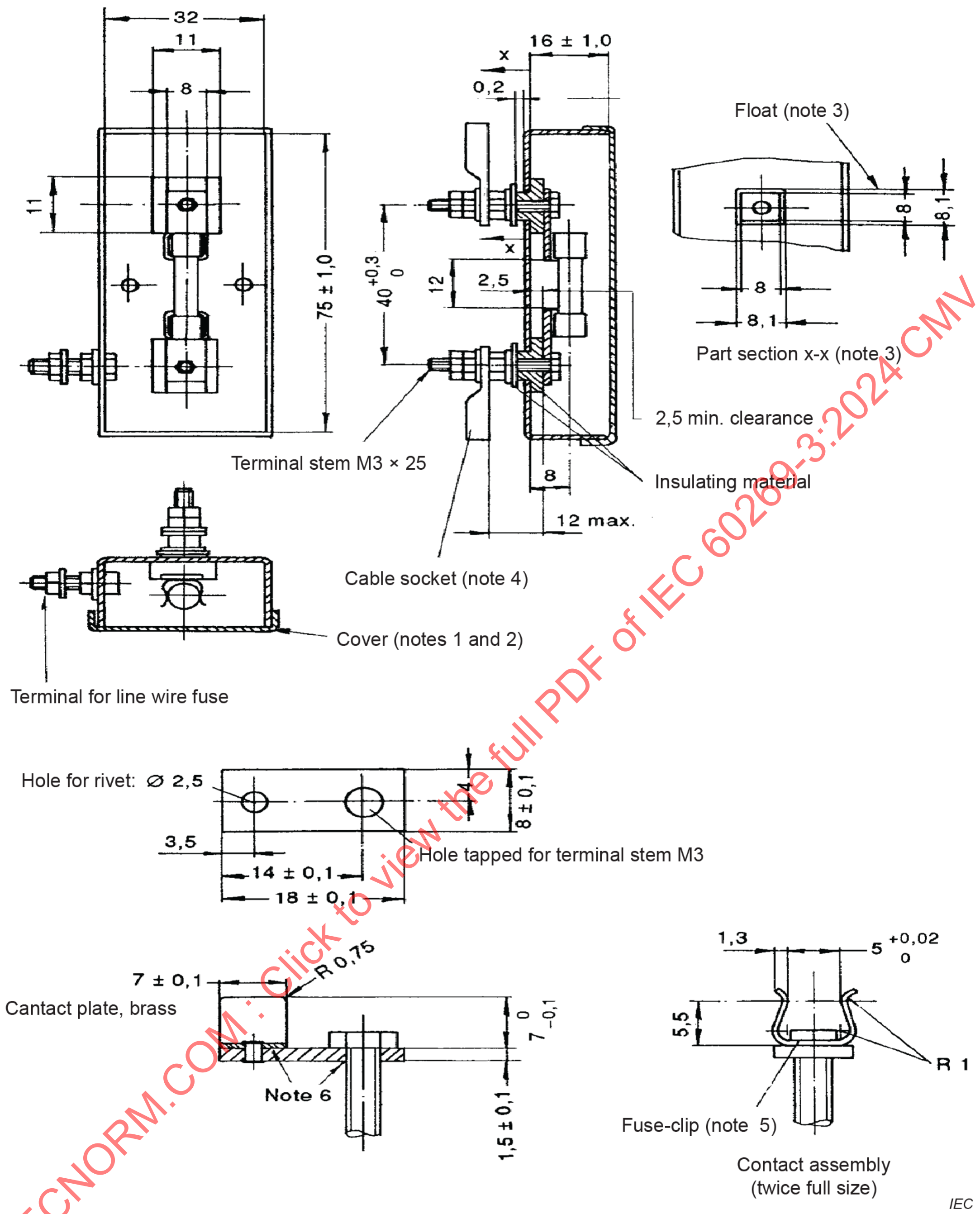


Figure 602 – Time-current zones for "gG" fuse-links

Dimensions in millimetres



NOTE 1 Box and cover should be made from 1,25 mm brass sheet, clean natural finish.

NOTE 2 The over should be a push fit on box and should not be rigidly attached.

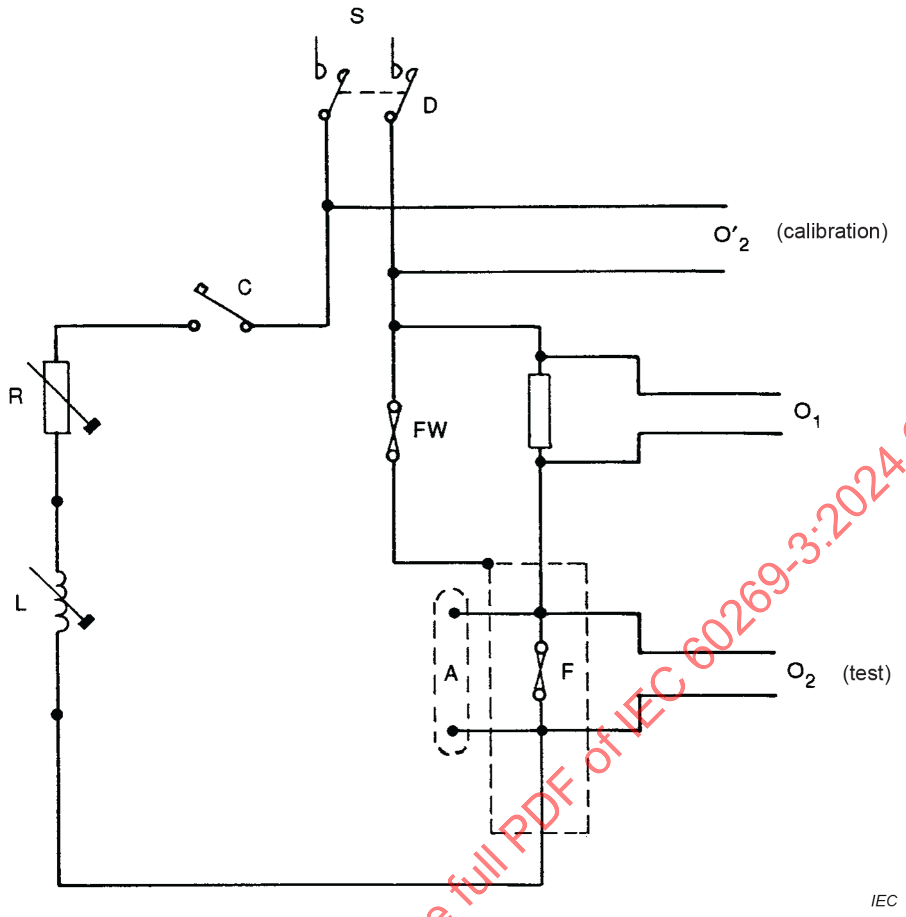
NOTE 3 The end float and clearance between the insulation and the box is to allow the contacts to be self-aligning.

NOTE 4 Cable sockets for 2,5 mm^2 cable for power-loss test. (Replaced by copper bar for breaking-capacity test, see 8.5.1.)

NOTE 5 Fuse-clip. Made from beryllium copper 0,45 mm thick and heat treated (170 HV min.). Base of clip should be flat; finish, silver-plated.

NOTE 6 Joints between clip, contact plate and terminal stem should be soldered.

Figure 603 – Test fuse-base



Key

A	removable link used for the calibration test
C	apparatus for closing the circuit
D	circuit-breaker or other apparatus for the protection of the source
F	fuse on test
FW	fine wire fuse
L	adjustance inductor
O_1	measuring circuit for recording the current
O_2	measuring circuit for recording the voltage during the test
O'_2	measuring circuit for recording the voltage during calibration
R	adjustable resistor
S	source of energy

Figure 604 – Typical diagram of the circuit used for breaking-capacity tests

Annex BB
(informative)
(for all fuse systems) –

Alternative tests for tests No. 1 and No. 2 of Table 20 of IEC 60269-1:2024

BB.1 Test method

In order to verify that the fuse satisfies the conditions of 7.5 of IEC 60269-1:2024, tests in accordance with Table 20 of IEC 60269-1:2024 shall be made. As an alternative to tests 1 and 2 of Table 20 for fuse-links with constant I^2t values at times less than 0,01s, the following test methods may be employed to achieve the test criteria for tests 1 and 2.

BB.2 Test No. 1

This test shall be performed on three samples at rated breaking capacity. As a guide the instant of making for all tests may be taken from Figure BB.1, provided that the angle of initiation of arcing complies with the requirements of IEC 60269-1.

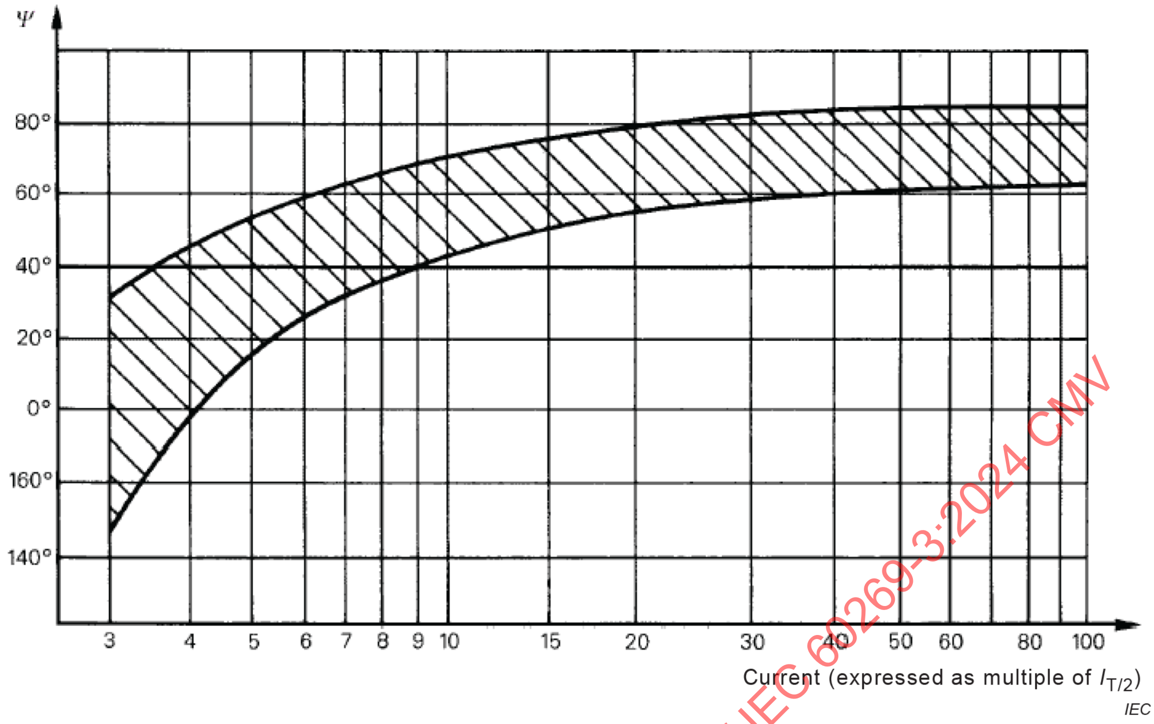
BB.3 Test No. 2

This test shall be performed on three samples. As a guide the prospective currents are indicated in Table BB.1.

Table BB.1 – Approximate values of prospective currents for breaking capacity test No. 2

Rated current of the fuse-link A	Prospective current A
≤ 2	100
> 2 ≤ 4	160
> 4 ≤ 6	315
> 6 ≤ 10	500
> 10 ≤ 16	630
> 16 ≤ 20	800
> 20 ≤ 25	1 000
> 25 ≤ 32	1 250
> 32 ≤ 40	1 600
> 40 ≤ 50	2 000
> 50 ≤ 63	2 500
> 63 ≤ 80	3 150
> 80 ≤ 100	5 000

NOTE In case of doubt, the definition of I_2 of IEC 60269-1 applies (see IEC 60269-1:2024, Table 20).



where

$I_{T/2}$ is the symmetrical current (RMS value) which causes the fuse-element to melt in the time of one half-cycle;

ψ is the making angle after the supply voltage zero.

Figure BB.1 – Instant of making for Test No. 1

Annex CC
(informative)

Recommendations for future designs of fuses (for all fuse systems)

CC.1 Overview

This standard is based on the present state of the art, i.e. well-established fuse systems used in many countries over many years.

Increasing safety requirements go in parallel with technical progress. For new fuse-designs it is recommended that attention should be paid to such features of fuses where improvement seems to be required. This applies in particular to the CC.2 and CC.3.

CC.2 Fuse contacts

The contact force should be independent of the user's skill in handling the fuse.

CC.3 Protection against electric shock

The degree of protection against electric shock during the period of replacing a fuse-link should be at least IP2X.

Bibliography

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60269-6, *Low-voltage fuses – Part 6: Supplementary requirements for fuse-links for the protection of solar photovoltaic energy systems*

ISO 228-1, *Pipe threads where pressure-tight joints are not made on the threads – Part 1: Dimensions, tolerances and designation*

ISO 228-2, *Pipe threads where pressure-tight joints are not made on the threads – Part 2: Verification by means of limit gauges*

ISO 965-1, *ISO general-purpose metric screw threads – Tolerances – Part 1: Principles and basic data*

ISO 1302, *Geometrical Product Specifications (GPS) – Indication of surface texture in technical product documentation*

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SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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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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L'IEC 60269-3 a été établie par le sous-comité 32B: Coupe-circuits à fusibles à basse tension, du comité d'études 32 de l'IEC: Coupe-circuits à fusibles. Il s'agit d'une Norme internationale.

Cette cinquième édition annule et remplace la quatrième édition parue en 2010, l'Amendement 1:2013 et l'Amendement 2:2019. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) l'introduction et le domaine d'application général ont été entièrement mis à jour;
b) les références normatives ont été mises à jour et des modifications rédactionnelles ont été apportées;
c) les termes "personne ordinaire", "opération" et "non-interchangeabilité" ont été définis;
d) dans le système A, les parties ont été définies pour l'enlèvement;
e) dans le système A, le marquage des socles a été ajouté pour indiquer la direction du courant;
f) dans le système A, des clarifications ont été ajoutées pour la connexion;
g) dans le système A, la construction du porte-fusible et de l'élément de remplacement a été clarifiée;
h) dans le système A, le mesurage de la chute de tension a été clarifié.

Le texte de cette Norme internationale est issu des documents suivants:

Projet	Rapport de vote
32B/745/FDIS	32B/754/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

La présente partie doit être utilisée conjointement avec l'IEC 60269-1:2024, *Fusibles basse tension – Partie 1: Exigences générales*.

La présente Partie 3 complète ou modifie les articles ou paragraphes correspondants de la Partie 1.

Lorsqu'aucune modification n'est nécessaire, la Partie 3 indique que l'article ou le paragraphe correspondant s'applique.

Les tableaux et figures qui s'ajoutent à ceux de la Partie 1 sont numérotés à partir de 101. Les annexes qui sont ajoutées sont désignées AA, BB, etc.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/standardsdev/publications.

L'IEC 60269, publiée sous le titre général *Fusibles basse tension*, est composée des parties suivantes:

Partie 1: *Exigences générales*

Partie 2: *Exigences supplémentaires pour les fusibles destinés à être utilisés par des personnes habilitées (fusibles pour usages essentiellement industriels) – Exemples de systèmes de fusibles normalisés A à K*

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*

Partie 4: *Exigences supplémentaires concernant les éléments de remplacement utilisés pour la protection des dispositifs à semiconducteurs*

Partie 5: *Lignes directrices pour l'application des fusibles basse tension*

Une liste de toutes les parties de la série IEC 60269, publiées sous le titre général *Fusibles basse tension*, se trouve sur le site web de l'IEC.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous webstore.iec.ch dans les données relatives au document recherché. À cette date, le document sera

- reconduit,
- supprimé, ou
- révisé.

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INTRODUCTION

Les fusibles destinés à être utilisés par des personnes non qualifiées qui appartiennent aux systèmes de fusibles suivants répondent à l'ensemble des paragraphes de l'IEC 60269-1, ainsi qu'aux exigences des systèmes de fusibles applicables.

La présente partie de l'IEC 60269 est divisée en quatre systèmes de fusibles traitant chacun d'un exemple spécifique de fusible normalisé destiné à être utilisés par des personnes non qualifiées.

Tous les systèmes fournissent leur propre solution mécanique pour éviter l'utilisation d'un élément de remplacement avec un courant assigné supérieur (non-interchangeabilité) afin d'assurer la protection des câbles et des lignes. Le demandeur doit veiller à remplacer un élément de remplacement par un autre du même type.

Système de fusibles	Principes de non-interchangeabilité
Système de fusibles A: Système de fusibles du type D 1)	Le diamètre et la forme de la partie inférieure des éléments de remplacement diffèrent, les socles nécessitent des éléments de calibrage
Système de fusibles B: Fusibles cylindriques (système de fusibles cylindriques NF) 2)	Les éléments de remplacement et les ensembles-porteurs (porte-fusibles) adaptés fournissent des dimensions uniques
Système de fusibles C: Fusibles cylindriques (système de fusibles cylindriques BS) 2)	Les éléments de remplacement et les ensembles-porteurs (porte-fusibles) adaptés fournissent des dimensions uniques
Système de fusibles F: Éléments de remplacement cylindriques destinés à être utilisés dans des fiches de prise de courant (système de fusibles pour fiches à fusibles BS) 1)	Les éléments de remplacement et les ensembles-porteurs (porte-fusibles) adaptés fournissent des dimensions uniques

NOTE 1 Les demandeurs des systèmes A et F peuvent disposer de socles au sein de leur installation qui ne procurent pas le degré de protection IP2X à tout moment. Le degré de protection peut être temporairement réduit à l'IP1X durant le remplacement de l'élément de remplacement. Il n'est pas nécessaire de considérer la suspension temporaire de la protection complète IP2X contre les chocs électriques (après de nombreuses années d'utilisation en toute sécurité du système de fusibles de type D par des personnes non qualifiées) comme dangereuse, compte tenu de l'expérience suffisante acquise avec le remplacement de lampes à incandescence, lorsqu'il existe des niveaux de sécurité comparables. Pour les développements futurs, l'Annexe CC recommande que le degré de protection contre les chocs électriques durant le remplacement de l'élément de remplacement soit au moins IP2X.

NOTE 2 Ne pas interchanger les éléments de remplacement avec des éléments de remplacement de même dimension, mais de caractéristiques différentes (par exemple, aM).

Pour des raisons de sécurité, il est strictement interdit de combiner les composants de différents systèmes de fusibles, par exemple éléments de remplacement, ensembles-porteurs et socles.

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

1 Domaine d'application général

La présente partie de l'IEC 60269 est divisée en quatre systèmes de fusibles traitant chacun d'un exemple spécifique de fusible normalisé destiné à être utilisés par des personnes non qualifiées.

La présente partie s'applique uniquement aux fusibles "gG".

Les personnes non qualifiées ne disposent pas des connaissances techniques ou d'une expérience suffisante. Pour éviter les dangers que l'électricité peut présenter, la partie de la norme relative aux fusibles doit fournir des exigences pour une sécurité maximale en service. L'IEC 60269-3 définit quatre systèmes destinés à être utilisés par des personnes non qualifiées. Des instructions permettant le fonctionnement en toute sécurité des éléments de remplacement sont fournies dans la documentation du fabricant.

Tous les systèmes fournissent leur propre solution mécanique pour éviter l'utilisation d'un élément de remplacement avec un courant assigné supérieur (non-interchangeabilité) tandis que la protection des câbles et des lignes est assurée. Le demandeur doit veiller à remplacer un élément de remplacement par un autre du même type.

Système de fusibles	Principes de non-interchangeabilité
Système de fusibles A: Système de fusibles du type D 1)	Le diamètre et la forme de la partie inférieure des éléments de remplacement diffèrent, les socles nécessitent des éléments de calibrage
Système de fusibles B: Fusibles cylindriques (système de fusibles cylindriques NF) 2)	Les éléments de remplacement et les ensembles-porteurs (porte-fusibles) adaptés fournissent des dimensions uniques
Système de fusibles C: Fusibles cylindriques (système de fusibles cylindriques BS) 2)	Les éléments de remplacement et les ensembles-porteurs (porte-fusibles) adaptés fournissent des dimensions uniques
Système de fusibles F: Éléments de remplacement cylindriques destinés à être utilisés dans des fiches de prise de courant (système de fusibles pour fiches à fusibles BS) 1)	Les éléments de remplacement et les ensembles-porteurs (porte-fusibles) adaptés fournissent des dimensions uniques

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60068-2-31, *Essais d'environnement – Partie 2-31: Essais – Essai Ec: Choc lié à des manutentions brutales, essai destiné en premier lieu aux matériels*

IEC 60269-1:2024, *Fusibles basse tension – Partie 1: Exigences générales*

IEC 60664 (toutes les parties), *Coordination de l'isolement des matériels dans les systèmes (réseaux) à basse tension*

IEC 60898-1:2015, *Petit appareillage électrique – Disjoncteurs pour la protection contre les surintensités pour installations domestiques et analogues – Partie 1:* Disjoncteurs pour le fonctionnement en courant alternatif
IEC 60898-1:2015/AMD1:2019

IEC 60999-1:1999, *Dispositifs de connexion – Conducteurs électriques en cuivre – Prescriptions de sécurité pour organes de serrage à vis et sans vis – Partie 1: Prescriptions générales et particulières pour les organes de serrage pour les conducteurs de 0,2 mm^2 à 35 mm^2 (inclus)*

IEC 61439-1, *Ensembles d'appareillage à basse tension – Partie 1: Règles générales*

IEC 61439-3:2012, *Ensembles d'appareillage à basse tension – Partie 3: Tableaux de répartition destinés à être utilisés par des personnes ordinaires (DBO)*

3 Termes et définitions

Pour les besoins du présent document, les termes et les définitions de l'IEC 60269-1:2024 ainsi que les suivants s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse https://www.electropedia.org/
- ISO Online browsing platform: disponible à l'adresse https://www.iso.org/obp

3.1
personne ordinaire
personne qui n'est ni une personne qualifiée ni une personne avertie

3.2
opération
dans la présente norme, le terme "opération" est défini comme le remplacement de l'élément de remplacement

3.3
non-interchangeabilité
caractéristiques limitatives de forme et/ou de dimensions destinées à éviter l'utilisation par mégarde, sur un socle déterminé, d'éléments de remplacement ayant des propriétés électriques autres que celles assurant le degré voulu de protection

[SOURCE: IEC 60050-441:1984, 441-18-33]

Système de fusibles A:
Système de fusibles du type D

1 Généralités

L'IEC 60269-1 s'applique avec les exigences supplémentaires suivantes.

1.1 Domaine d'application

Les exigences supplémentaires suivantes s'appliquent aux fusibles "gG" destinés à être utilisés par des personnes non qualifiées dans des applications domestiques et analogues, de courants assignés inférieurs ou égaux à 100 A et de tensions assignées inférieures ou égales à 500 V en courant alternatif et à 500 V en courant continu.

En supplément de l'IEC 60269-1, les caractéristiques suivantes des fusibles sont spécifiées:

- la tension assignée;
- la puissance dissipée assignée de l'élément de remplacement et la puissance dissipée acceptable assignée de l'ensemble-porteur;
- la caractéristique temps-courant;
- les balises, les caractéristiques I^2t et les courants et temps conventionnels;
- le pouvoir de coupure assigné;
- les marquages apposés sur le fusible;
- les conditions normales d'établissement;
- les essais.

2 Termes et définitions

L'IEC 60269-1 s'applique, avec les ajouts suivants.

2.1.13

Parties définies qui peuvent être enlevées d'un fusible: porte-fusible et élément de remplacement.

3 Conditions de fonctionnement en service

L'IEC 60269-1 s'applique.

4 Classification

L'IEC 60269-1 s'applique.

5 Caractéristiques des fusibles

L'IEC 60269-1 s'applique avec les exigences supplémentaires suivantes.

5.2 Tension assignée

En courant alternatif, les valeurs normalisées de la tension assignée sont de 400 V pour les fusibles de tailles D01, D02 et D03[1] et de 500 V pour les fusibles de tailles DII, DIII et DIV.

En courant continu, les valeurs de la tension assignée sont de 250 V pour les fusibles de tailles D01, D02 et D03 et de 500 V pour les fusibles de tailles DII, DIII et DIV.

5.3.1 Courant assigné de l'élément de remplacement

Les courants assignés des éléments de remplacement sont spécifiés sur la Figure 110 et la Figure 111.

5.3.2 Courant assigné de l'ensemble-porteur

Les courants assignés des porte-fusibles sont spécifiés sur la Figure 112, la Figure 113 et la Figure 114. Les courants assignés des socles sont spécifiés sur la Figure 118, la Figure 119 et la Figure 120.

5.3.3 Courant assigné de l'élément de calibrage

Le courant assigné de l'élément de calibrage est identique au courant assigné de l'élément de remplacement le plus élevé que peut recevoir l'élément de calibrage.

5.5 Puissance dissipée assignée d'un élément de remplacement et puissance dissipée acceptable assignée pour un ensemble-porteur

Les valeurs maximales de la puissance dissipée des éléments de remplacement de type D sont indiquées dans le Tableau 101.

Tableau 101 – Valeurs maximales de la puissance dissipée

Courant assigné In A	Puissance maximale dissipée W	
	D01 à D03	DII à 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	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

[1] Ces trois tailles s'appliquent également aux réseaux à 415 V.

5.6 Limites des caractéristiques temps-courant

5.6.1 Caractéristiques temps-courant, zones temps-courant et courbes de surcharge

En complément des limites de durée de préarc données par les balises et les temps et courants conventionnels, des zones temps-courant sont spécifiées sur la Figure 101, la Figure 102, la Figure 103 et la Figure 127. La tolérance sur la caractéristique temps-courant indiquée par le fabricant ne doit pas s'écarter de plus de ±10 % en ce qui concerne le courant.

Les zones temps-courant spécifiées sur la Figure 101, la Figure 102, la Figure 103 et la Figure 127, y compris les tolérances de fabrication, doivent être respectées pour toutes les durées de préarc et de fonctionnement mesurées à la tension d'essai selon le 8.7.4.

5.6.2 Courants et temps conventionnels

En complément des valeurs indiquées dans l'IEC 60269-1, les courants et temps conventionnels sont donnés dans le Tableau 102.

Tableau 102 – Courants et temps conventionnels pour les éléments de remplacement "gG"

Courant assigné I_n	Temps conventionnel	Courant conventionnel	
A	h	I_{nf}	I_f
2 et 4	1	1,5 I_n	2,1 I_n
6 et 10	1	1,5 I_n	1,9 I_n
13 ≤ I_n ≤ 35	1	1,25 I_n	1,6 I_n

5.6.3 Balises

Pour les éléments de remplacement "gG", les balises données dans le Tableau 103 s'appliquent, en complément de celles indiquées dans l'IEC 60269-1.

Tableau 103 – Balises des durées de préarc spécifiées pour des éléments de remplacement "gG" avec un courant assigné de 2 A, 4 A, 6 A, 10 A, 13 A et 35 A

I_n	I_{min} (10 s)	I_{max} (5 s)	I_{min} (0,1 s)	I_{max} (0,1 s)
A	A	A	A	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 Zone de coupure et pouvoir de coupure

5.7.2 Pouvoir de coupure assigné

Les valeurs du pouvoir de coupure assigné doivent être supérieures ou égales aux valeurs suivantes:

- 50 kA en courant alternatif;
- 8 kA en courant continu.

6 Marquages

6.1 Généralités

L'IEC 60269-1 s'applique avec les exigences supplémentaires suivantes.

Les éléments de remplacement et ensembles-porteurs qui satisfont aux exigences et essais du présent système de fusibles peuvent porter l'indication "IEC 60269-3".

6.2 Marquage des socles

Si les socles n'assurent pas une circulation bidirectionnelle du courant, ils doivent porter le marquage du sens de circulation du courant sur leur partie frontale ou latérale. Il convient de préférence d'utiliser le symbole 5107A selon l'IEC 60417 à cette fin. Les flèches peuvent être masquées lorsque le socle est installé.

Dans le cas de socles pour montage sur jeu de barres, le marquage du sens de circulation du courant n'est pas exigé.

6.3 Marquage des éléments de calibrage

- nom du fabricant ou marque commerciale qui permet de l'identifier facilement;
- courant assigné ou code de couleur.

Pour les éléments de calibrage de très faibles dimensions, le nom du fabricant peut être omis, à condition qu'il soit indiqué sur l'emballage.

7 Conditions normales d'établissement

L'IEC 60269-1 s'applique avec les exigences supplémentaires suivantes.

7.1 Réalisation mécanique

L'IEC 60269-1 s'applique avec les ajouts et modifications suivants.

7.1.2 Connexions, y compris les bornes

Le montage de tous les socles de fusibles et le câblage doivent être effectués par une personne autorisée/qualifiée.

Les bornes doivent être en mesure de revoir les sections de conducteurs indiquées dans le Tableau 104.

Les plus grandes des sections spécifiées dans le Tableau 104 peuvent être réduites à 6 mm^2 (taille DII), 16 mm^2 (taille DIII) et 35 mm^2 (taille DIV) sous réserve que les bornes du socle soient raccordées à des conducteurs internes de tableaux de distribution, de coffrets fusibles, etc., et que des conducteurs externes soient donc adaptés aux bornes d'alimentation distinctes d'un ensemble de série ou dérivé de série.

Dans le cas de socles pour montage sur jeu de barres, les dimensions du jeu de barres et les entraxes doivent être spécifiés par le fabricant. La section du jeu de barres doit correspondre à la valeur Q conformément au tableau de la Figure 118.

Les connexions aux jeux de barre doivent satisfaire aux exigences décrites en 8.10.

Tableau 104 – Sections de conducteurs en cuivre rigide (à âmes massives ou câblées) ou souples

Socle		Section
Taille	I_n	
	A	mm^2
D01	16	1,5 à 4
D02	63	1,5 à 25
D03	100	10 à 50
DII	25	1,5 à 10
DIII	63	2,5 à 25
DIV	100	10 à 50

7.1.3 Contacts du fusible

Les contacts du fusible doivent être nickelés ou protégés par d'autres matériaux qui procurent une protection au moins équivalente.

Les contacts des éléments de remplacement qui ont un courant assigné supérieur ou égal à 50 A et les contacts des éléments de remplacement D02 qui ont un courant assigné compris entre 32 A et 40 A doivent être argentés avec une épaisseur minimale de la couche d'argent de 3 µm.

7.1.4 Construction de l'élément de calibrage

Les pièces de contact, le cas échéant, doivent être en une seule pièce et constituées d'un alliage de cuivre qui contient au moins 50 % de cuivre. Leurs surfaces de contact doivent être planes et sans bavures.

La partie métallique des éléments de calibrage de tailles DII et DIII doit avoir, sur ses deux faces, des surfaces de contact lisses et sans bavures dans la zone indiquée, et les deux surfaces de contact doivent faire saillie par rapport à la matière céramique adjacente.

Dans le cas des fusibles de types DII, DIII et DIV, la partie qui constitue la bague de calibrage doit être en céramique. La couleur de la face de la bague de calibrage doit être conforme à la couleur de l'indicateur de fusion selon le tableau de la Figure 111.

NOTE Les éléments de calibrage assurent la non-interchangeabilité. Ils sont donc conçus pour être insérés ou remplacés seulement à l'aide de clés spéciales qui ne sont pas accessibles aux personnes non qualifiées.

La conformité aux exigences du paragraphe doit être vérifiée par examen.

Il existe deux types d'éléments de calibrage qui correspondent aux deux types de socles de tailles DII et DIII:

– les éléments de calibrage à visser (Figure 122);
– les éléments de calibrage à insérer de force (Figure 123).

Voir la Figure 121, la Figure 122, la Figure 123 et la Figure 124.

7.1.6 Construction du porte-fusible

Le porte-fusible doit être équipé de moyens pour maintenir l'élément de remplacement en position, que le porte-fusible soit inséré ou non dans le socle.

Définies selon la Figure 112 pour les porte-fusibles D0, selon la Figure 113 pour les porte-fusibles de type D, selon la Figure 110 pour les éléments de remplacement pour D0 et selon la Figure 111 pour les éléments de remplacement de type D.

Le porte-fusible destiné aux éléments de remplacement pour lesquels un indicateur est exigé doit être équipé d'une ouverture appropriée pour l'observation de l'indicateur. L'ouverture doit être fermée par un regard en matériau transparent solidement fixé ou par un autre moyen approprié qui procure une protection contre les matériaux qui peuvent être éjectés de l'indicateur.

Le capot vissé doit être constitué d'un alliage de cuivre qui contient au moins 50 % de cuivre lorsqu'il est obtenu à partir de barres et au moins 62 % de cuivre lorsqu'il est obtenu par laminage.

Les parties isolantes doivent être en céramique ou d'un autre matériau suffisamment résistant à la chaleur.

Le trou pour l'appareil de contrôle de la tension est facultatif.

Voir la Figure 112, la Figure 113, la Figure 114, la Figure 115 et la Figure 116.

7.1.7 Construction de l'élément de remplacement

L'élément de remplacement doit être réalisé de façon qu'il ne soit pas possible d'enlever ou de remplacer des pièces qui assurent l'interchangeabilité sans l'aide d'un outil approprié.

Un élément de remplacement ne comporte pas de pièces interchangeables. Seul l'élément de calibrage assure la non-interchangeabilité. Il n'est pas possible d'échanger un élément de remplacement avec un élément présentant une valeur assignée supérieure.

Si l'élément de remplacement est équipé d'un indicateur, l'indication donnée par celui-ci doit être visible lorsque l'élément de remplacement est inséré dans l'ensemble-porteur ou dans le porte-fusible.

Le corps de l'élément de remplacement doit être en céramique. Les pièces de contact doivent être en cuivre ou constituées d'un alliage qui contient au moins 62 % de cuivre. La couleur de l'indicateur de fusion doit être conforme à la Figure 111.

Voir la Figure 110 et la Figure 111.

7.1.8 Non-interchangeabilité

Les fusibles doivent être conçus de façon qu'un élément de remplacement ne puisse pas être remplacé, par inadvertance, par un autre élément de courant assigné supérieur à une valeur prédéterminée.

Pour les courants assignés inférieurs à 10 A, la non-interchangeabilité n'est pas exigée.

7.1.9 Construction du socle

Le socle du fusible doit être conçu de manière à pouvoir être solidement fixé d'une façon qui empêche tout enlèvement involontaire.

Le socle prévu pour l'emploi d'éléments de calibrage doit être équipé de moyens appropriés pour maintenir les éléments de calibrage en position et ne permettre leur enlèvement qu'à l'aide d'un outil approprié.

Les couvercles des socles qui procurent une protection contre l'accès aux parties actives doivent résister aux contraintes mécaniques qui se produisent pendant la fixation et doivent être fixés solidement de façon à ne pouvoir être enlevés, lorsqu'ils sont en place, qu'à l'aide d'un outil ou au moyen une action volontaire.

Les bornes doivent permettre le raccordement de conducteurs de section appropriée.

Les parties qui transportent le courant constituées d'alliage de cuivre doivent avoir une teneur en cuivre d'au moins 50 % lorsqu'elles sont obtenues à partir de barres et d'au moins 62 % lorsqu'elles sont obtenues par laminage.

Un socle destiné à être monté sur rail ne doit pas se désaccoupler lorsque l'élément de remplacement est inséré ou retiré (le couple doit correspondre aux deux tiers de la valeur indiquée dans le Tableau 115 pour le porte-fusible).

Le socle peut se déplacer longitudinalement dans les deux sens sur le rail.

Un socle destiné à être monté en surface ne doit pas osciller lorsqu'il est placé sur une surface plane.

Pour les socles de tailles DII et DIII, il existe deux types qui diffèrent en fonction de la construction de l'élément de calibrage:

– les socles avec bagues de calibrage à visser (Figure 119);
– les socles avec bagues de calibrage à insérer de force (Figure 120).

Voir la Figure 115, la Figure 117, la Figure 118, la Figure 119, la Figure 120 et la Figure 124.

7.2 Propriétés isolantes et aptitude au sectionnement

Les valeurs minimales des lignes de fuite, des distances dans l'air et des distances à travers les matériaux isolants ou de remplissage doivent correspondre aux valeurs indiquées dans le Tableau 105. Dans le cas de socles pour montage sur jeu de barres, les valeurs spécifiées doivent être observées lorsque les jeux de barre avec les dimensions maximales et les distances minimales de séparation sont utilisés.

Tableau 105 – Lignes de fuite, distances dans l'air et distances à travers les matériaux de remplissage

Lignes de fuite mm	DII à DIV	D01 à D03
Entre les parties métalliques, y compris les contacts, qui, après fonctionnement de l'élément de remplacement, sont de polarité différente	5	4
Entre les parties actives et les parties métalliques accessibles, y compris les vis de fixation du socle ou les moyens de fixation métalliques pour le montage sur rails, un porte-fusible, un élément de remplacement et un élément de calibrage étant en place	5	3
Distances dans l'air mm	**DII à DIV**	**D01 à D03**
Entre les parties métalliques, y compris les contacts, qui, après fonctionnement de l'élément de remplacement, sont de polarité différente	5	3
Entre les parties actives et les parties métalliques accessibles, y compris les vis de fixation du socle ou les moyens de fixation métalliques pour le montage sur rails, un porte-fusible, un élément de remplacement et un élément de calibrage étant en place	5	3
Distances mm	**DII à DIV**	**D01 à D03**
Entre les parties actives et la surface de fixation dans le cas des socles à prise avant	10	6
À travers le matériau de remplissage entre parties actives couvertes d'au moins 2,5 mm de matériau de remplissage et la surface de fixation dans le cas des socles à prise avant	5	3
NOTE Le doigt d'épreuve normalisé mentionné dans ce tableau est spécifié dans l'IEC 60529.		

7.3 Échauffement, puissance dissipée de l'élément de remplacement et puissance dissipée acceptable pour l'ensemble-porteur

Le Tableau 5 de l'IEC 60269-1:2024 est remplacé par le Tableau 106.

Tableau 106 – Limite d'échauffement des bornes

Lorsque le socle est équipé de conducteurs de section conforme au Tableau 17 de l'EC 60269-1:2024, les limites d'échauffement des bornes ne doivent pas dépasser, pour le courant assigné correspondant	65K

7.7 Caractéristiques I^2t

7.7.1 Valeurs de I^2t de préarc

En complément du Tableau 7 de l'IEC 60269-1:2024, les valeurs de I^2t de préarc indiquées dans le Tableau 107 s'appliquent.

Tableau 107 – Valeurs de I^2t de préarc à 0,01 s pour éléments de remplacement "gG"

I_n A	I^2t_{min} A^2s	I^2t_{max} A^2s
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 Valeurs de I^2t de fonctionnement

Les valeurs maximales de I^2t de préarc indiquées dans le Tableau 107 du présent document et dans le Tableau 7 de l'IEC 60269-1:2024 doivent être prises comme valeurs maximales de I^2t de fonctionnement et doivent être vérifiées par l'essai du pouvoir de coupure spécifié en 8.7.1 de l'IEC 60269-1:2024.

7.8 Sélectivité en cas de surintensité des éléments de remplacement "gG"

Les éléments de remplacement de courant assigné supérieur ou égal à 16 A montés en série et dont le rapport entre les courants assignés est de 1:1,6 doivent fonctionner de manière sélective sur toute la zone de coupure (voir le 8.7.4).

En ce qui concerne la sélectivité lorsque des disjoncteurs sont utilisés, les valeurs suivantes de I^2t spécifiées dans le Tableau 108 doivent être respectées:

Tableau 108 – Valeurs de I^2t pour la sélectivité avec les disjoncteurs

I_n A	I^2t_{min} A^2s	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 contre les chocs électriques

Le degré de protection du fusible doit être d'au moins IP2X dans les conditions de service normales.

Pour les fusibles de type D, l'opération de remplacement d'un élément de remplacement est différenciée en deux étapes qui sont: "enlever l'élément de remplacement et le porte-fusible" et "l'élément de remplacement et le porte-fusible sont enlevés". La première étape est considérée comme représentant des fusibles du type D dans des conditions de service normales. Uniquement lorsque l'élément de remplacement et le porte-fusible sont enlevés, le degré de protection peut être temporairement réduit à IP1X.

NOTE Il n'est pas nécessaire de considérer la suspension temporaire de la protection complète IP2X contre les chocs électriques (après de nombreuses années d'utilisation en toute sécurité du système de fusibles de type D par des personnes non qualifiées) comme dangereuse, compte tenu de l'expérience suffisante acquise avec le remplacement de lampes à incandescence, lorsqu'il existe des niveaux de sécurité comparables.

8 Essais

L'IEC 60269-1 s'applique avec les exigences supplémentaires suivantes.

8.1.4 Disposition du fusible et dimensions

L'épaisseur du capot vissé des socles et des porte-fusibles doit être mesurée (par exemple, au moyen d'un micromètre à pointes). Les valeurs moyennes de deux séries de trois mesurages doivent être au moins égales à la valeur spécifiée sur la Figure 112, la Figure 113, la Figure 114, la Figure 118, la Figure 119 et la Figure 120.

Deux séries de mesurages sont effectuées sur l'une de deux lignes longitudinales décalées d'au moins 30° l'une par rapport à l'autre.

Les trois mesurages le long de la ligne longitudinale sont également répartis sur celle-ci, si possible, aux points les plus défavorables.

Pour les filetages, un des mesurages est effectué au sommet, un en bas du filetage et le dernier au choix entre ces deux points.

Pour les porte-fusibles, les mesurages sont effectués sur la partie du capot vissé qui dépasse de l'isolateur.

Pour les socles, aucun mesurage n'est effectué sur le premier pas du filet.

Dans le cas de socles pour montage sur jeu de barres, les dimensions du jeu de barres et les entraxes spécifiés par le fabricant doivent être pris en compte. Les jeux de barre utilisés pour les essais individuels doivent être choisis selon les contraintes électriques, thermiques et mécaniques respectives.

Les jeux de barre utilisés pour les essais individuels doivent être spécifiés dans le rapport d'essai (matériaux, dimensions).

8.1.5.1 Essais complets

Les essais supplémentaires suivants sont exigés selon le Tableau 109 et le Tableau 110.

Tableau 109 – Liste des essais des éléments de remplacement

Essai selon le paragraphe		Nombre d'échantillons à soumettre à l'essai					
		3	4	1	1	2	1
8.4.3.2	Vérification du courant assigné	x					
8.7.4	Vérification de la sélectivité en cas de surintensités		x				
8.11.1	Résistance mécanique			x	x		
8.11.2.4	Résistance au stockage à température élevée					x	x
8.11.2.6	Dimensions et non-interchangeabilité	x	x				

Tableau 110 – Liste des essais des socles, porte-fusibles et éléments de calibrage

Essai selon le paragraphe	Nombre d'échantillons à soumettre à l'essai									
	Socles				Porte-fusibles					Éléments de calibrage
	1	1	3	1	1	1	1	3	1	1 1
8.9 Vérification de la résistance à la chaleur	x				x					
8.11.1 Résistance mécanique		x				x	x			x x
8.11.2.4 Résistance au stockage à température élevée			x	x				x	x	
8.11.2.6 Dimensions et non-interchangeabilité										x x

8.1.5.2 Essais des éléments de remplacement d'une série homogène

En complément de l'IEC 60269-1, ce qui suit s'applique.

Lorsque des éléments de remplacement ne diffèrent les uns des autres que par leurs pièces de contact et la forme des corps en matière céramique et que cette distinction n'est destinée qu'à assurer la non-interchangeabilité sans influer sur le fonctionnement, ils sont considérés comme satisfaisant aux exigences d'une série homogène.

8.2 Vérification des qualités isolantes et de l'aptitude au sectionnement

8.2.1 Disposition de l'ensemble-porteur

En complément de l'IEC 60269-1, ce qui suit s'applique.

Les garnitures métalliques (il peut s'agir d'une feuille d'aluminium) ne doivent pas être appuyées contre la vitre du regard. Dans le cas de porte-fusibles, la garniture métallique doit être en retrait de 3 mm du bord externe inférieur de la partie isolante.

Les socles pour montage sur jeu de barres doivent être utilisés avec les jeux de barre qui présentent les dimensions maximales et les distances minimales de séparation.

8.2.2.3 Méthode d'essai

En complément de l'IEC 60269-1, ce qui suit s'applique.

8.2.2.3.1 Cet essai doit être effectué immédiatement après le conditionnement hygroscopique décrit en 8.2.2.3.2 de l'IEC 60269-1:2024. L'ensemble-porteur doit être soumis à la tension d'essai indiquée dans le Tableau 15 de l'IEC 60269-1:2024.

8.2.6 Lignes de fuite, distances dans l'air et distances à travers les matériaux de remplissage

8.2.6.1 Méthode d'essai

Les lignes de fuite, les distances dans l'air et les distances sont mesurées sur le fusible complet en utilisant d'abord le conducteur qui présente la plus petite des sections indiquées dans le Tableau 104, puis le conducteur qui présente la plus grande des sections.

NOTE La contribution d'une rainure de moins de 1 mm de largeur à la ligne de fuite se limite à sa largeur. Un entrefer de moins de 1 mm de largeur n'est pas pris en compte dans le calcul de la distance dans l'air totale.

8.2.6.2 Recevabilité des résultats d'essai

Les lignes de fuite, les distances dans l'air et les distances ne doivent pas être inférieures aux valeurs en millimètres indiquées dans le Tableau 105.

8.3 Vérification des limites d'échauffement et de la puissance dissipée

8.3.1 Disposition du fusible

Le porte-fusible doit être inséré en appliquant un couple de torsion indiqué dans le Tableau 111.

Tableau 111 – Couples de torsion pour l'essai de vérification des limites d'échauffement et de la puissance dissipée

Taille	Couple de torsion Nm
D01	1,0
D02	1,0
D03	1,7
DII	2,7
DIII	4,3
DIV	6,7

Le couple de torsion à appliquer aux vis des bornes correspond aux deux tiers des valeurs indiquées dans le Tableau 116.

Dans le cas de socles pour montage sur jeu de barres, les jeux de barres dont les dimensions spécifiées par le fabricant sont les plus faibles doivent être utilisés.

8.3.3 Mesure de la puissance dissipée de l'élément de remplacement

Les points au niveau desquels la puissance dissipée est mesurée sont indiqués par B et C sur la Figure 109.

8.3.4.1 Échauffement de l'ensemble-porteur

L'essai doit être effectué avec l'élément de remplacement conventionnel d'essai spécifié sur la Figure 104 pour le courant assigné de l'ensemble-porteur. Les points au niveau desquels l'échauffement est mesuré sont indiqués par A et D sur la Figure 109.

8.3.5 Recevabilité des résultats d'essai

Pour les bornes, les limites d'échauffement doivent correspondre aux valeurs du Tableau 106 lorsque le socle est équipé de conducteurs d'une section indiquée dans le Tableau 17 de l'IEC 60269-1:2024 pour le courant assigné correspondant du socle.

La puissance dissipée de l'élément de remplacement ne doit pas être supérieure aux valeurs spécifiées dans le Tableau 101.

8.4.3.1 Vérification des courants conventionnels de non-fusion et de fusion

Cet essai doit être effectué en utilisant le socle conventionnel d'essai représenté sur la Figure 105 et la Figure 106.

8.4.3.2 Vérification du courant assigné d'éléments de remplacement

Trois éléments de remplacement sont soumis à 100 cycles de fonctionnement, chaque cycle comprenant une période de 1 h sous courant d'essai et une période de 15 min sans courant.

Le courant d'essai de 1,2 I_n ± 2,5 % ne s'applique qu'aux éléments de remplacement de courant assigné < 16 A. Pour les éléments de remplacement de courant assigné 16 A, la conformité à ces exigences est vérifiée par l'essai décrit en 8.4.3.2 de l'IEC 60269-1:2024, sauf qu'il est effectué sur trois échantillons.

Pendant ces cycles, les éléments de remplacement ne doivent pas fonctionner. Après avoir refroidi approximativement à température ambiante, les éléments de remplacement sont soumis à un courant égal à 0,9 fois I_{nf} selon le Tableau 2 de l'IEC 60269-1:2024 et le Tableau 102 du présent document. Ils ne doivent pas fonctionner dans le temps conventionnel indiqué dans le Tableau 2 de l'IEC 60269-1:2024 et dans le Tableau 102 du présent document.

Après avoir refroidi approximativement à température ambiante, les fusibles sont soumis au courant I_f. Les éléments de remplacement doivent fonctionner avant expiration du temps conventionnel.

8.4.3.5 Essai conventionnel de protection des conducteurs contre les surcharges

La procédure d'essai décrite en 8.4.3.5 de l'IEC 60269-1:2024 ne s'applique pas aux fusibles de courant assigné < 16 A.

NOTE (pour les fusibles gG seulement) Les essais de l'IEC 60269-1 sont considérés comme donnant des résultats satisfaisants à 1,45 I_n à une température ambiante de 30 °C dans les circuits habituels. Un essai spécial peut être exigé par certains pays afin de prouver que les fusibles et les disjoncteurs miniatures sont des dispositifs de protection équivalents. Les particularités de cet essai spécial sont données à l'Annexe AA du présent document.

8.4.3.6 Fonctionnement des indicateurs de fusion et des percuteurs éventuels

Pour les indicateurs de fusion, les exigences énoncées dans l'IEC 60269-1 sont complétées comme suit.

Si les essais sont effectués sous tension réduite, la tension du circuit d'essai doit être de 100 V ± 5 V et le courant d'essai doit être de 2 × I_f $^{+20}_{0}$ %.

8.5.1 Disposition du fusible

Dans le cas de socles pour montage sur jeu de barres, les jeux de barres dont les dimensions spécifiées par le fabricant sont les plus importantes doivent être utilisés.

8.5.2 Caractéristiques du circuit d'essai

Pour l'essai en courant continu, le Tableau 21 de l'IEC 60269-1:2024 s'applique, sauf pour l'exception indiquée dans le Tableau 112.

Tableau 112 – Essai selon le 8.5.5.1

	N° 1, N° 2	N° 3, N° 4, N° 5
Constante de temps	15 $^{+5}_{0}$ ms [a]	≤ 3 ms

[a] La constante de temps susmentionnée se situe à l'intérieur des limites données dans l'IEC 60269-1.

8.5.5 Méthode d'essai

8.5.5.1 Pour vérifier que le fusible remplit les conditions du 7.5 de l'IEC 60269-1:2024, les essais indiqués dans le Tableau 20 de l'IEC 60269-1:2024 doivent être effectués. Une méthode alternative pour les essais n° 1 et n° 2 du Tableau 20 est donnée à l'Annexe B.

8.5.8 Recevabilité des résultats d'essai

En complément du 8.5.8 de l'IEC 60269-1:2024, ce qui suit s'applique.

Après cet essai, les capsules des éléments de remplacement peuvent présenter de petits trous, des boursouflures, des taches et des bosses localisées, à condition que l'élément de calibrage et le porte-fusible ne soient pas endommagés. Un éventuel noircissement de la vitre du regard n'est pas pris en considération.

8.7.4 Vérification de la sélectivité en cas de surintensité

Les échantillons sont disposés comme pour l'essai de vérification du pouvoir de coupure selon le 8.5 de l'IEC 60269-1.

Deux échantillons sont soumis à l'essai au courant I_{min} et deux autres au courant I_{max}. Les valeurs du courant sont données dans le Tableau 113.

La tension d'essai en courant alternatif est: $\frac{1{,}1 \times U_n}{\sqrt{3}}$

Les autres caractéristiques du circuit d'essai correspondent à celles de l'essai de vérification du pouvoir de coupure n° 2 (voir le Tableau 20 de l'IEC 60269-1:2006).

Les valeurs estimées de I^2t doivent correspondre aux limites de I^2t spécifiées dans le Tableau 113.

Tableau 113 – Courants d'essai et limites de I^2t pour l'essai de vérification de la sélectivité

Valeurs minimales de I^2t de préarc			Valeurs de I^2t de fonctionnement		Rapport de sélectivité
I_n A	Valeur présumée de I_{min} kA efficace	I^2t_{min} A^2s	Valeur présumée de I_{max} kA efficace	I^2t_{max} A^2s	
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	1:1,6
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	
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	

Les valeurs de I^2t de préarc mesurées au courant d'essai I_{min} doivent être supérieures à la valeur de I^2t spécifiée dans la colonne 3 du Tableau 113. Les valeurs de I^2t de fonctionnement mesurées au courant d'essai I_{max} doivent être inférieures aux valeurs de I^2t spécifiées dans la colonne 5 du Tableau 113.

8.9 Vérification de la résistance à la chaleur

8.9.1 Socle

L'essai n'est effectué que sur des socles en matériau isolant non céramique.

8.9.1.1 Disposition d'essai

Le socle à soumettre à l'essai est équipé de l'élément de remplacement conventionnel d'essai conforme à la Figure 104, dont la puissance dissipée au courant d'essai est comprise dans les limites indiquées dans le Tableau 114.

Le couple de torsion appliqué au porte-fusible doit correspondre aux deux tiers de la valeur indiquée dans le Tableau 115. La section des conducteurs raccordés est fonction du courant assigné maximal de l'élément de remplacement de plus grande taille à insérer dans le socle (voir le Tableau 17 de l'IEC 60269-1:2024). Dans le cas de socles pour montage sur jeu de barres, les jeux de barres dont les dimensions spécifiées par le fabricant sont les plus faibles doivent être utilisés.

Tableau 114 – Puissance dissipée d'un élément de remplacement conventionnel d'essai aux courants assigné et conventionnel de fusion, y compris les tolérances

Taille		D01	D02	D03	DII	DIII	DIV
Puissance dissipée à I_n	W	2,5	5,5	7,0	4,0	7,0	9,0
Puissance dissipée au courant d'essai I_f [a]	W	6,7	14,1	17,9	10,3	17,9	23,0
Force appliquée à l'élément de remplacement conventionnel d'essai	N	35,0	50,0	75,0	50,0	75,0	110,0
[a] Pour ces valeurs, une tolérance de ±3 % s'applique.							

Le fusible, inséré dans le dispositif d'essai selon la Figure 107, est placé dans une enceinte chauffante, et les trous prévus pour le passage des conducteurs sont obturés. Les connexions à l'extérieur de l'enceinte chauffante doivent avoir une longueur minimale de 1 m. L'enceinte chauffante doit être telle que pendant l'essai, la température de l'air, mesurée dans le plan de l'échantillon à une distance d'environ 15 cm environ, soit maintenue à 80 °C ± 5 °C.

8.9.1.2 Méthode d'essai

La température de l'air dans l'enceinte chauffante est portée à 80 °C ± 5 °C et maintenue pendant 2 h. Immédiatement après, mais en maintenant la température de l'enceinte chauffante, l'échantillon est soumis à un courant d'essai qui correspond approximativement à I_f. Sous ce courant d'essai, la puissance dissipée de l'élément de remplacement conventionnel d'essai doit se situer à l'intérieur des limites indiquées dans le Tableau 114. Le courant doit être maintenu constant pendant toute la durée d'essai de 2 h. À la fin de l'essai, un poids est appliqué d'aplomb et sans à-coups en position 4 (voir la Figure 107), de manière à générer sur l'élément de remplacement conventionnel d'essai, le long de la flèche G, une force (en tenant compte de l'effet de levier) conforme au Tableau 114. Pour l'application de cette force, la vitre du regard doit être enlevée. L'échantillon peut être raccordé à une source de tension réduite.

8.9.1.3 Recevabilité des résultats d'essai

Après application de la force, le courant doit continuer à parcourir l'échantillon. La force est maintenue pendant 15 min et le courant doit continuer à parcourir l'échantillon sans variation. De plus, après cet essai, le socle ne doit pas présenter de dommage nuisible à son usage ultérieur.

8.9.2 Porte-fusible

8.9.2.1 Disposition d'essai

Un socle doit être monté sur une planche en contre-plaqué de 15 mm d'épaisseur. La disposition doit être la même qu'en usage normal. Le socle est équipé d'un élément de remplacement conventionnel d'essai conforme à la Figure 104. La section des conducteurs est fonction du courant assigné du socle (voir le Tableau 17 de l'IEC 60269-1:2024). La longueur des conducteurs doit être d'au moins 1 m à l'extérieur de l'enceinte chauffante dans laquelle le dispositif d'essai doit être placé.

Le couple de torsion appliqué au porte-fusible doit correspondre aux valeurs du Tableau 115. Pour le serrage et le desserrage ultérieur du porte-fusible, un dispositif d'adaptation pour porte-fusible, dont la forme intérieure est telle qu'elle assure une connexion étroite à la partie isolée du porte-fusible, est utilisé. Le dispositif d'adaptation du porte-fusible est serré au moyen d'une clé dynamométrique à tige carrée de type commercial (voir la Figure 108). L'écrou et le dispositif d'essai décrit doivent être placés dans l'enceinte chauffante susmentionnée.

8.9.2.2 Méthode d'essai

La température de l'air dans l'enceinte chauffante est portée à 80 °C ± 5 °C et maintenue pendant 2 h. Immédiatement après, le fusible est soumis, pendant 2 h, à un courant d'essai qui correspond approximativement à I_f. Le courant d'essai doit être réglé de telle sorte que la puissance dissipée de l'élément de remplacement conventionnel d'essai se situe à l'intérieur des limites indiquées dans le Tableau 114.

Le courant d'essai doit être maintenu constant pendant 2 h. Immédiatement après l'ouverture de l'enceinte chauffante, l'écrou chauffé pendant l'essai est inséré dans la clé dynamométrique, à l'aide de cette clé, le porte-fusible est dévissé puis revissé à deux reprises.

8.9.2.3 Recevabilité des résultats d'essai

Après cet essai, le porte-fusible ne doit présenter aucun dommage nuisible à son usage ultérieur; en particulier, le matériau isolant ne doit présenter ni fissure ni rétrécissement inadmissible.

8.10 Vérification de la non-détérioration des contacts

Le 8.10 de l'IEC 60269-1:2024 s'applique.

8.10.1 Disposition du fusible

Le 8.10.1 de l'IEC 60269-1:2024 s'applique avec l'ajout suivant.

L'élément de remplacement conventionnel d'essai est représenté sur la Figure 104 du présent document.

Les couples à appliquer au porte-fusible correspondent à 40 % des valeurs indiquées dans le Tableau 115.

8.10.2 Méthode d'essai

Le texte suivant est ajouté après le premier alinéa du 8.10.2 de l'IEC 60269-1:2024.

Le courant d'essai est le courant conventionnel de non-fusion.

La durée en charge représente 75 % du temps conventionnel.

La durée sans charge représente 25 % du temps conventionnel.

Le temps conventionnel ainsi que le courant de non-fusion sont indiqués dans le Tableau 2 de l'IEC 60269-1:2024. Une tension d'essai inférieure à la tension assignée peut être utilisée.

Pendant la période sans charge les échantillons sont refroidis jusqu'à une température inférieure à 35 °C; un refroidissement complémentaire (par exemple, par ventilateur) est admis.

Le troisième alinéa du 8.10.2 de l'IEC 60269-1:2024 est remplacé par le texte suivant.

Avant le début de l'essai cyclique, l'échauffement des contacts doit être mesuré sous le courant assigné lorsque les conditions d'équilibre ont été obtenues. La chute de tension doit être mesurée après 250 cycles et, si l'équation (1) du 8.10.3 n'est pas respectée, le mesurage doit être répété après 750 cycles (voir l'équation (2) du 8.10.3).

La chute de tension des contacts est mesurée après 50 cycles, 250 cycles et 750 cycles, sous un courant continu I_m = (0,05 à 0,30) I_n. Néanmoins, le courant I_m doit être choisi de façon à produire une chute de tension d'au moins 100 µV.

La tolérance sur I_m pendant le mesurage ne doit pas être supérieure à $^{+10}_{\ 0}$ %. Les points de mesure sont indiqués sur la Figure 109.

La résistance de contact est ensuite déterminée à partir de la chute de tension. Avant le mesurage, l'échantillon doit être refroidi à température ambiante. Si la température ambiante durant le mesurage diffère de 20 °C, la formule suivante peut être appliquée.

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

où

R_{20} est la résistance à une température de 20 °C;

R_T est la résistance à la température T;

α_{20} est le coefficient de température.

8.10.3 Recevabilité des résultats d'essai

À l'issue de 250 cycles (Équation (1)) et à l'issue de 750 cycles (Équation (2)), les limites suivantes ne doivent pas être dépassées:

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

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

En variante, la température mesurée conformément à la Figure 109 peut être utilisée pour la vérification. Comme points de mesure, il convient d'utiliser les bornes cosses du socle (Figure 109). Dans ce cas, la limite suivante ne doit pas être dépassée:

après 250 cycles, les valeurs mesurées d'échauffement ne doivent pas dépasser de plus de 15 K les valeurs d'échauffement mesurées au début de l'essai cyclique et après 750 cycles, les valeurs mesurées d'échauffement ne doivent pas dépasser de plus de 20 K les valeurs d'échauffement mesurées au début de l'essai.

8.11 Essais mécaniques et divers

8.11.1 Résistance mécanique

8.11.1.1 Résistance mécanique de l'élément de calibrage

8.11.1.1.1 Élément de calibrage de tailles DII et DIII (éléments de calibrage à visser)

Les éléments de calibrage doivent être conçus de manière que les parties qui transportent le courant en une seule pièce et qu'elles supportent les contraintes mécaniques qui se produisent en usage normal.

La conformité est vérifiée par examen et par les essais suivants.

L'élément de calibrage est vissé dans un socle en appliquant, pendant 1 in, un couple de torsion de 1 Nm. Il est ensuite retiré à l'aide d'une clé à main appropriée. De plus, une force axiale de 10 N est appliquée dans les deux sens entre la partie métallique et la partie céramique de l'élément de calibrage. L'essai est effectué sur l'élément de calibrage en l'état de livraison. Dans le cas d'éléments de calibrage avec des pièces cimentées ou assemblées par collage, l'essai est répété après immersion des échantillons dans de l'eau à 20 °C ± 5 °C pendant 24 h, puis de nouveau après chauffage pendant 1 h à une température de 200 °C ± 5 °C.

Après ces essais, les échantillons ne doivent pas présenter de modifications nuisibles à leur usage ultérieur; en particulier, la partie filetée ne doit pas être endommagée et les parties céramiques doivent rester solidement fixées l'une à l'autre et ne doivent pas se dégager de la partie métallique.

8.11.1.1.2 Élément de calibrage de tailles D01, D02, D03, DIV et bagues de calibrage à insérer de force de type D

Au moyen d'un mesurage de la force, vérifier si la pince élastique peut maintenir l'élément de calibrage avec une force déterminée ≥ 2 N.

8.11.1.2 Résistance mécanique du porte-fusible

Une force de 2,5 N (porte-fusibles D01 et D02) et de 5 N (dans tous les autres cas) est appliquée graduellement à la vitre du regard, à partir de l'intérieur, au moyen d'une tige d'acier de 6 mm de diamètre. La vitre du regard ne doit pas avoir été brisée ni déplacée pendant l'essai.

Un mandrin d'essai dont le diamètre correspond au diamètre maximal de l'élément de remplacement d_3 ou d_4 selon la Figure 110 ou la Figure 111 est inséré cinq fois dans le porte-fusible. Après cet essai, l'élément conventionnel d'essai représenté sur la Figure 126 doit être retenu dans le porte-fusible lorsque celui-ci est tenu à l'envers.

8.11.1.3 Résistance mécanique de l'élément de remplacement

L'élément de remplacement doit avoir une résistance mécanique appropriée et ses contacts doivent être solidement fixés. Leur conformité doit être vérifiée par l'essai suivant.

L'élément de remplacement est placé dans le porte-fusible approprié conforme à la Figure 112, la Figure 113 ou la Figure 114, qui est vissé dans un socle conforme à la Figure 118, la Figure 119 ou la Figure 120, un élément de calibrage conforme à la Figure 121, la Figure 122 ou la Figure 123 étant en place. Le diamètre d_1 de l'élément de calibrage est égal à la valeur minimale spécifiée pour le courant assigné correspondant.

Le couple de torsion appliqué au porte-fusible correspond à celui spécifié dans le Tableau 115. Le porte-fusible est ensuite retiré. Cette opération est effectuée cinq fois. Après cet essai, l'élément de remplacement ne doit pas présenter de détérioration au sens du présent document. Il ne doit pas possible d'enlever les capsules des éléments de remplacement à la main.

8.11.1.4 Résistance mécanique du fusible

Le porte-fusible équipé d'un élément de remplacement conforme aux normes est vissé dans le socle équipé de l'élément de calibrage en appliquant le couple de torsion indiqué dans le Tableau 115, puis retiré. Cette opération est répétée cinq fois. Dans le cas de socles pour montage sur jeu de barres, les jeux de barres dont les dimensions spécifiées par le fabricant sont les plus faibles doivent être utilisés. Après cet essai, les échantillons ne doivent pas présenter de modifications nuisibles à leur usage ultérieur.

Les essais spécifiés en 8.11.1.3 et 8.11.1.4 peuvent être effectués en même temps.

Tableau 115 – Couple de torsion pour l'essai de la résistance mécanique

Taille	Couple de torsion Nm
D01	1,5
D02	1,5
D03	2,5
DII	4,0
DIII	6,5
DIV	10,0

Résistance mécanique du filetage ou du taraudage:

Les vis destinées à être manœuvrées lors de l'installation du fusible, y compris les vis des bornes et les vis de fixation des couvercles, mais à l'exception des vis de fixation du socle sur la surface de fixation, sont soumises à l'essai suivant.

Les vis sont serrées et desserrées au moyen d'une clé ou d'un tournevis en appliquant le couple de torsion indiqué dans le Tableau 116, cinq fois dans le cas d'un filetage ou taraudage métallique et dix fois dans le cas d'un filetage ou taraudage non métallique.

Pour l'essai des vis des bornes, un conducteur de la plus grande section spécifiée par le fabricant ou indiquée dans l'IEC 60269-1 doit être placé dans la borne. Le conducteur doit être déplacé après chaque opération de façon à présenter une nouvelle surface à la vis de la borne.

Tableau 116 – Résistance mécanique du filetage ou du taraudage

Diamètre nominal de la partie filetée ou taraudée mm	Couple de torsion Nm
≤ 2,6	0,4
> 2,6 ≤ 3,0	0,5
> 3,0 ≤ 3,5	0,8
> 3,5 ≤ 4,0	1,2
> 4,0 ≤ 5,0	2,0
> 5,0 ≤ 6,0	2,5
> 6,0 ≤ 8,0	5,5
> 8,0 ≤ 10,0	7,5

Pendant l'essai, il ne doit se produire aucune modification qui compromette l'utilisation ultérieure de la connexion vissée.

8.11.2.4 Résistance au stockage à température élevée

8.11.2.4.1 Disposition d'essai

Pour l'essai des parties isolantes autres que celles en céramique qui servent de support à des parties qui transportent le courant, trois porte-fusibles et trois socles doivent être placés pendant 168 h dans une enceinte chauffante à une température de 180 °C ± 5 °C.

Les couvercles doivent être placés pendant 168 h dans une enceinte chauffante à la température suivante: 100 °C ± 5 °C.

Pour satisfaire aux exigences relatives aux parties cimentées, matériaux de remplissage et couleurs d'identification, un fusible complet doit être exposé pendant 1 h à une température de 150 °C ± 5 °C.

8.11.2.4.2 Méthode d'essai

Après refroidissement à température ambiante, les échantillons doivent être soumis aux essais suivants.

Un porte-fusible et un socle doivent être soumis aux conditions d'humidité atmosphérique décrites en 8.2.2.3.2 de l'IEC 60269-1:2024. Immédiatement après ce traitement, les propriétés isolantes doivent être vérifiées à une tension d'essai de 2,0 kV conformément aux 8.2.1, 8.2.2.1 et 8.2.2.3.1 de l'IEC 60269-1:2024, à l'exception du Tableau 15.

Les deux autres porte-fusibles et socles doivent être soumis à l'essai suivant.

Les porte-fusibles équipés d'éléments de remplacement conformes aux normes sont vissés dans les socles équipés d'éléments de calibrage en appliquant le couple de torsion indiqué dans le Tableau 111, puis retirés. Cette opération est répétée cinq fois.

8.11.2.4.3 Recevabilité des résultats d'essai

Après cet essai, les échantillons d'essai ne doivent pas présenter de modifications nuisibles à leur usage ultérieur. La résistance mécanique, notamment celle des parties cimentées, doit être maintenue.

Le matériau de remplissage ne doit pas avoir bougé au point de rendre accessibles les parties actives. Après cet essai, les couleurs d'identification ne doivent pas avoir varié de manière sensible.

8.11.2.6 Dimensions et non-interchangeabilité

La conformité au 8.1.4 de l'IEC 60269-1:2024 et au 7.1.8 du présent document doit être vérifiée en mesurant les dimensions des éléments de remplacement et en les comparant aux dimensions correspondantes dans les autres parties du fusible.

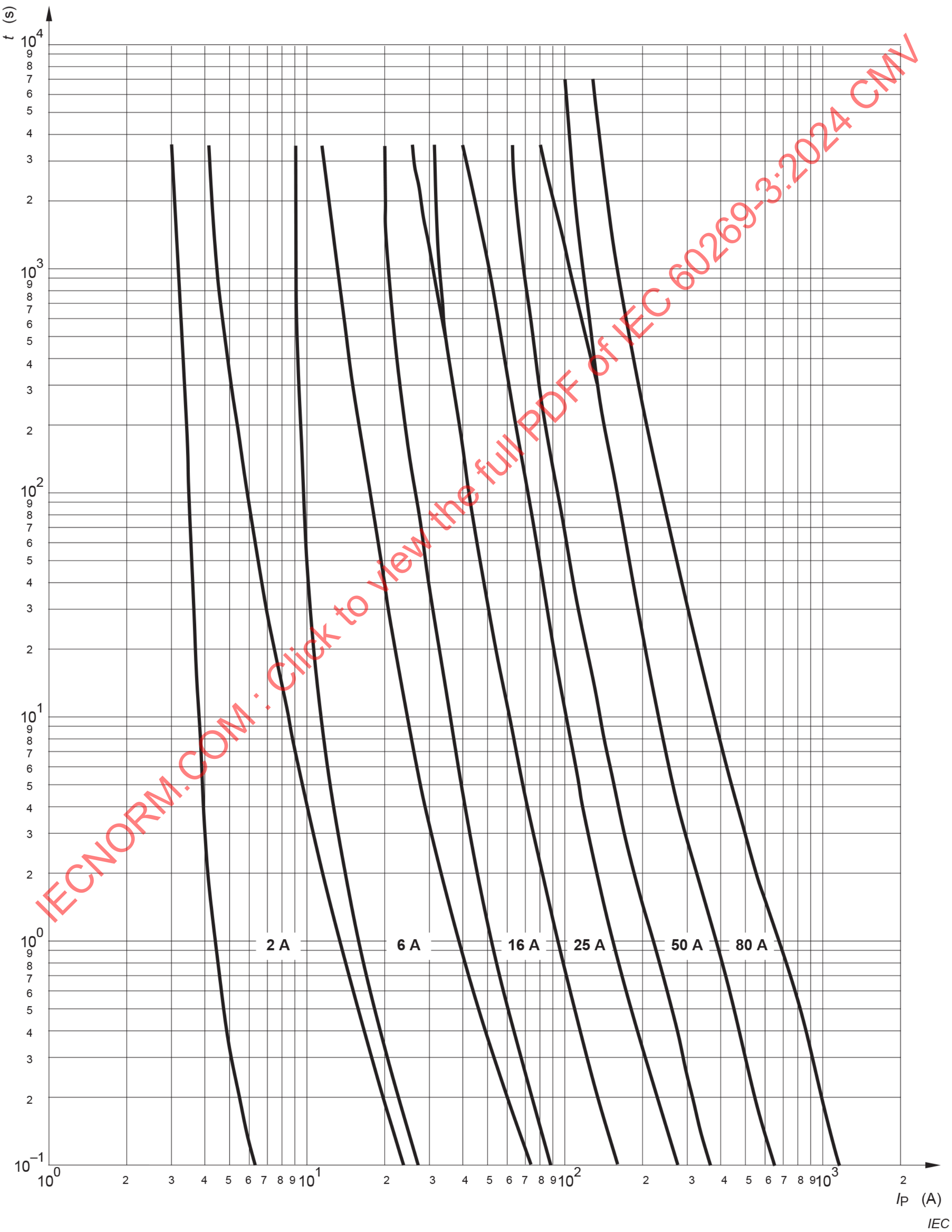


Figure 101 – Zones temps-courant pour éléments de remplacement "gG"

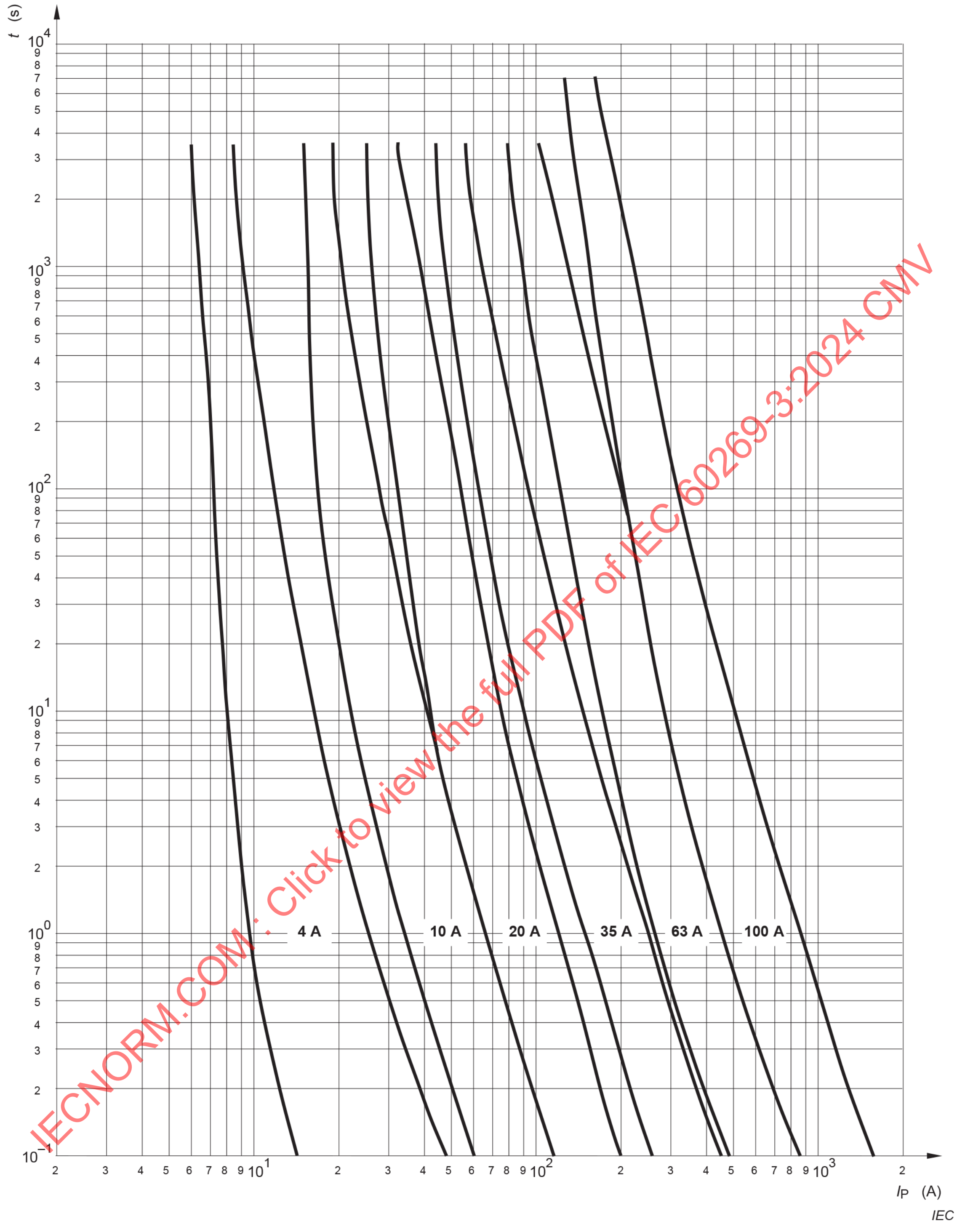


Figure 102 – Zones temps-courant pour éléments de remplacement "gG"

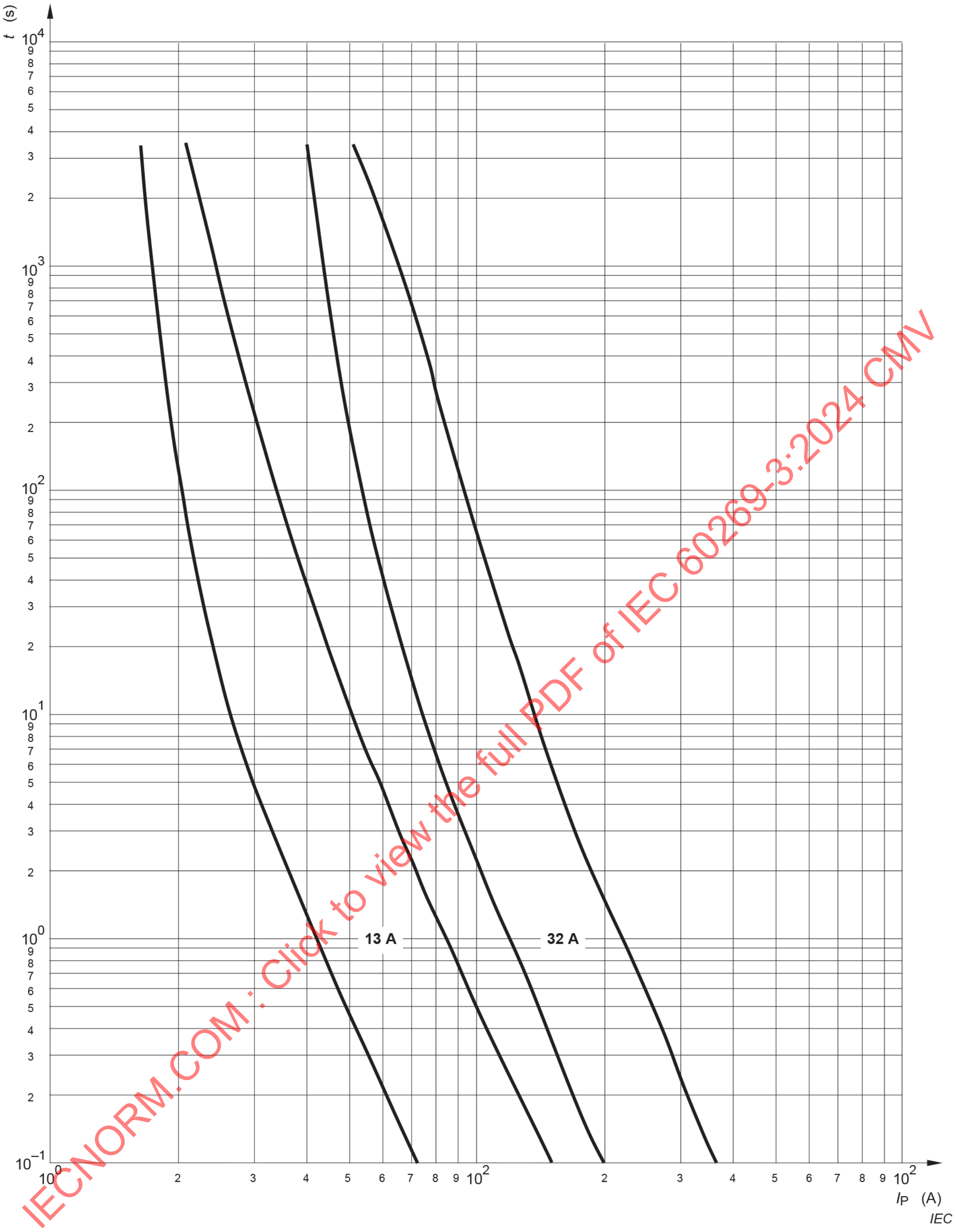
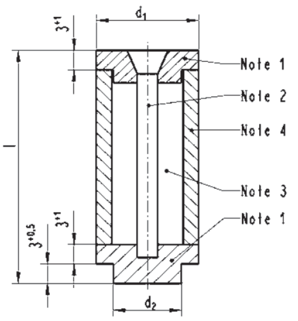
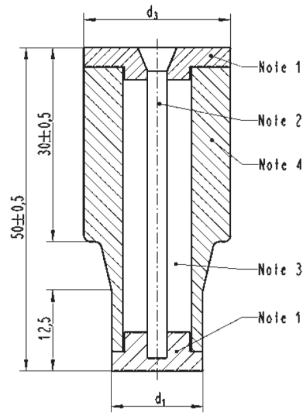


Figure 103 – Zones temps-courant pour éléments de remplacement "gG" 13 A et 32 A



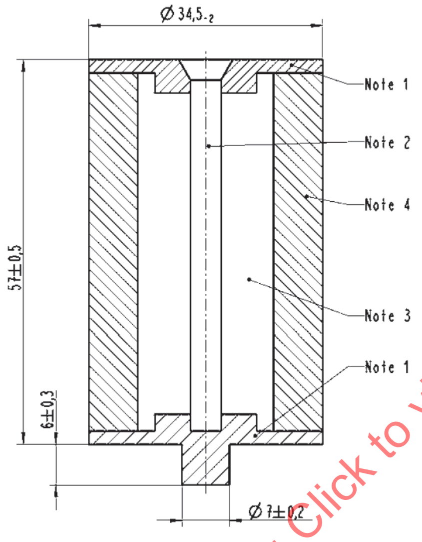
D01 … D03

IEC



DII, DIII

IEC



DIV

IEC

Dimensions en millimètres

Taille	$d_1\,{}^{0}_{-0,5}$	$d_2\,{}^{0}_{-0,5}$	$l \pm 0,5$
D01	10,5	6	36
D02	15	10	36
D03	22	18	43

Taille	$d_1\,{}^{+0,2}_{-0,4}$	$d_3\,{}^{0}_{-1,5}$
DII	14	22,5
DIII	20	28

NOTE 1 Pièce de contact CuZn, argentée.

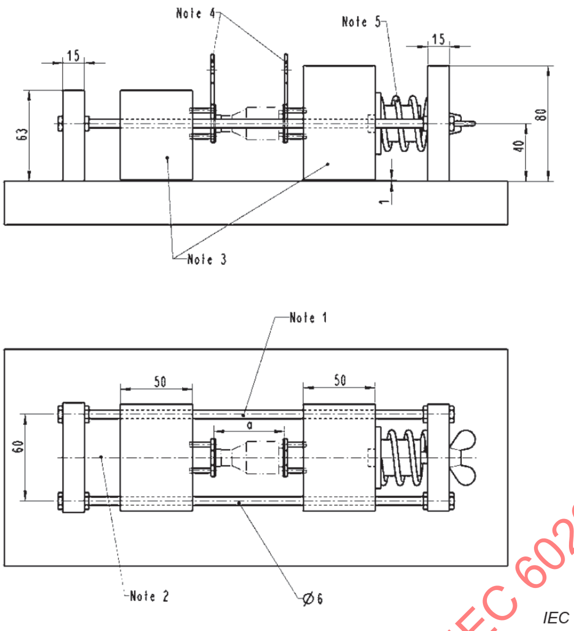
NOTE 2 Cu56Ni44 ou matériau équivalent de valeurs de résistance spécifique et de coefficient de température similaires.

NOTE 3 Sable quartzeux.

NOTE 4 Corps en céramique.

Figure 104 – Éléments de remplacement conventionnels d'essai selon les 8.3 et 8.9.1.1

Dimensions en millimètres
Dimension a: voir la Figure 106



NOTE 1 Barre métallique.

NOTE 2 Distance pour le réglage de la force de contact.

NOTE 3 Matériau isolant.

NOTE 4 Pièces de contact argentées.

NOTE 5 Ressort d'acier.

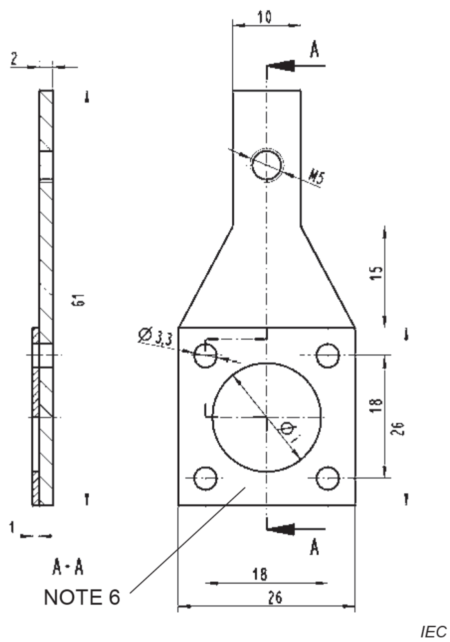
Figure 105 – Socles conventionnels d'essai pour éléments de remplacement

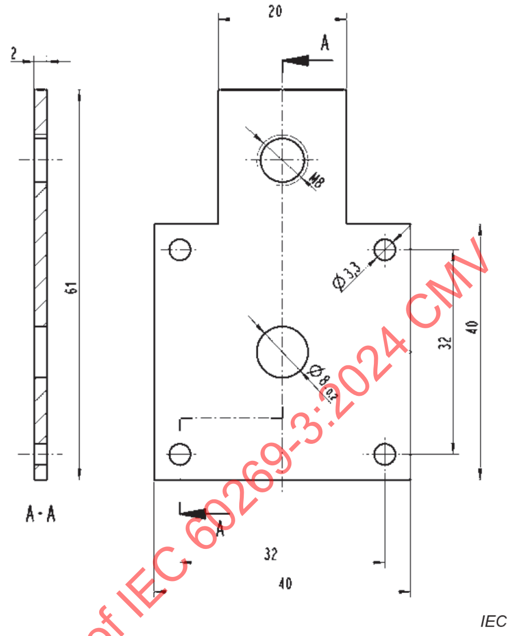
Taille	Dimensions		Force de contact
	a [a] mm	∅ i mm	 N
D01	35^{+2}_{0}	11,5	40 ± 10 %
D02	35^{+2}_{0}	16,0	80 ± 10 %
D03	42^{+2}_{0}	23,0	120 ± 10 %
DII	49^{+2}_{0}	14,5	200 ± 10 %
DIII	49^{+2}_{0}	20,5	320 ± 10 %
DIV	$56^{+2,5}_{0}$	–	550 ± 10 %

[a] Voir la Figure 105.

Dimensions en millimètres

Pièces de contact argentées (voir la Note 4 de la Figure 105)

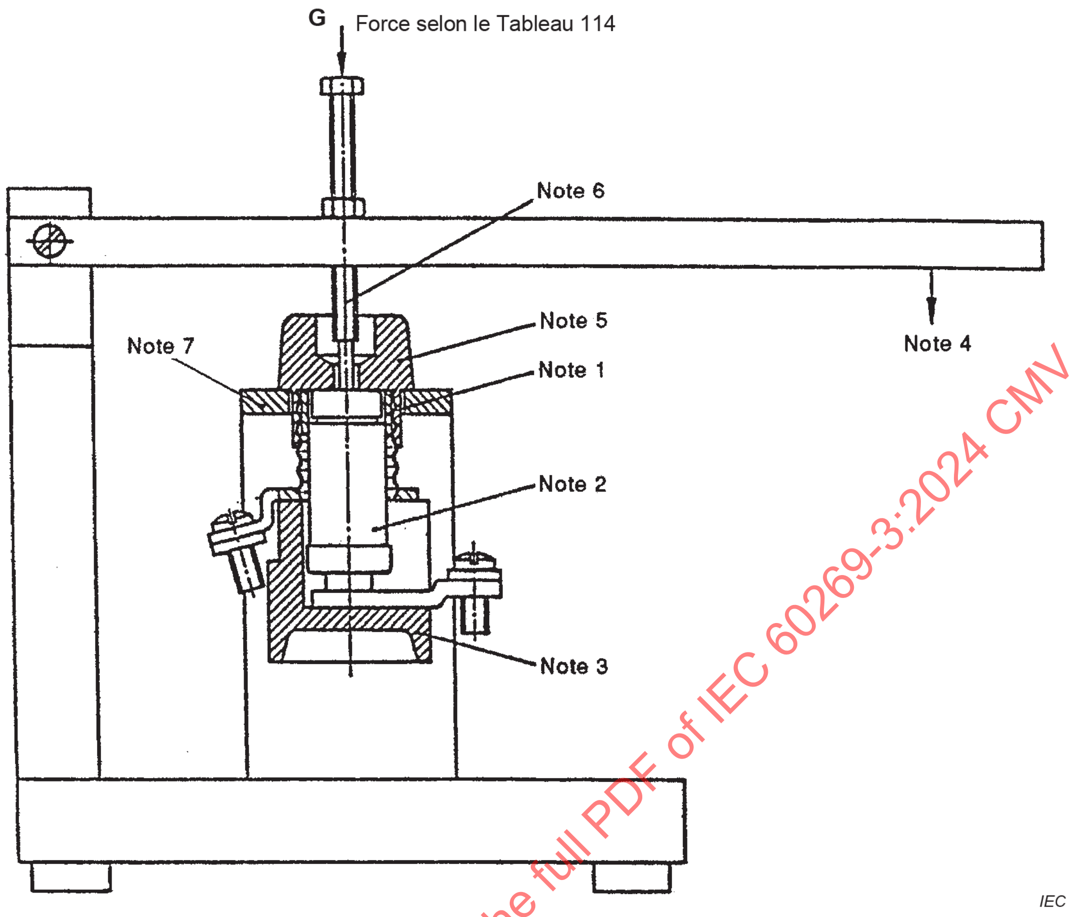




Tailles D01 à D03 et DII, DIII **Taille DIV**

NOTE 6 Plaque de centrage en matériau isolant.

Figure 106 – Socles conventionnels d'essai pour éléments de remplacement



NOTE 1 Isolement entre la capsule et le capot vissé, sauf sur la face.

NOTE 2 Élément de remplacement conventionnel d'essai.

NOTE 3 Socle.

NOTE 4 Direction de la force appliquée.

NOTE 5 Porte-fusible.

NOTE 6 Piston.

NOTE 7 Surface de montage.

Figure 107 – Disposition d'essai pour socles selon le 8.9.1.2

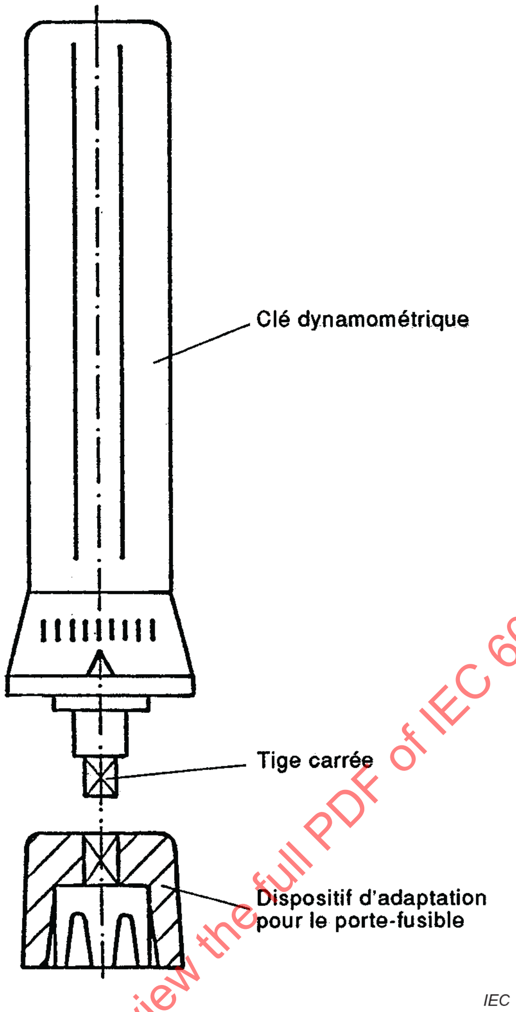


Figure 108 – Exemple de clé dynamométrique selon le 8.9.2

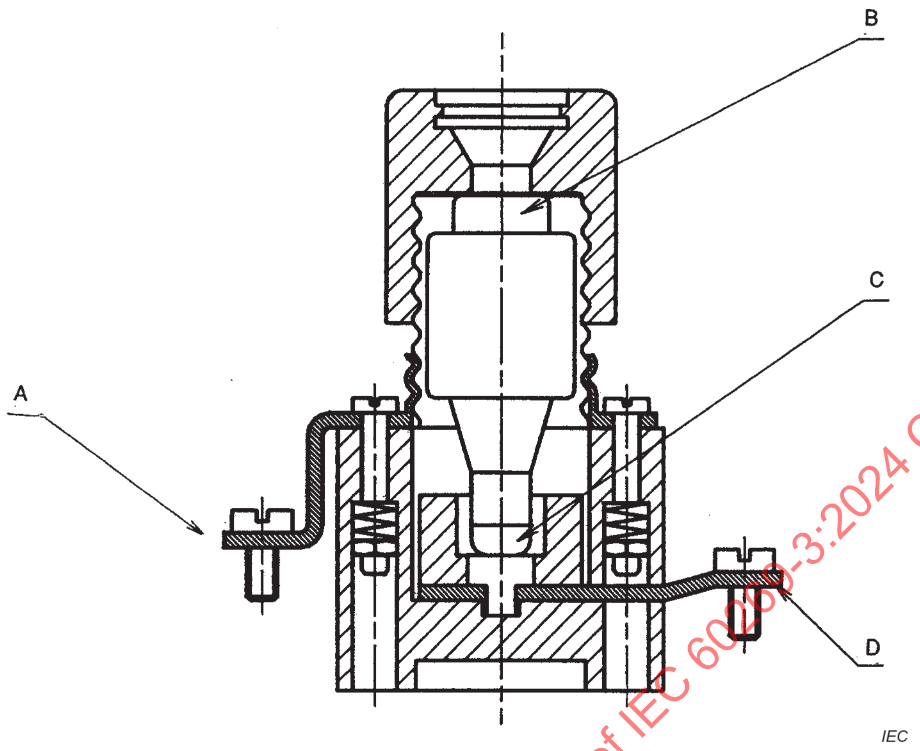
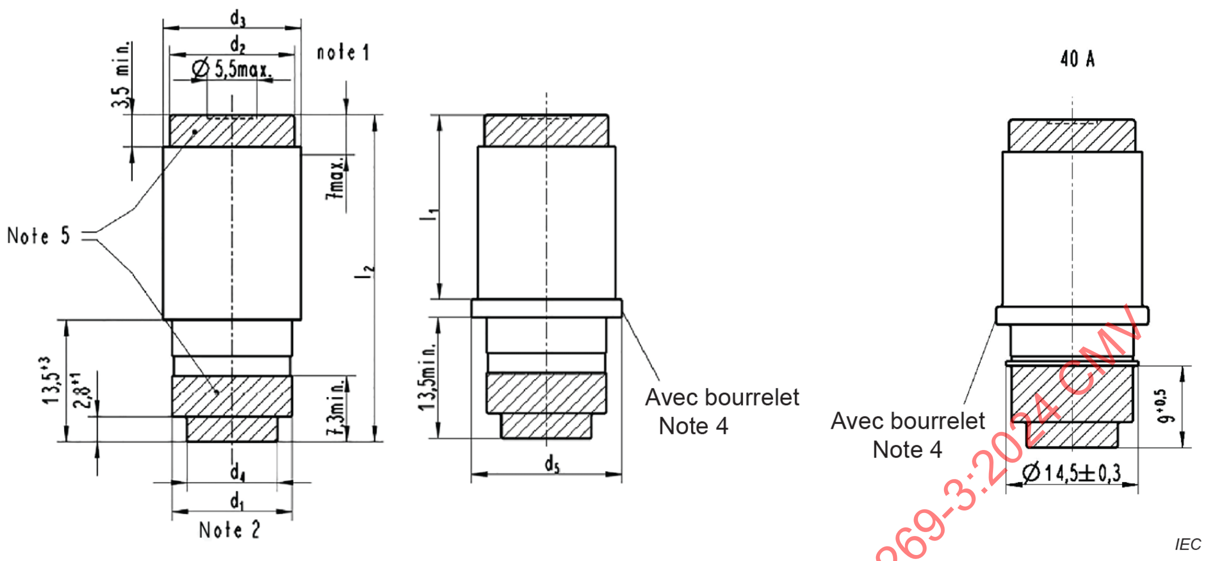


Figure 109 – Points de mesure selon les 8.3.3, 8.3.4.1 et 8.10.2 du système de fusibles A

Dimensions en millimètres



	I_n A	d_1 (note 2) ±0,3 mm	d_2 (mini) mm	d_3 mm	d_4 (maxi) mm	d_5 (note 4) mm	l_1 (note 4) mm	l_2 ± 1 mm	r (maxi) mm
D01	2	7,3	9,8	$11\ ^{0}_{-0,7}$	6	–	–	36	1
	4	7,3							
	6	7,3							
	10	8,5							
	13	8,5							
	16	9,7							
D02	20	10,9	13,8	$15,3\ ^{0}_{-0,8}$	10	16,7 (maxi)	18,5	36	1
	25	12,1				16,7 (maxi)			
	32	13,3				16,7 (maxi)			
	35	13,3				16,7 (maxi)			
	40	13,3				16,7 (maxi)			
	50 (note 4)	14,5				$16,7\ ^{0}_{-1,3}$			
	63	15,9				16,7 (maxi)			
D03	80 (note 4)	22	20,6	$22,5\ ^{0}_{-1}$	18	$25,6\ ^{0}_{-2,3}$	22,5	43	1,6
	100	25				25,6 (maxi)			

NOTE 1 Diamètre de l'indicateur de fusion.

NOTE 2 La valeur maximale de d_1 ne doit pas être dépassée sur la longueur de 13,5 mm.

NOTE 4 Choix du fabricant, obligatoire pour 50 A et 80 A. Le bourrelet est nécessaire pour ces valeurs afin d'assurer une insertion correcte. Le bourrelet peut être utilisé pour d'autres courants assignés dans les tailles D02 et D03.

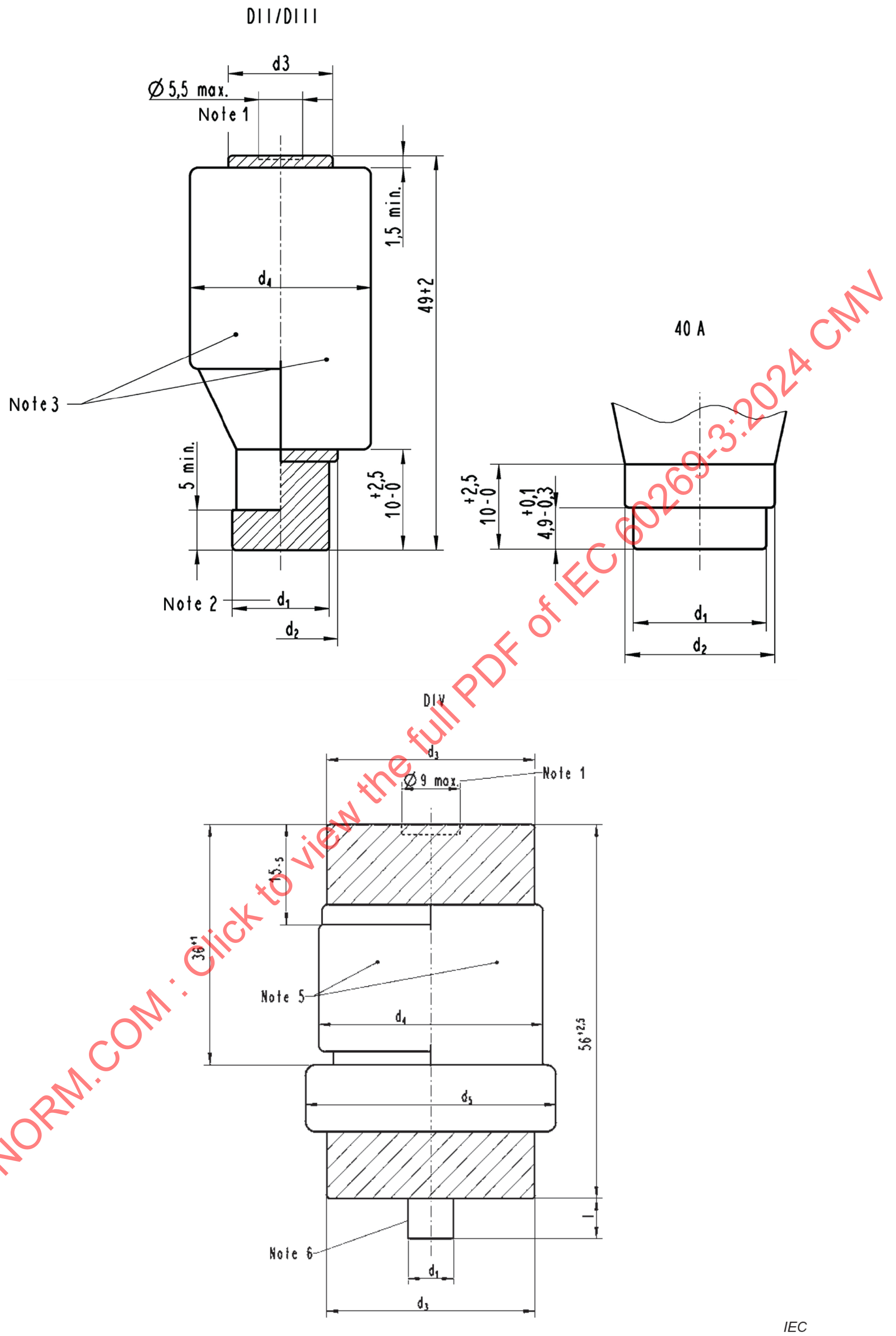
NOTE 5 Les parties hachurées représentent les zones de contact.

Corps de l'élément de remplacement en céramique.

NOTE 6 Les dessins ne sont pas destinés à imposer la conception, sauf en ce qui concerne les dimensions indiquées.

Figure 110 – Élément de remplacement, type D. Tailles D01-D03

Dimensions en millimètres



Les dessins ne sont pas destinés à imposer la conception, sauf en ce qui concerne les dimensions indiquées.

Les parties hachurées représentent les zones de contact.

Corps de l'élément de remplacement en céramique.

	I_n A	d_1 (note 2) mm		d_2 (maxi) mm	d_3 mm	d_4 mm	d_5 $^{0}_{-2}$ mm	l ±0,3 mm
DII	2	6	$^{+0,2}_{-0,4}$	14,2	11 min	22,5 $^{0}_{-1,5}$	–	–
	4							
	6							
	10	8						
	13							
	16	10			13 min			
	20	12						
	25	14						
DIII	32	16	$^{+0,2}_{-0,4}$	20,2	15 min	28 $^{0}_{-2}$	–	–
	35	16	$^{+0,2}_{-0,4}$	20,2	15 min	28 $^{0}_{-2}$	–	–
	40	16	±0,2	18,2	15 min	28 $^{0}_{-2}$	–	–
	50	18	$^{+0,2}_{-0,4}$	20,2	15 min	28 $^{0}_{-2}$	–	–
	63	20	$^{+0,2}_{-0,4}$	20,2	15 min	28 $^{0}_{-2}$	–	–
DIV	80 (6)	5	±0,2	–	32 $^{0}_{-8}$	34,5 $^{0}_{-2}$	38,5	6
	100	7						

I_n A	Couleur de l'indicateur de fusion
2	Rose
4	Brun
6	Vert
10	Rouge
13	Noir
16	Gris
20	Bleu
25	Jaune
32	Violet
35	Noir
40	Vert
50	Blanc
63	Cuivre
80	Argent
100	Rouge

NOTE 1 Diamètre de l'indicateur de fusion.

NOTE 2 La valeur maximale de d_1 ne doit pas être dépassée sur la longueur de 10 mm pour les éléments de remplacement DII et DIII mesurée à partir de la face inférieure de contact.

NOTE 3 Forme facultative.

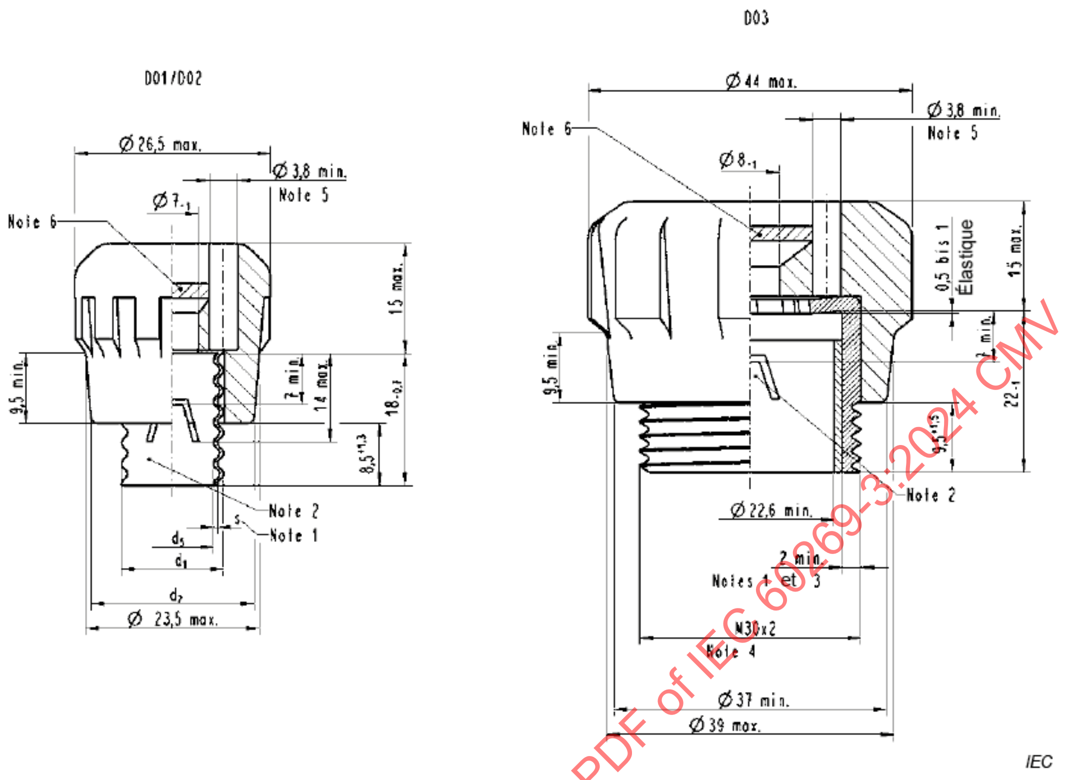
NOTE 4 Enveloppe métallique facultative.

NOTE 5 La broche de calibrage n'est pas exigée pour les éléments de remplacement qui ont un courant assigné de 80 A.

L'utilisation de ces couleurs est également obligatoire pour les tailles D01-D03.

Figure 111 – Élément de remplacement, type D. Tailles DII-DIV

Dimensions en millimètres



Les dessins ne sont pas destinés à imposer la conception, sauf en ce qui concerne les dimensions indiquées.

Les parties isolantes sont en céramique ou d'un autre matériau suffisamment résistant à la chaleur.

	I_n A	d_1 mm	d_2 **(mini)** mm	d_5 **(maxi)** mm	s **(note 1) (mini)** mm
D01	16	E14	18	11,1	0,27
D02	63	E18	22	15,4	0,37

NOTE 1 Valeur moyenne.

NOTE 2 Clip de maintien; d'autres moyens de maintien sont admis.

NOTE 3 Tolérance sur le premier pas du filetage $^{0}_{-0,25}$.

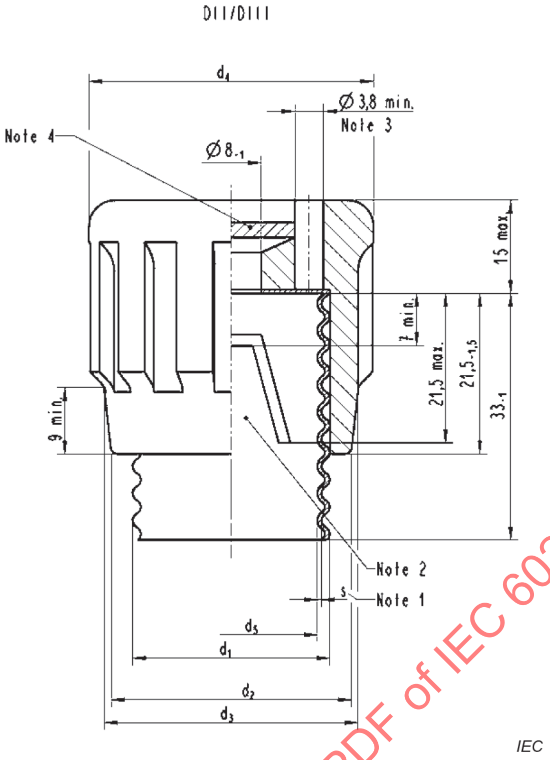
NOTE 4 Filetage selon l'ISO 965-1, classe 8g.

NOTE 5 Le trou pour l'appareil de contrôle de la tension est facultatif.

NOTE 6 Matériau: verre ou tout autre matériau transparent approprié.

Figure 112 – Porte-fusible, type D. Tailles D01-D03

Dimensions en millimètres



Les dessins ne sont pas destinés à imposer la conception, sauf en ce qui concerne les dimensions indiquées.

Les parties isolantes sont en céramique ou d'un autre matériau suffisamment résistant à la chaleur.

	I_n A	d_1 mm	d_2 (mini) mm	d_3 (maxi) mm	d_4 (maxi) mm	d_5 (mini) mm	s (note 1) (mini) mm
DII	25	E27		34	38	22,6	0,27
DIII	63	E33	40	43	48	28,1	0,37

NOTE 1 Valeur moyenne.

NOTE 2 Clip de maintien; d'autres moyens de maintien sont admis.

NOTE 3 Le trou pour l'appareil de contrôle de la tension est facultatif.

NOTE 4 Matériau: verre ou tout autre matériau transparent approprié.

Figure 113 – Porte-fusible, type D. Tailles DII-DIII