# INTERNATIONAL STANDARD

# IEC 60269-2-1

Fourth edition
2004-06



## Low-voltage fuses –

## Part 2-1:
## Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) – Sections I to VI: Examples of types of standardized fuses

*This **English-language** version is derived from the original **bilingual** publication by leaving out all French-language pages. Missing page numbers correspond to the French-language pages.*

Reference number
IEC 60269-2-1:2004(E)

## Publication numbering

As from 1 January 1997 all IEC publications are issued with a designation in the 60000 series. For example, IEC 34-1 is now referred to as IEC 60034-1.

## Consolidated editions

The IEC is now publishing consolidated versions of its publications. For example, edition numbers 1.0, 1.1 and 1.2 refer, respectively, to the base publication, the base publication incorporating amendment 1 and the base publication incorporating amendments 1 and 2.

## Further information on IEC publications

The technical content of IEC publications is kept under constant review by the IEC, thus ensuring that the content reflects current technology. Information relating to this publication, including its validity, is available in the IEC Catalogue of publications (see below) in addition to new editions, amendments and corrigenda. Information on the subjects under consideration and work in progress undertaken by the technical committee which has prepared this publication, as well as the list of publications issued, is also available from the following:

- **IEC Web Site (www.iec.ch)**

- **Catalogue of IEC publications**

  The on-line catalogue on the IEC web site (http://www.iec.ch/searchpub/cur_fut.htm) enables you to search by a variety of criteria including text searches, technical committees and date of publication. On-line information is also available on recently issued publications, withdrawn and replaced publications, as well as corrigenda.

- **IEC Just Published**

  This summary of recently issued publications (http://www.iec.ch/online_news/justpub/jp_entry.htm) is also available by email. Please contact the Customer Service Centre (see below) for further information.

- **Customer Service Centre**

  If you have any questions regarding this publication or need further assistance, please contact the Customer Service Centre:

  Email: custserv@iec.ch
  Tel: +41 22 919 02 11
  Fax: +41 22 919 03 00

# INTERNATIONAL STANDARD

# IEC 60269-2-1

Fourth edition
2004-06

## Low-voltage fuses –

## Part 2-1: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) – Sections I to VI: Examples of types of standardized fuses





International Electrotechnical Commission, 3, rue de Varembé, PO Box 131, CH-1211 Geneva 20, Switzerland
Telephone: +41 22 919 02 11 Telefax: +41 22 919 03 00 E-mail: inmail@iec.ch Web: www.iec.ch

Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

PRICE CODE XG

*For price, see current catalogue*

CONTENTS

SECTION IA – FUSES WITH STRIKER FUSE-LINKS WITH BLADE CONTACTS (NH FUSE SYSTEM)

SECTION IB – FUSE-RAILS (NH FUSE SYSTEM)



SECTION IC – FUSE-BASES FOR BUSBAR MOUNTING (40 mm-SYSTEM) (NH FUSE SYSTEM)

SECTION II – FUSES WITH FUSE-LINKS FOR BOLTED CONNECTIONS
(BS BOLTED FUSE SYSTEM)



SECTION III – FUSES WITH FUSE-LINKS HAVING CYLINDRICAL CONTACT CAPS
(NF CYLINDRICAL FUSE SYSTEM)

INTERNATIONAL ELECTROTECHNICAL COMMISSION

---

# LOW-VOLTAGE FUSES –

## Part 2-1: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) – Sections I to VI: Examples of types of standardized fuses

## FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 60269-2-1 has been prepared by subcommittee 32B: Low-voltage fuses, of IEC technical committee 32: Fuses.

This fourth edition of IEC 60269-2-1 cancels and replaces the third edition published in 1998, amendment 1 (1999), and amendment 2 (2002). This edition constitutes a minor revision.

The document 32B/445/FDIS, circulated to the National Committees as amendment 3, led to the publication of the new edition.

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

- addition of a new section IB "Fuse-rails"
- addition of a new section IC "Fuse-bases for busbar mounting"
- section III rewritten to make it independent of section I
- addition of a new section VI "Fuse-links with wedge tightening contacts"

The text of this standard is based on the third edition, its amendment 1, amendment 2 and on the following document:

| FDIS | Report on voting |
|---|---|
| 32B/445/FDIS | 32B/449/RVD |

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

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

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

# LOW-VOLTAGE FUSES –

## Part 2-1: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) – Sections I to VI: Examples of types of standardized fuses

EXPLANATORY NOTE

In view of the fact that this standard should be read together with IEC 60269-1 and IEC 60269-2, the numbering of its clauses and subclauses are made to correspond to these publications. Regarding the tables, their numbering also corresponds to that of IEC 60269-1; however, when additional tables appear they are referred to by capital letters, for example, Table A, Table B, etc.

## 1 General

Fuses for use by authorized persons according to the following sections shall also comply with all subclauses of

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

IEC 60269-2, *Low-voltage fuses – Part 2: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial applications)*

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

Section I: Fuses with fuse-links with blade contacts (NH fuse system)

Section IA: Fuses with striker fuse-links with blade contacts (NH fuse system)

Section IB: Fuse-rails (NH fuse system)

Section IC: Fuse-bases for busbar mounting (NH fuse system)

Section II: Fuses with fuse-links for bolted connections (BS bolted fuse system)

Section III: Fuses with fuse-links having cylindrical contact caps (NF cylindrical fuse system)

Section IV: Fuses with fuse-links with offset blade contacts (BS clip-in fuse-system)

Section V: Fuses with fuse-links having "gD" and "gN" characteristic (Class J and class L time delay and non time delay fuse types)

Section VI: gU fuse-links with wedge tightening contacts

## 2 Normative references

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

IEC 60060-1:*High-voltage test techniques – Part 1: General definitions and test requirements*

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

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

IEC 60269-2, *Low-voltage fuses – Part 2: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial applications)*

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

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

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

# Section I – Fuses with fuse-links with blade contacts (NH fuse system)

## 1.1 Scope

The following additional requirements apply to fuses with fuse-links having blade contacts intended to be replaced by means of a device, for example, replacement handle (see Figure 3(I)), which complies with the dimensions specified in Figures 1(I*) and 2(I*). Such fuses have rated currents up to and including 1 250 A and rated voltages up to and including AC 690 V or DC 440 V.

## 2 Definitions

Add to the definitions of IEC 60269-1:

**2.1.12**
**linked fuse-carrier**

fuse-carrier which is mechanically linked to the fuse-base and gives a defined insertion and withdrawal movement to the fuse-link

NOTE See also IEC 60947.

**2.1.13**
**gripping-lugs**
parts of a fuse-link which are engaged with the replacement handle or fuse-carrier. Gripping-lugs may be made of metal or insulating material. Metal gripping-lugs may be live or not live under service conditions

**2.1.13.1**
**live gripping-lugs**
metal gripping-lugs electrically connected to the blade contacts of the fuse-link. Metal gripping-lugs without electrical contact to the blade contacts are also deemed to be live in case of inadequate creepage distances and clearances according to this standard

**2.1.13.2**
**isolated gripping-lugs**
not-live gripping-lugs made of insulating material or metal. If they are made of metal, the required creepage distances and clearances according to the relevant overvoltage category should be met between the gripping-lugs and the blade contacts as well as between the gripping-lugs and the fuse-base contacts

## 5.2 Rated voltage

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

The rated voltage of fuse-bases according to Figure 2(I) is 690 V.



* Refers to section I.

### 5.3.1 Rated current of the fuse-link

For each size the maximum rated currents are given in Figure 1(I). These values depend upon the utilization categories and rated voltages.

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

### 5.3.2 Rated current of the fuse-holder

The rated current for the different sizes of the fuse-bases is given in Figure 2(I).

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

The maximum values of rated power dissipation for the different sizes of fuse-links are specified in Figure 1(I). The values apply to the maximum rated currents of the fuse-links. The values of rated acceptable power dissipation of fuse-bases are given in Figure 2(I).

## 5.6 Limits of time-current characteristics

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

The tolerance on time-current characteristics given by the manufacturer shall not deviate by more than ±10 % in terms of current. The time-current zones given in Figure 4(I), including manufacturing tolerances shall be met by all pre-arcing and total times measured at the test voltage according to 8.7.4.

### 5.6.2 Conventional times and currents

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

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

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

### 5.6.3 Gates

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

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

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

# 6 Marking

Fuse-links and fuse-holders which meet the requirements and tests of section I of this standard may be marked with IEC 60269-2-1.

## 6.1 Markings of fuse-holders

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

## 6.2 Markings of fuse-links

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

| Characteristic | gG | | aM | |
|---|---|---|---|---|
| Colour of marking | Black | | Green | |
| Kind of print | Strip with inverse print | Normal print | Strip with inverse print | Normal print |
| Voltage | | | | |
| 400 V[1)] | X | | X | |
| 500 V | | X | | X |
| 690 V | X | | X | |

1) For 400 V gG, a blue colour is also permitted.

Fuse-links with isolated gripping-lugs may be marked in a place easily visible from the front with the graphical symbol of a gripping-lug in a square. If marked, conformity of these fuse-links is verified according to 8.2.

NOTE See Figure 12(I) for detailed dimensions of the symbol.

## 7.1 Mechanical design

The dimensions of fuse-links and fuse-bases are given in Figures 1(I) and 2(I).

### 7.1.2 Connections, including terminals

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

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

**Table D – Minimum cross-sectional ranges of unprepared conductors**

| Size | Range of the rated currents of the fuse-links<br>A | Cross-sectional area ranges mm² Copper | Cross-sectional area ranges mm² Aluminium |
|---|---|---|---|
| 00 | 6 to 160 | 6 to 70 | 25 to 95 |
| 0* | 6 to 160 | 6 to 70 | 25 to 95 |
| 1 | 80 to 250 | 25 to 120 | 35 to 150 |
| 2 | 125 to 400 | 50 to 240 | 70 to 300 |
| 3 | 315 to 630 | No values available | |
| 4 | 500 to 1 000 | | |
| 4a | 500 to 1 250 | | |

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

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

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

### 7.1.3 Fuse-contacts

The contact surfaces of fuse-links and fuse bases should be silver-plated, otherwise it shall be verified that contacting is not impaired in normal operation. If the surface plating of the blade contacts of a fuse-link is other than silver the test according to 8.10 has to be passed with dummies described in 8.10.1.

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

### 7.1.5 Construction of fuse-bases

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

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

### 7.1.7 Construction of a fuse-link

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

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

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

## 7.2 Insulating properties

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

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

## 7.7 $I^2t$ characteristics

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

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

| $I_n$ A | $I^2t_{min}$ A²s | $I^2t_{max}$ A²s |
|---|---|---|
| 2 | 1,00 | 23,00 |
| 4 | 6,25 | 90,25 |
| 6 | 24,00 | 225,00 |
| 8 | 49,00 | 420,00 |
| 10 | 100,00 | 576,00 |
| 12 | 160,00 | 750,00 |
| 224 | 200 000 | 520 000 |

## 7.8 Overcurrent discrimination of "gG" fuse-links

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

With regard to discrimination when circuit-breakers are used the following $I^2t$ values in Table E have to be followed.

**Table E – Pre-arcing $I^2t$ values for discrimination**

| $I_n$ A | $I^2t_{min}$ A²s | at $I_p$ A |
|---|---|---|
| 16 | 250 | 500 |
| 20 | 450 | 670 |
| 25 | 810 | 900 |
| 32 | 1 400 | 1 180 |
| 40 | 2 500 | 1 580 |
| 50 | 4 000 | 2 000 |
| 63 | 6 300 | 2 510 |
| 80 | 10 000 | 3 160 |
| 100 | 16 000 | 4 000 |
| 125 | 24 000 | 4 900 |
| 160 | 42 500 | 6 520 |
| 200 | 78 000 | 8 830 |

### 7.9 Protection against electric shock

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

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

### 8.1.4 Arrangement of the fuse and dimensions

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

In case of isolated metal gripping-lugs the creepage distances and clearances of the fuse-link according to 7.2 are verified. The clearances are also verified on a fuse-link inserted into a model fuse-base according to Figure 11(I).

### 8.1.6 Testing of fuse-holders

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

**Table VIII – Survey of tests on fuse holders and number of fuse holders to be tested**

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

### 8.2.2 Points of application of the test voltage

In addition to IEC 60269-1 the following applies:

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

### 8.2.3 Value of test voltage

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

**Table BB — Rated impulse withstand voltage**

| Rated voltage<br>V | Rated impulse withstand voltage<br>kV |
|---|---|
| 400 | 4 |
| 500 | 4 |
| 690 | 6 |

### 8.2.4 Test method

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

NOTE 1 If not otherwise specified, the impedance of the impulse generator should not exceed 500 Ω.

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

### 8.2.5 Acceptability of test results

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

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

### 8.2.6 Resistance to tracking

The test of plastic parts of fuse-links and fuse-bases is carried out according to IEC 60112. Five specimens shall be tested and shall pass at a PTI level stated by the manufacturer. Ceramic isolators need not be tested.

## 8.3 Verification of temperature rise and power dissipation

### 8.3.1 Arrangement of the fuse

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

In case the test arrangement contains more than one fuse, the test specimens are mounted in conventional service position on a wooden plate at a distance between centre lines of $3e_2$ according to Figure 1(I).

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

**Table F – Torque to be applied to the terminal screws**

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



#### 8.3.2 Measurement of the temperature rise

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

#### 8.3.4.1 Temperature rise of the fuse-holder

The dummy is given in Figure 5(I). The point at which the temperature rise is measured is marked with E in Figure 6(I).

#### 8.3.4.2 Power dissipation of a fuse-link

The points between which the power dissipation of a fuse-link is measured are marked with S in Figure 6(I).

#### 8.4.3.1 Verification of conventional non-fusing and fusing current

In case the non-fusing current test is also used for the verification of the time current characteristic a second test specimen shall be used for b).

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

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

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

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

#### 8.5.5.1.1 Arrangement of the fuse

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

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

**Table G – Test currents**

| Size | Cut-off current<br>kA |
|---|---|
| 00 | 22...24 |
| 0 | 22...24 |
| 1 | 34...37 |
| 2 | 44...48 |
| 3 | 65...70 |

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

If the cut-off current range cannot be attained with the highest rating of the size, correspondingly higher series connected fuse shall be used. In this case the test specimen shall be equipped with a dummy fuse-link. Its external dimensions correspond to the dimensions given in Figure 1(I).

#### 8.5.5.1.2 Test method

The test shall be performed on two fuse-bases. In the case of fuse-base 1, a hardened and polished test knife of steel, shown in Figure 7(I), shall be inserted by hand in order to open up the contacts to a certain extent. The purpose of this test is to ensure that the resilient spring travel is limited to the elastic range. The contacts shall be opened up three times. This test will be dispensed with if a mechanical stop limits the gap to less than 7 mm so that the test blade cannot be correctly fitted by hand. Fuse-base 2 is tested in accordance with 8.11.1.2. The values of $F_{max}$ according to Table J shall be adhered to. After these pre-tests the above-mentioned current test shall be performed.

#### 8.5.5.1.3 Acceptability of test results

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

### 8.5.8 Acceptability of test results

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

### 8.7.4 Verification of overcurrent discrimination

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

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

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

The test voltage for 690 V fuses is $1{,}05 \times \frac{U_n}{\sqrt{3}}$.

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

**Table H – Test currents and $I^2t$ limits for discrimination test**

| $I_n$ | Minimum pre-arcing $I^2t$ | | Maximum operating $I^2t$ | | Discrimination ratio |
|---|---|---|---|---|---|
| | Prospective $I$ r.m.s. | $I^2t$ | Prospective $I$ r.m.s. | $I^2t$ | |
| A | kA | $A^2s$ | kA | $A^2s$ | |
| 2 | 0,013 | 0,67 | 0,064 | 16,4 | Can be calculated |
| 4 | 0,035 | 4,90 | 0,130 | 67,6 | |
| 6 | 0,064 | 16,40 | 0,220 | 193,6 | |
| 8 | 0,100 | 40,00 | 0,310 | 390,0 | |
| 10 | 0,130 | 67,60 | 0,400 | 640,0 | |
| 12 | 0,180 | 130,00 | 0,450 | 820,0 | |
| 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 | |
| 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 | |
| 125 | 3,000 | 36 000,00 | 5,100 | 104 000,0 | |
| 160 | 4,000 | 64 000,00 | 6,800 | 185 000,0 | |
| 200 | 5,100 | 104 000,00 | 8,700 | 302 000,0 | |
| 224 | 5,900 | 139 000 | 10,200 | 412 000,0 | |
| 250 | 6,800 | 185 000,00 | 11,800 | 557 000,0 | |
| 315 | 8,700 | 302 000,00 | 15,000 | 900 000,0 | |
| 400 | 11,800 | 557 000,00 | 20,000 | 1 600 000,0 | |
| 500 | 15,000 | 900 000,00 | 26,000 | 2 700 000,0 | |
| 630 | 20,000 | 1 600 000,00 | 37,000 | 5 470 000,0 | |
| 800 | 26,000 | 2 700 000,00 | 50,000 | 10 000 000,0 | |
| 1 000 | 37,000 | 5 470 000,00 | 66,000 | 17 400 000,0 | |
| 1 250 | 50,000 | 10 000 000,00 | 90,000 | 33 100 000,0 | |

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

## 8.9 Verification of resistance to heat

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

### 8.9.1 Fuse-base

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

#### 8.9.1.1 Test arrangement

A dummy fuse-link according to Figure 5(I) is fitted into a fuse-base and also suspended from a measuring device as shown, for example, in Figure 8(I). The manner in which the dummy is fitted and secured (for example, by locking pins), in fuse-bases shall ensure that heat dissipation is not seriously affected. The conductor cross-section depends upon the rated current (see IEC 60269-1, Table X), and the connections outside the heating chamber must be at least 1 m long. The test set-up is installed in such a heating chamber or below a heatable cowl of at least 50 l capacity, care being taken to see that the bushings etc. for the measuring facility and connections are suitably sealed. The heaters shall be such as to ensure that during the test sequence described below a temperature of $(80^{+5}_{0})$ °C is maintained with or without the test current, the temperature being measured at a horizontal distance of 150 mm from the dummy centre point.

#### 8.9.1.2 Test method

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

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

#### 8.9.1.3 Acceptability of test results

After this test the contact pieces of the fuse-base shall not have moved to such an extent as to affect the further use of the fuse-base. After pulling out of the dummy the dimensions of Figure 2(I), are to be considered. The insulating mounting part of the fuse-base shall neither be broken nor show any signs of cracks.

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

#### 8.9.2.1 Test arrangement

A fuse-link of the highest rating for a size is fitted into a fuse-base; it shall be arrested there and also suspended from a measuring device as shown in Figure 8(I).

#### 8.9.2.2 Test method

The temperature in the heating chamber is raised to $(80^{+5}_{0})$ °C and maintained for 2 h. The fuse-link is then loaded with 150 % rated current until it operates, but the test is restricted to the conventional time. A reduced test voltage may be used. Three minutes after the fuse-link has operated or the conventional testing time has expired, a tensile force $F_{max}$ (see Table J) is applied smoothly to the gripping lugs. The force is exerted for a period of about 15 s.

#### 8.9.2.3 Acceptability of test results

The gripping lugs shall remain fully operational, and the length of the neck ($2{,}5^{+0{,}5}_{0}$) mm in particular shall not be exceeded by more than 2 mm, in keeping with the dimensions *d* of Figure 1(I). The same applies to the maximum values of dimension $c_1$.

### 8.10 Verification of non-deterioration of contacts and direct terminal clamps

#### 8.10.1 Arrangement of the fuse

The dummy fuse-link is given in Figure 5(I). The dummy fuse-link shown with silver-plated blade contacts is representative for fuse-links with silver-plated blade contacts. If the non-deterioration test proves that a surface plating of the blade contacts of a fuse-link other than silver fulfils the requirements, then the surface of the blade contacts of the dummy fuse-link shall be plated accordingly.

For lug terminals the torques are given in Table F.

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

The insulation of the conductors shall be removed over the whole length.

#### 8.10.1.1 Contacts

Subclause 8.10.1 of IEC 60269-1 applies.

#### 8.10.1.2 Direct terminal clamps

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

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

The test arrangement shall be as follows: the fuse bases shall be mounted in a vertical position, side by side with a distance between the fuse base centres of at least three times $e_2$, shown in Figure 1(I). The test of direct terminal clamps, which can be used for copper as well as aluminium conductors, shall be made with aluminium conductors.

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

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

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

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

| Thread | Torque<br>Nm |
|---|---|
| M5 | 2,6 |
| M6 | 4,5 |
| M8 | 11 |
| M10 | 21 |
| M12 | 38 |

Direct terminal clamps only for copper conductors are tested like direct terminal clamps for aluminium with the exception that cleaning and storage are not necessary. Furthermore, for copper clamps, the test can be part of the test of contacts. If the requirements for the contacts after 250 cycles (see 8.10. 2.1) are met, the clamps for copper have satisfied this requirement.

The conductor cross-section depends upon the rated current (for copper conductors, see Table 10 of IEC 60269-1).

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

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

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

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

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

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

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

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

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

### 8.10.2 Test method

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

| | | |
|---|---|---|
| Test current: | conventional non-fusing current $I_{nf}$ | see Table 2 of IEC 60269-1 |
| Load period: | 25 % of the conventional time | |
| No-load period: | 10 % of the conventional time | |

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

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

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

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

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

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

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

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

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

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

#### 8.10.2.1 Contacts

The points between which the voltage drop is measured are marked as A and B in Figure 6(I).

At the conclusion of the test after 250 cycles and 750 cycles, the withdrawal forces are measured. For this purpose a hardened and polished steel test knife as shown in Figure 7(I) shall be inserted in order, if possible, to open the contacts up, to a certain extent (see 8.5.5.1.2).

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

### 8.10.2.2 Direct terminal clamps

The points between which the voltage drop Δ$U$ of the test sample is measured are given in Figure 10(I). The point of measurement on the conductor F shall be a centre punch point where solid conductors are concerned or a bare wire wrapped around stranded conductors. For aluminium conductors, special precautions shall be implemented by use, for example, of a welded equalizer (the aluminium cable is cut; the conductors of each part are welded together, then the two parts are welded and the measure can be carried out in a hole drilled in a welded part).

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

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

**Table S – Test sequence for direct terminal clamps**

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

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

### 8.10.3 Acceptability of test results

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

### 8.10.3.1 Contacts

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

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

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

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

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

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

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

### 8.10.3.2 Direct terminal clamps

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

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

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

**Table T – Permissible changes of the resistance**

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

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

## 8.11 Mechanical and miscellaneous tests

### 8.11.1.2 Mechanical strength of the fuse-base

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

The test to verify the contact force of fuse-bases is performed with three unused fuse-bases as supplied. A test-link made of hardened steel with polished and chrome-plated surfaces is inserted three times in the fuse-base. The dimensions of the blade contacts of the fuse-link are identical with the dimensions according to Figure 1(I).

When pulling steadily by means of suitable test equipment, the withdrawal force *F* measured (see Figure 8(I)) shall be found to lie within the limits as specified in Table J.

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

| Size | Withdrawal force | |
|---|---|---|
| | $F_{min}$ N | $F_{max}$ N |
| 00 | 60 | 250 |
| 0 | 80 | 300 |
| 1 | 110 | 350 |
| 2 | 150 | 400 |
| 3 | 210 | 400 |

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

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

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

##### 8.11.1.8.1 Test arrangement

The facility to verify impact resistance is given in Figure 9(I). The weight of the drop hammer is 300 g, the height of fall between the impact-mandrel and the gripping-lug is 300 mm.

##### 8.11.1.8.2 Test method

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

The samples are placed in the test facility of Figure 9(I) in such a way that the direction of the stroke is parallel to the longitudinal axis of the fuse-link. Each of the gripping-lugs is only once exposed to stress at which the place of impact shall be the middle of the gripping-lug-neck. It shall be guaranteed that each time only the upper gripping-lug is stressed by the impact.

##### 8.11.1.8.3 Acceptability of test results

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

#### 8.11.2.3 Verification of resistance to rusting

**8.11.2.3.1** The test shall be carried out according to ISO 6988 with cyclic moist atmosphere containing 0,2 % SO2 (SFW 0,2 S); number of cycles: 1.

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

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

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

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

##### 8.11.2.4.1 Test method

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

*For a period of 168 h*

(150 ± 5) °C for equipment comprising moulded elements intended to support live parts,

(100 ± 5) °C for covers,

*for a period greater than 1 h*

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

After cooling to ambient temperature the following shall be tested:

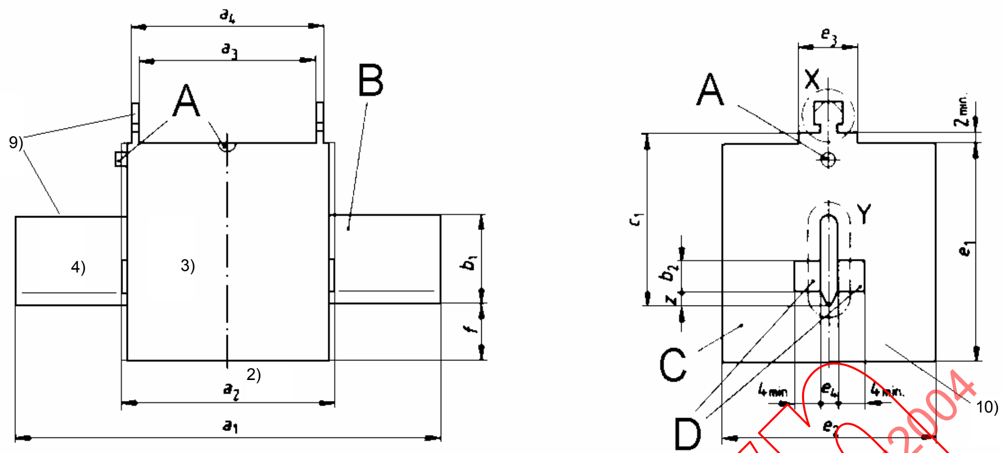
Fuse-links: verification of the breaking capacity with $I_1$ and $I_2$ in accordance with 8.5 of IEC 60269-1.

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

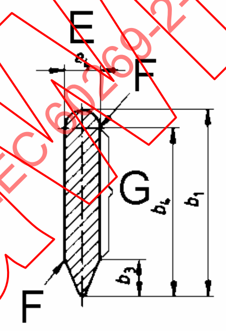
##### 8.11.2.4.2 Acceptability of test results

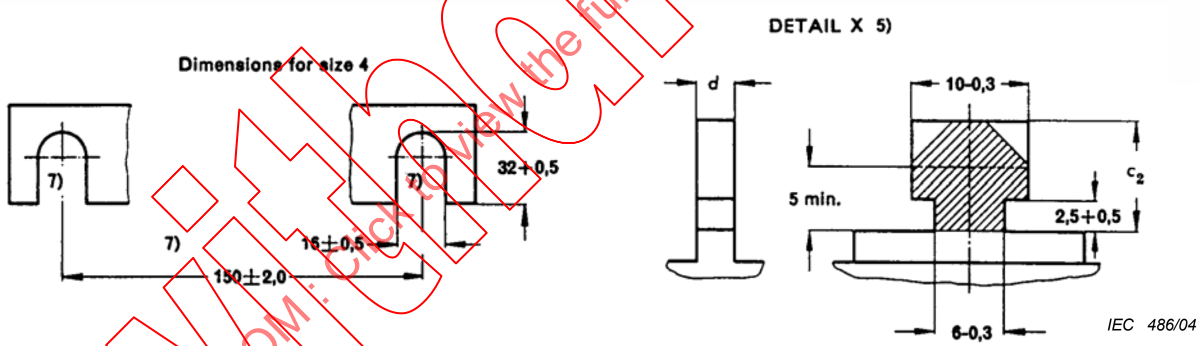
The positions of the fuse-base contacts taking the fuse-link shall not have changed in a manner likely to affect its correct functioning. The insulating body on which the terminals are fixed shall neither fracture nor show any signs of a fracture. The mechanical strength of cemented joints shall not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

The marking shall be durable and easily legible.




A indicating device
B contact
C endplate
D stop face
E detail Y (sectional view)
F rounded, see note 13)
G contact face




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

*Maximum values of the rated power dissipation $P_n$*

| Size | gG | | | | | | aM | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | AC 400 V | | AC 500 V | | AC 690 V | | AC 400 V and 500 V | | AC 690 V | |
| | $I_n$ A | $P_n$ W | $I_n$ A | $P_n$ W | $I_n$ A | $P_n$ W | $I_n$ A | $P_n$ W | $I_n$ A | $P_n$ W |
| 000 | 100 | 5,5 | 100 | 7,5 | 63 | 12 | 100 | 7,5 | 80 | 12 |
| 00 | 160 | 12 | 160 | 12 | 100 | 12 | 100/160 | 7,5/12 | 160 | 12 |
| 0 | 160 | 12 | 160 | 16 | 100 | 25 | 160 | 16 | 100 | 25 |
| 1 | 250 | 18 | 250 | 23 | 200 | 32 | 250 | 23 | 250 | 32 |
| 2 | 400 | 28 | 400 | 34 | 315 | 45 | 400 | 34 | 400 | 45 |
| 3 | 630 | 40 | 630 | 48 | 500 | 60 | 630 | 48 | 630 | 60 |
| 4 | - | - | 1 000 | 90 | 800 | 90 | 1 000 | 90 | 1 000 | 90 |
| 4a | 1 250 | 90 | 1 250 | 110 | 1000 | 110 | 1 250 | 110 | 1 250 | 110 |

**Figure 1(I*) – Fuse-links with blade contacts** *(continued)*

* Refer to section I.

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

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

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

3) Insulating material.

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

5) Attachment for replacement handle (detail X).

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

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

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

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

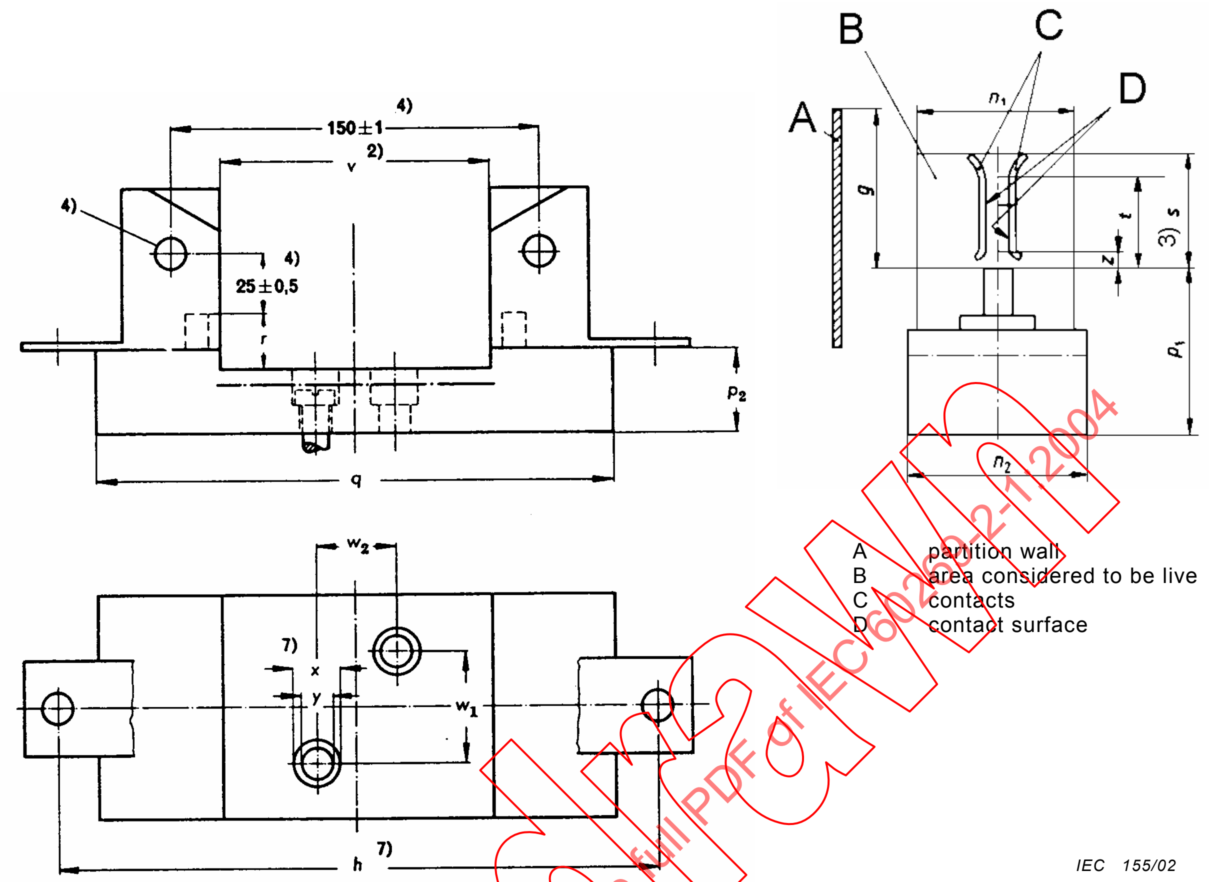
10) With the exception of the attachment for the replacement handle (detail X), the endplates are not permitted to protrude radially from the insulation body.

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

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

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

**Figure 1(I) – Fuse-links with blade contacts** *(concluded)*



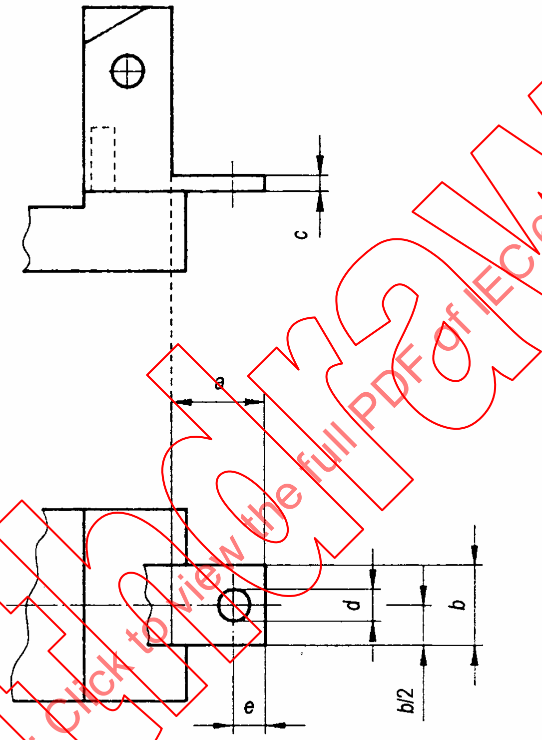

*Dimensions in millimetres*

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

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

**Figure 2(l) – Fuse-bases for fuse-links with blade contacts** *(continued)*

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




*IEC 147/96*

*Dimensions in millimetres*

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

**Figure 2(l) – Fuse-bases for fuse-links with blade contacts** *(continued)*

1) This area is considered to be live.

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

3) Height of contact surface. It shall also be possible to insert fuse-links with blade contacts according to figure 1(I), even if the contact surface is not smooth but grooved or divided.

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

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

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

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

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

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

10) M12 with through hole 14 permitted.

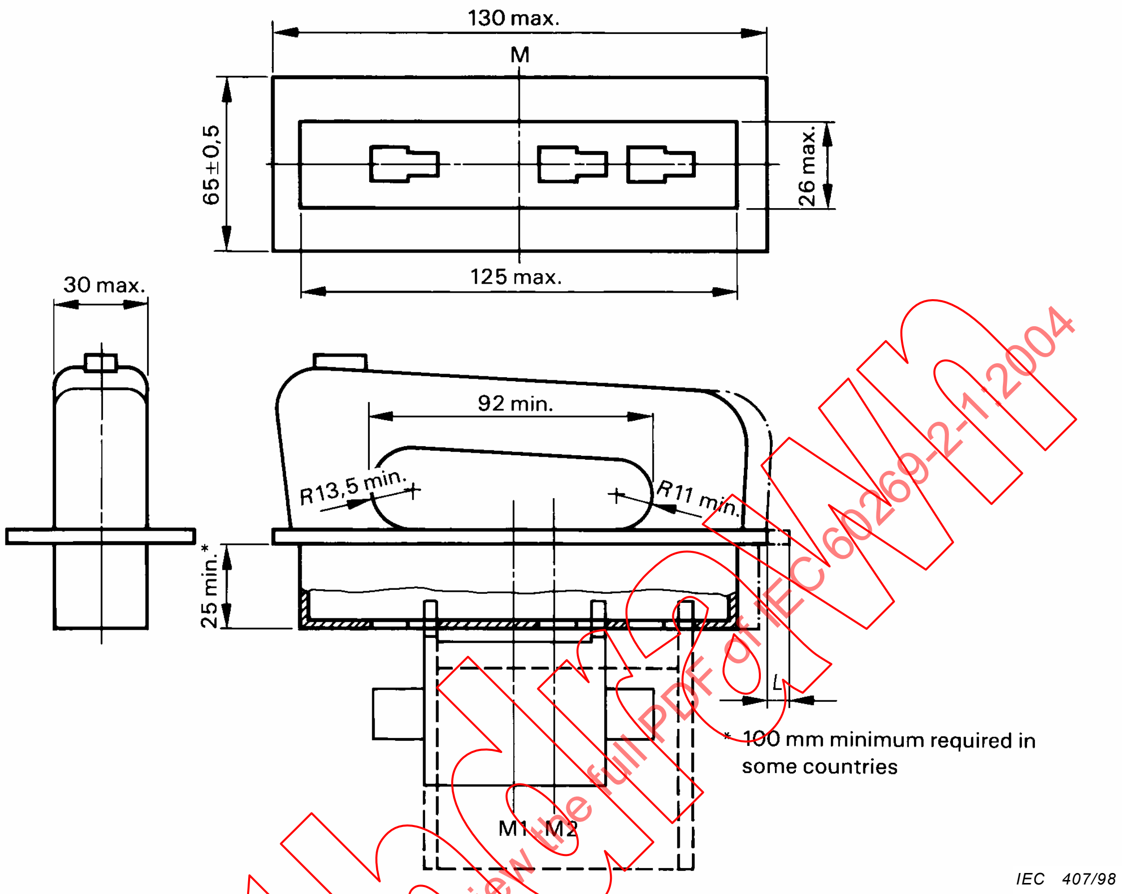
11) Dimension "*c*" may be lower provided the mechanical stress when connecting the conductors can be withstood without deformation of the connection. Types with thread shall comply with test-torque requirements.

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

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

**Figure 2(I) – Fuse-bases for fuse-links with blade contacts** *(concluded)*

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






*Dimensions in millimetres*

| Size | *L* | Distance | |
|---|---|---|---|
| | | **M-M1** | **M-M2** |
| 00 | 14 | 0 ± 3 | – |
| 0 ... 3 | 16 | – | 11 ± 3 |

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

M1 for size 00

M2 for the sizes 0...3

M = Centre of the coupling

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

**Figure 3(l) – Replacement handle**

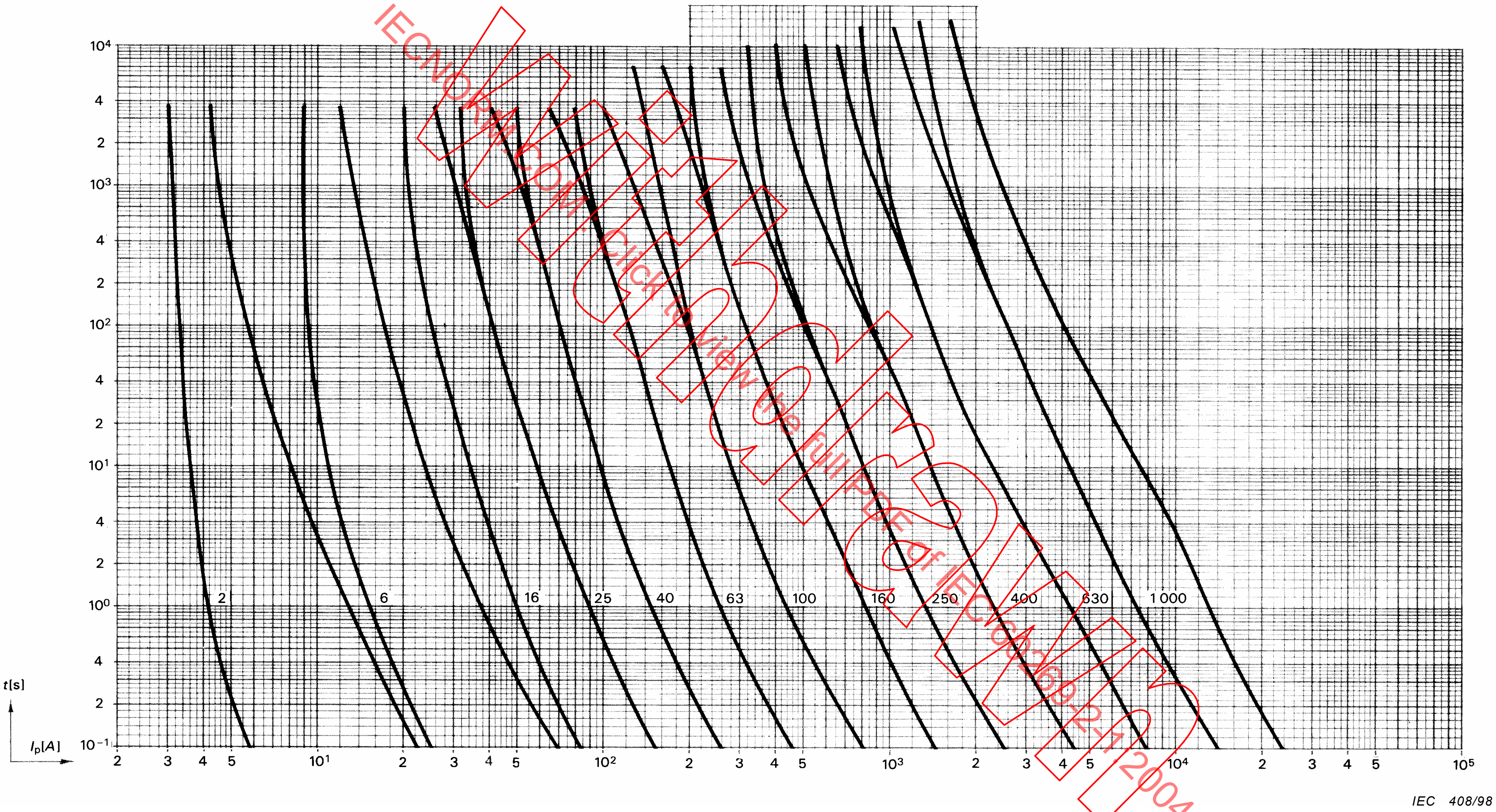





**Figure 4(I) – Time-current zones for "gG" fuse-link** *(continued)*

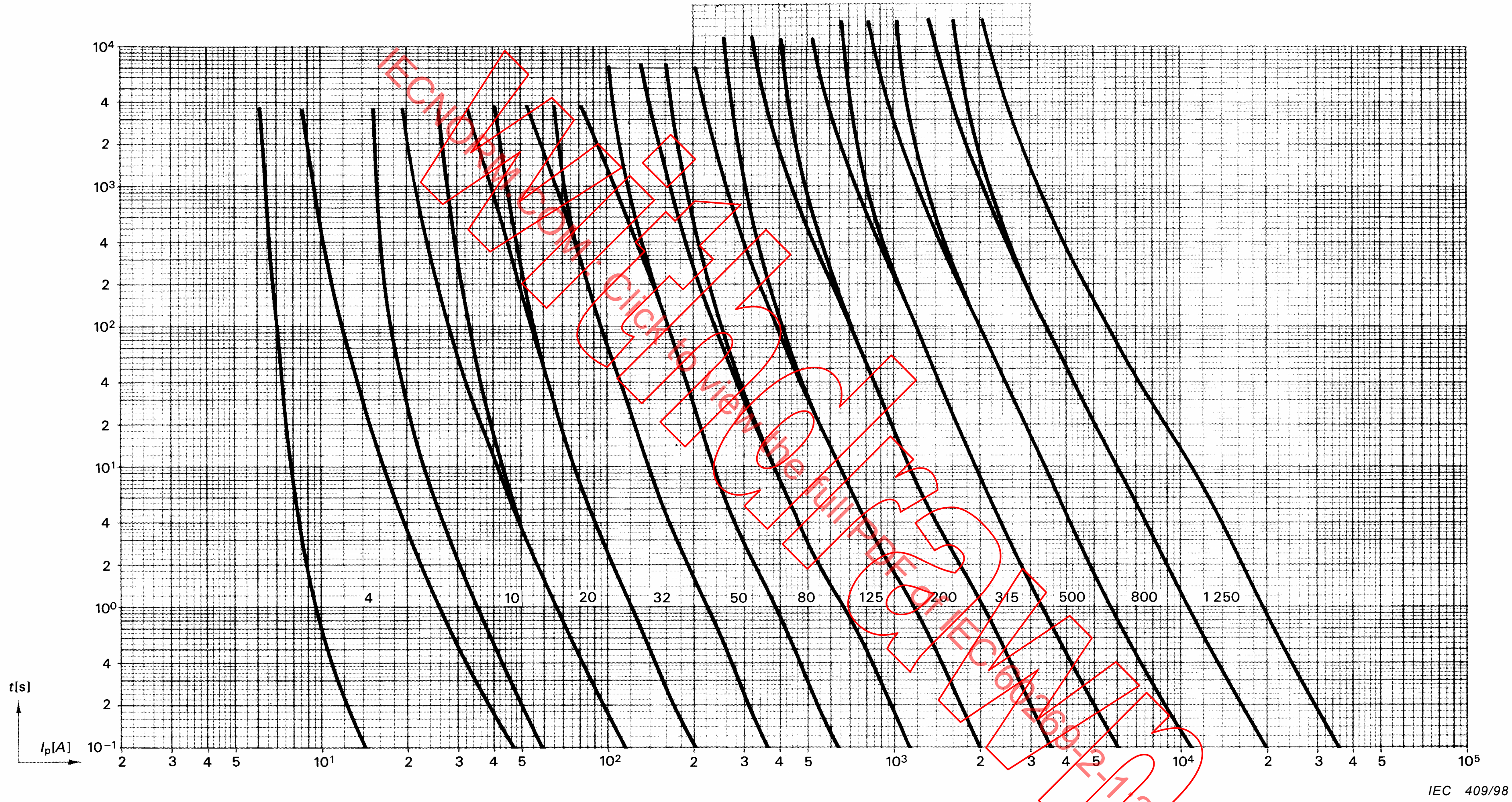





**Figure 4(I) – Time-current zones for "gG" fuse-links** *(continued)*

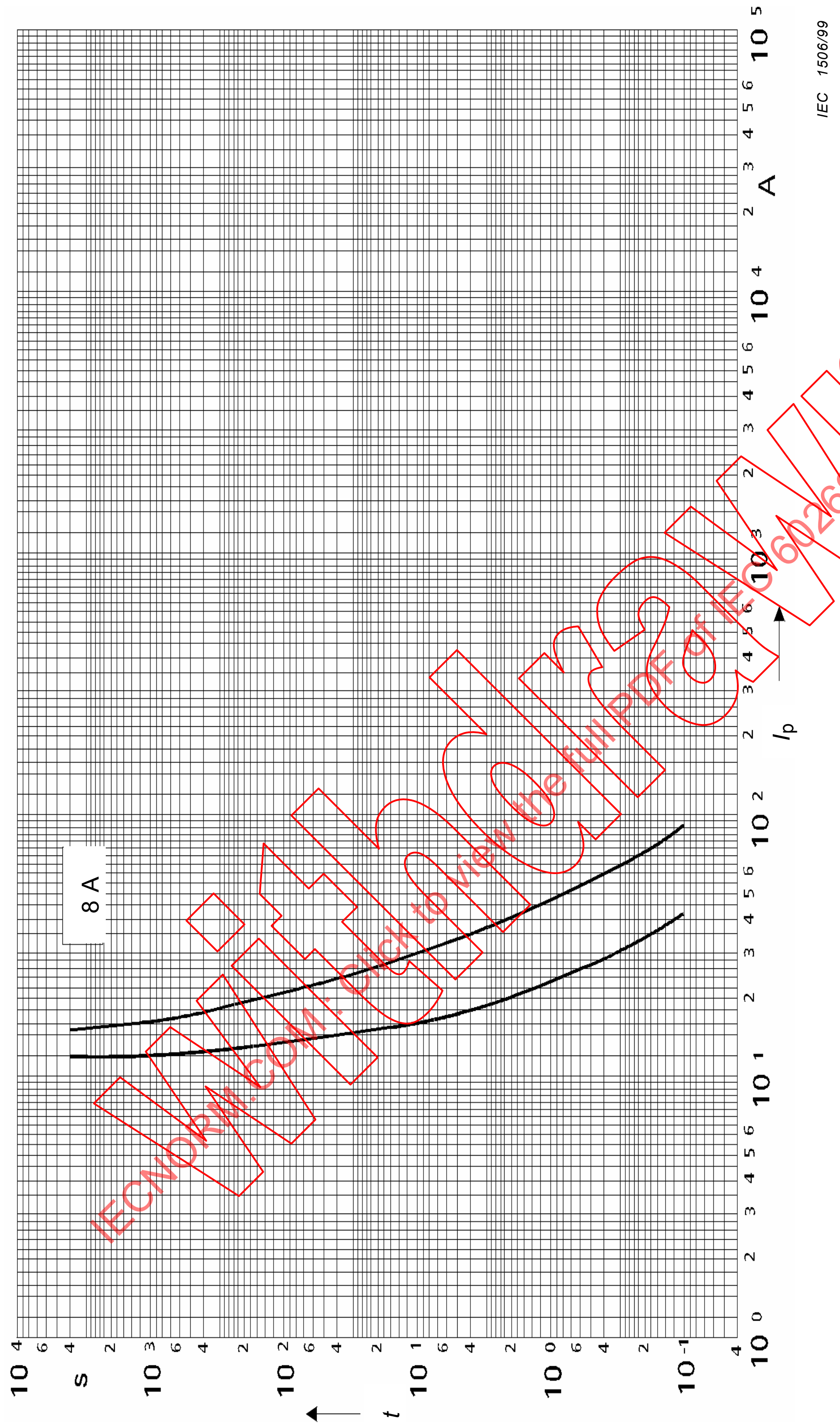



**Figure 4(l) – Time-current zones for "gG" fuse-links, 8 A** *(continued)*

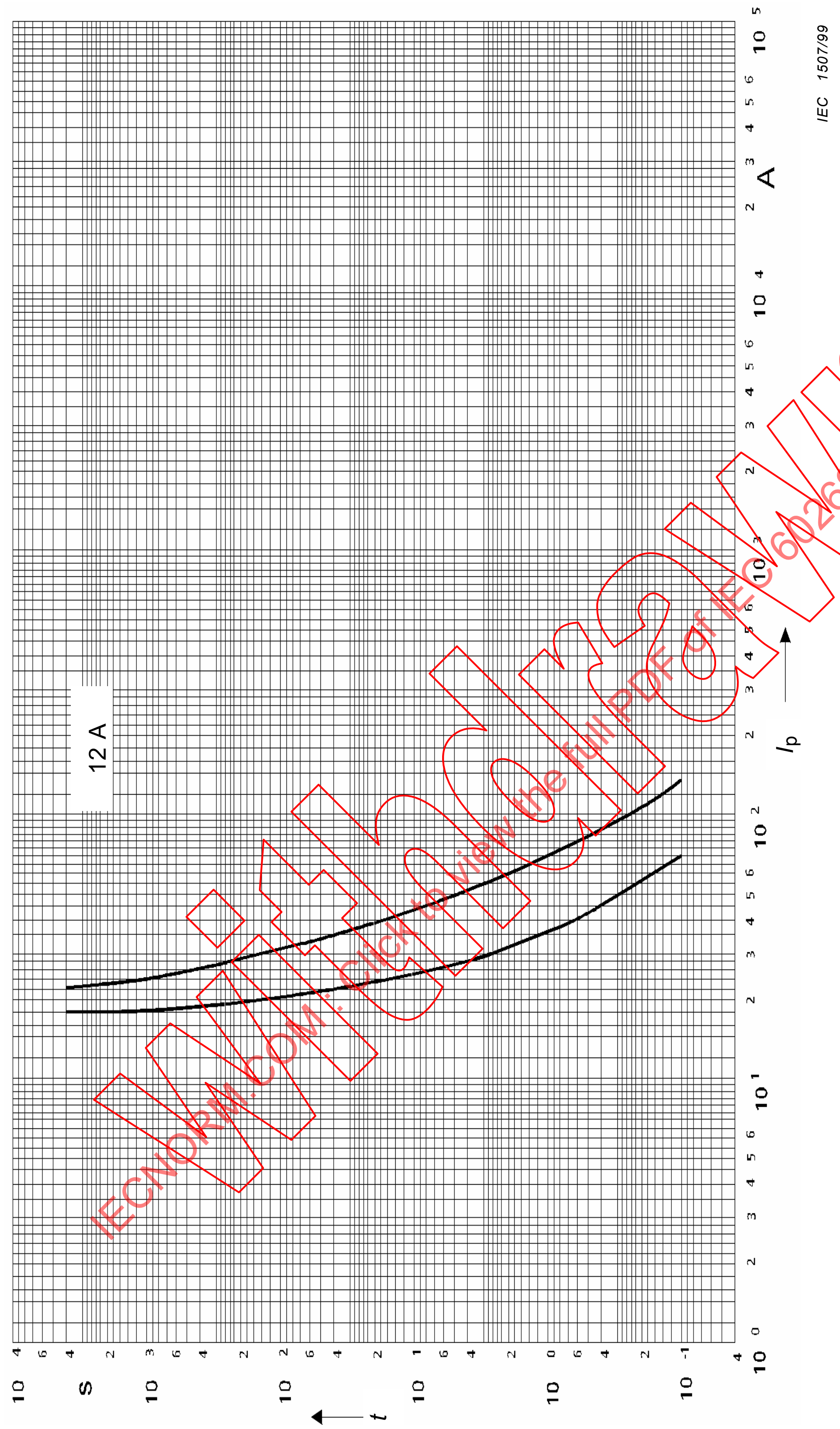



**Figure 4(l) – Time-current zones for "gG" fuse-links, 12 A** *(continued)*

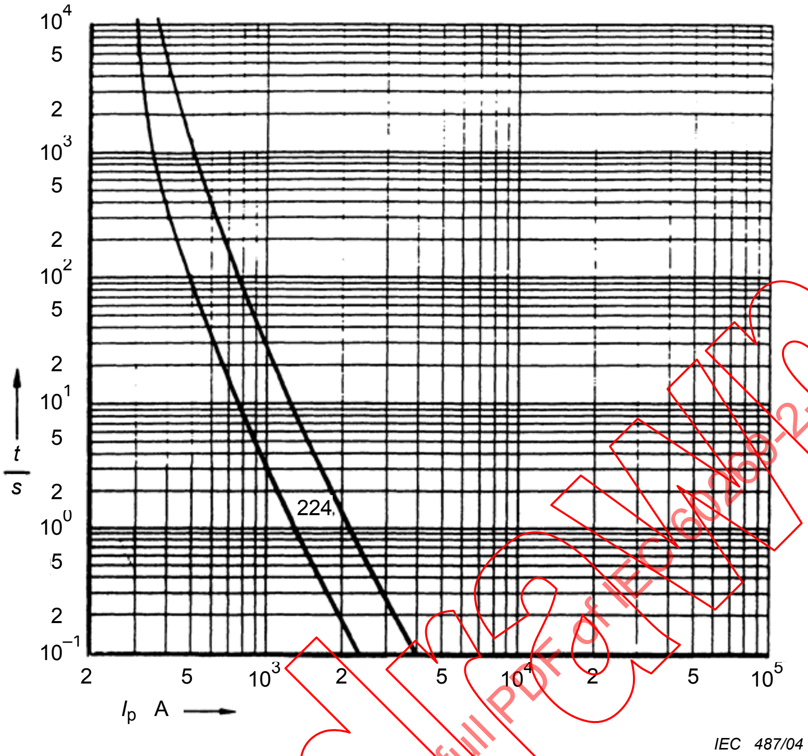
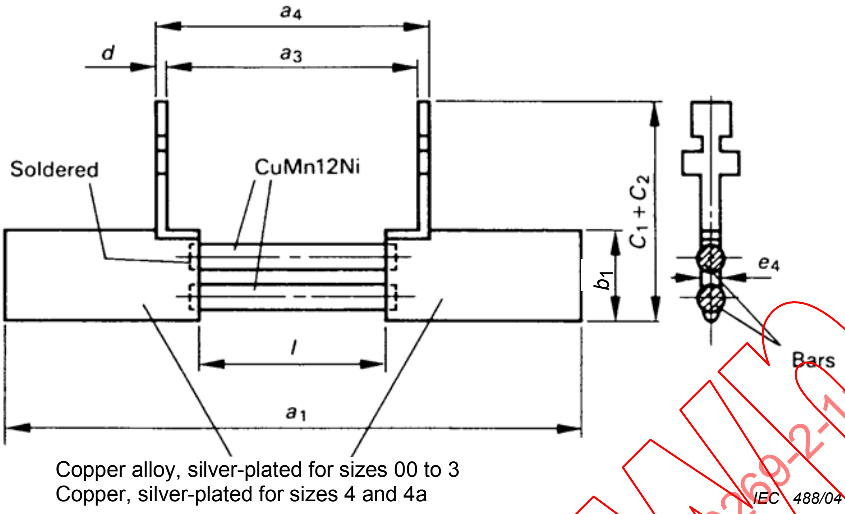



**Figure 4(l) – Time-current zones for "gG" fuse-link** *(concluded)*

Dimensions of the gripping-lugs, see Figure 1(I).



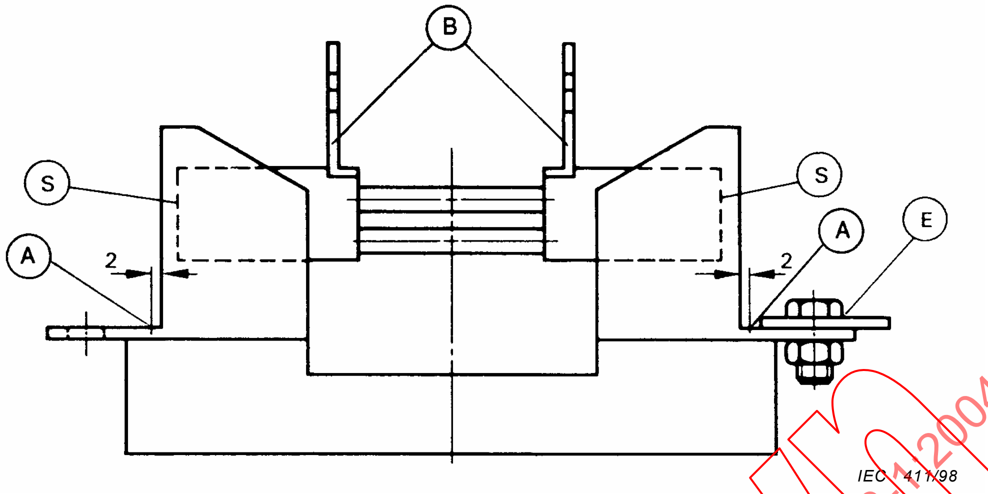

*Dimensions in millimetres*

Other dimensions, see Figure 1(I) continued.

| Size | $l$ | P* W | R** mΩ | Bars Number | Bars Diameter |
|---|---|---|---|---|---|
| 00 | $30,5\,^{0}_{-3}$ | 12 | 0,47 | 1 | 7 |
| 0[14)] | $46\,^{0}_{-4}$ | 25 | 0,97 | 1 | 6 |
| 1 | $46\,^{0}_{-4}$ | 32 | 0,51 | 1 | 8 |
| 2 | $46\,^{0}_{-4}$ | 45 | 0,281 | 2 | 8 |
| 3 | $46\,^{0}_{-4}$ | 60 | 0,151 | 3 | 9 |
| 4 | $54\,^{0}_{-6}$ | 90 | 0,09 | 3 | 12 |
| 4a | $54\,^{0}_{-6}$ | 110 | 0,07 | 4 | 12 |

* At the largest rated current of the size
** Measured at the gripping lugs; equalized with a tolerance of ±2 %

**Figure 5(I) – Dummy fuse-link according to 8.3.4.1, 8.9.1 and 8.10**




*Dimensions in millimetres*

**Figure 6(I) – Measuring points according to 8.3.4 of IEC 60269-1, 8.3.4.1(I), 8.3.4.2(I) and 8.10.2(I) of this publication**

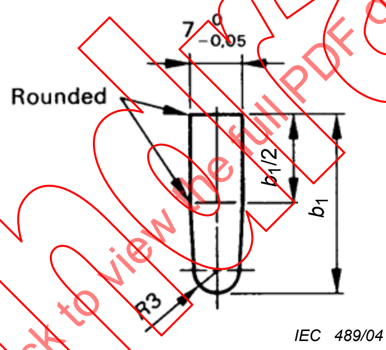
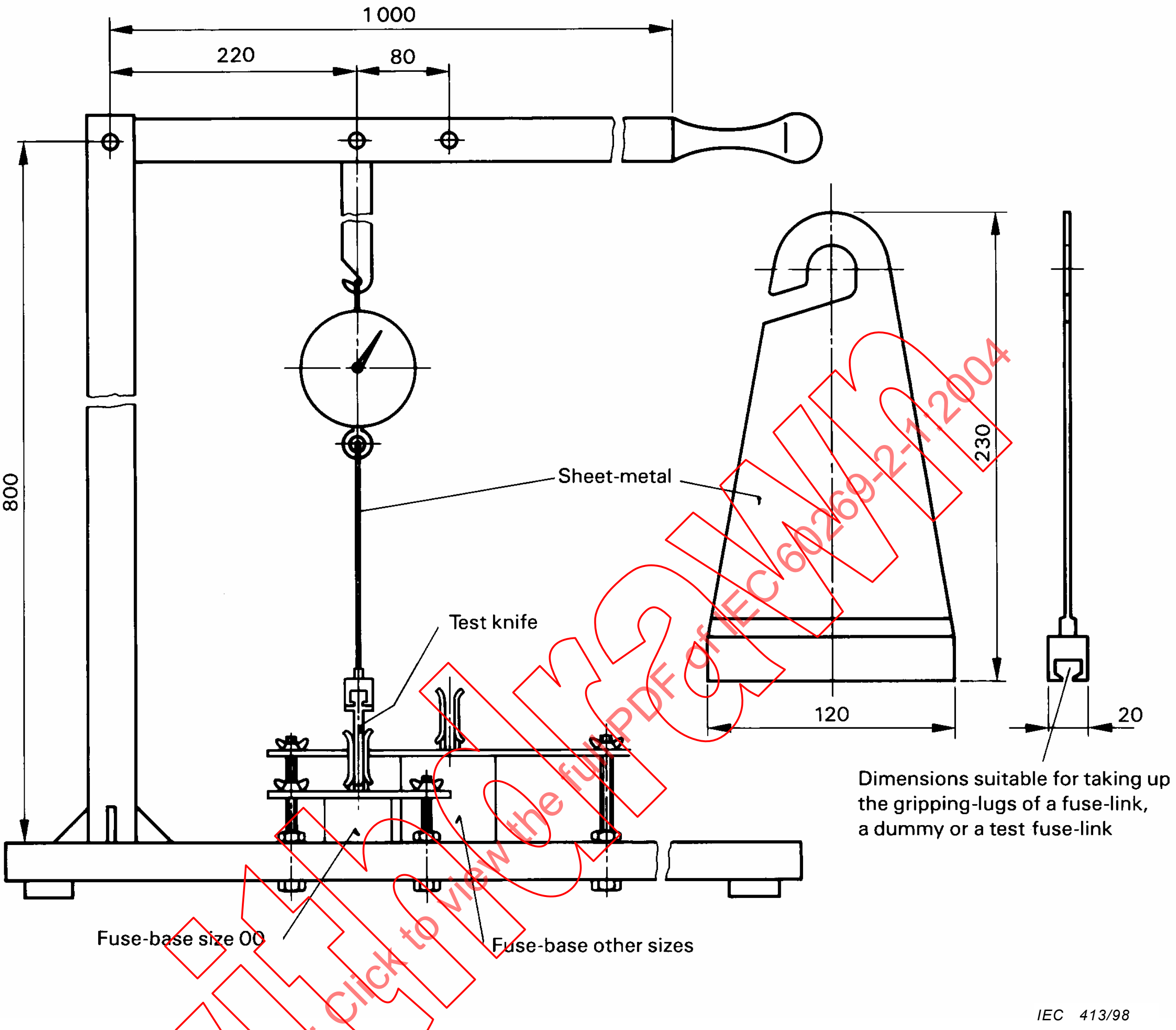
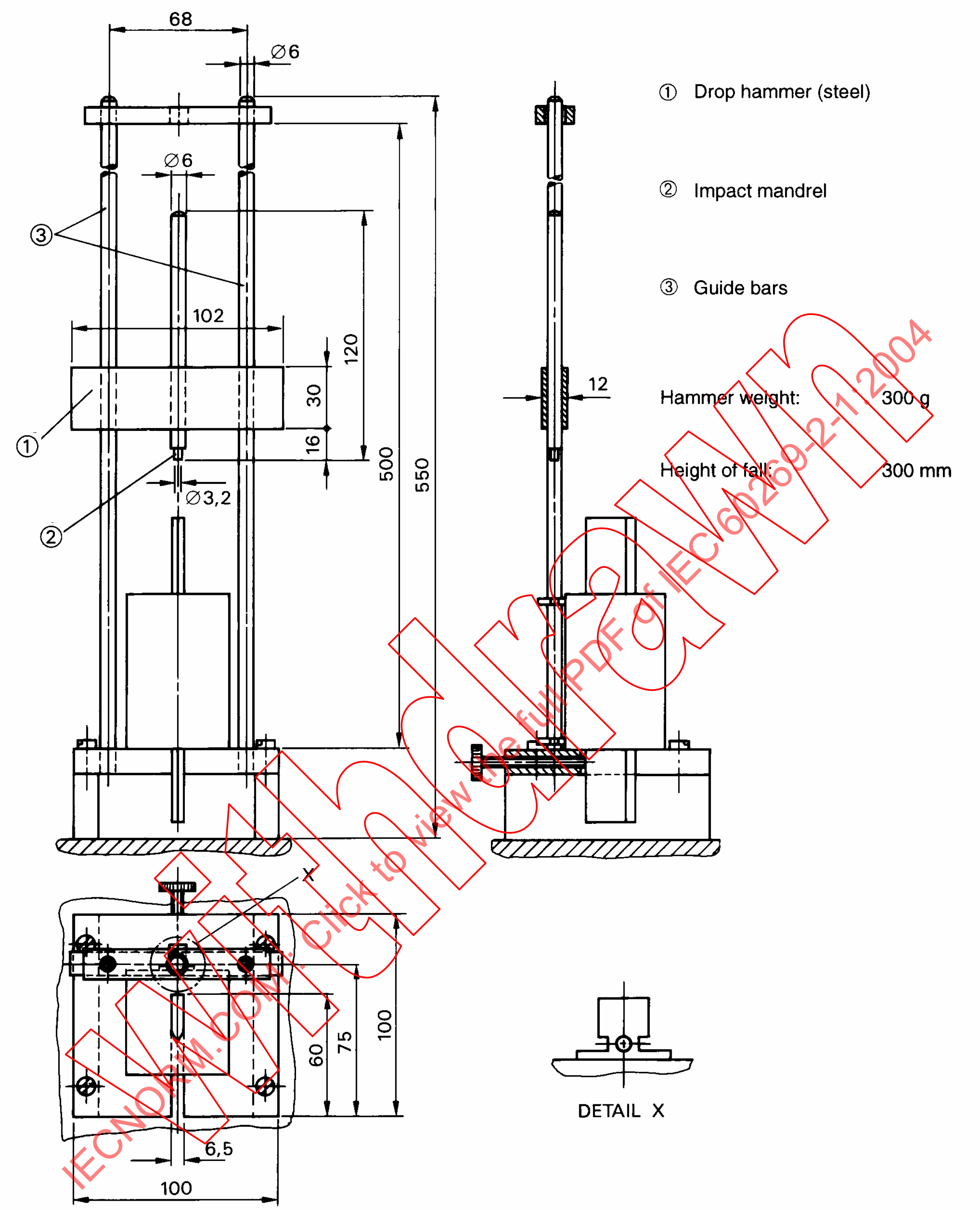



**Figure 7(I) – Test knife according to 8.5.5.1.2**




*Dimensions in millimetres*

**Figure 8(l) – Example of a measuring device for determining the withdrawal forces according to 8.9.1 and 8.11.1.2**

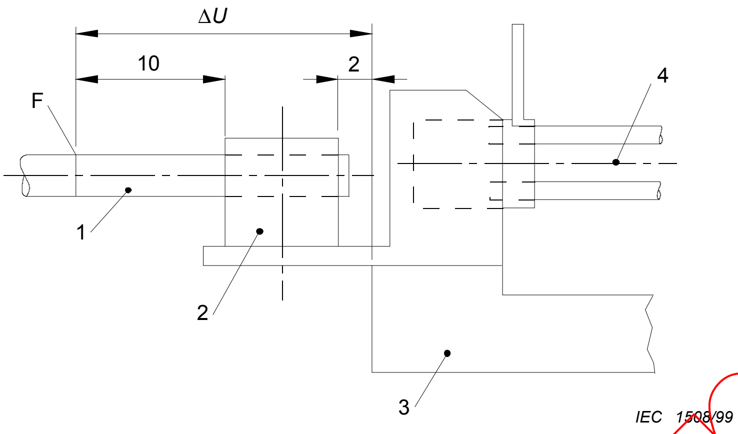





*Dimensions in millimetres*

*IEC 414/98*

**Figure 9(l) – Facility for verifying the mechanical strength of gripping lugs (see 8.11.1.8)**




*Dimensions in millimetres*

**Key**

1 Conductor
2 Clamp
3 Fuse-base
4 Dummy fuse-link

**Figure 10(l) – Measuring points according to 8.10.2**

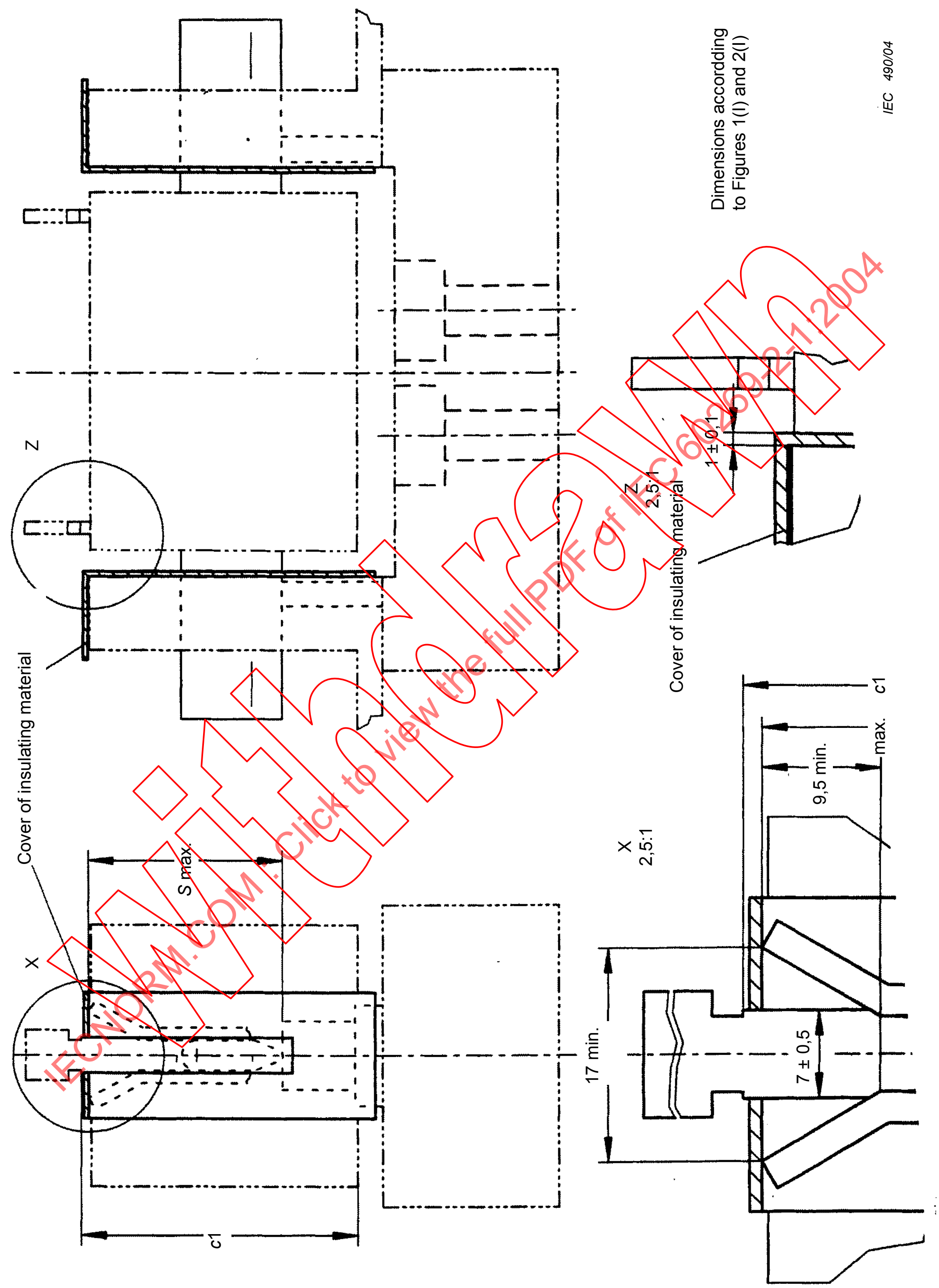





**Figure 11(I) – Reference fuse-base**

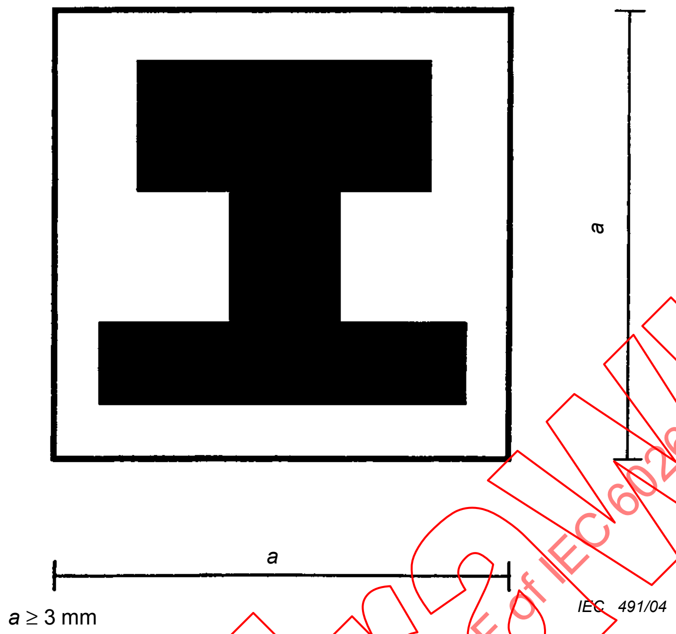



**Figure 12(l) — Design mark for isolated gripping-lugs**

# Annex A
(informative)

## Special test for cable overload protection
(see note in section I, to 8.4.3.5)

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

### A.1 Arrangement of the fuse

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

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

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

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

| | |
|---|---|
| $2{,}5 \times 10^{-3}$ m³ | for size 00, |
| $6 \times 10^{-3}$ m³ | for size 0, |
| $9 \times 10^{-3}$ m³ | for size 1 and |
| $12 \times 10^{-3}$ m³ | for size 2. |

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

### A.2 Test method and acceptability of test results

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

## Section IA – Fuses with striker fuse-links with blade contacts (NH fuse system)

### 1.1 Scope

The following additional requirements apply to fuses with striker fuse-links with blade contacts, intended to be replaced by means of a device, such as a replacement handle, which comply with the dimensions specified in Figures 1(IA) and 2(IA). Such fuses have rated currents up to and including 1 250 A and rated voltages up to and including 690 V a.c. or 440 V d.c.

Owing to the different operating features of fuses with strikers a distinction shall be made in this section between references A and B.

### 5.2 Rated voltage

See 5.2 of section I.

### 5.3.1 Rated current of the fuse-link

For each size, the maximum rated currents are given in Figure 1(IA). These values depend upon the utilisation categories and rated voltages.

### 5.3.2 Rated current of the fuse-holder

The rated current for the different sizes of the fuse-bases is given in Figure 2(IA).

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

The maximum values of rated power dissipation for the different sizes of fuse-links are specified in Figure 1(IA). The values apply to the maximum rated current of the fuse-links. The values of rated acceptable power dissipation of fuse-bases are given in Figure 2(IA).

### 5.6 Limits of time-current characteristics

See 5.6 of section I.

## 6 Marking

See Clause 6 of section I.

### 7.1 Mechanical design

The dimensions of fuse-links and fuse-bases are given in Figures 1(IA) and 2(IA).

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

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

### 7.1.2 Connections, including terminals

See 7.1.2 of section I.

### 7.1.3 Fuse-contacts

See 7.1.3 of section I.

### 7.1.7 Construction of a fuse-link

Subclause 7.1.7 of section I applies with the following addition:

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

### 7.7 $I^2t$ characteristics

See 7.7 of section I.

### 7.8 Overcurrent discrimination of "gG" fuse-links

See 7.8 of section I.

### 7.9 Protection against electric shock

See 7.9 of section I.

### 8.1.6 Testing of fuse-holders

See 8.1.6 of section I.

### 8.3 Verification of temperature rise and power dissipation

See 8.3 of section I.

### 8.4.3.6 Operation of indicating devices and strikers, if any

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

After operation, the striker shall remain captive.

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

**Table Z – Position and force of the striker**

| Size | | Reference A | Reference B | |
|---|---|---|---|---|
| | | 0 to 4 | 1 to 4a | 00 |
| $S_{0max}$ | mm | 1 | 1 | 1 |
| $S_1$ | mm | 13 to 20 | 10 min. | 5,5 min. |
| $F_{min}$ between positions 0 and 1 | N | 8 | 1 | 1 |
| $F_{max}$ in position 1 | N | 20 | 20 | 20 |

$S_0$ : projection of the striker before operation (position 0)
$S_1$ : projection of the striker after operation (position 1)
$F$ : force of the striker

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

See 8.5.5.1 of section I.

#### 8.7.4 Verification of overcurrent discrimination

See 8.7.4 of section I.

#### 8.9.1 Fuse-base

See 8.9.1 of section I.

#### 8.9.1.1 Test arrangement

See 8.9.1.1 of section I.

#### 8.9.1.2 Test method

See 8.9.1.2 of section I.

#### 8.9.1.3 Acceptability of test results

After this test, the contact pieces of the fuse-base shall not have moved to such an extent as to affect the further use of the fuse-base. After extracting the dummy, the dimensions of Figure 2(IA) shall be considered. The insulating mounting part of the fuse-base shall neither be broken nor shall it show any signs of cracks.

#### 8.9.2.1 Test arrangement

See 8.9.2.1 of section I.

#### 8.9.2.2 Test method

See 8.9.2.2 of section I.

#### 8.9.2.3 Acceptability of test results

The gripping lugs shall remain fully operational, and the length of the neck (2,5 + 0,5/0) mm in particular shall not be exceeded by more than 2 mm, in keeping with the dimensions *d* of Figure 1(IA). The same applies to the maximum values of dimension $c_1$.

#### 8.11.1.2 Mechanical strength of the fuse-base

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

The test to verify the contact force of fuse-bases is performed on three unused fuse-bases as supplied. A test-link made of hardened steel with polished and chrome-plated surfaces is inserted three times in the fuse-base. The dimensions of the blade contacts of the fuse-link are identical with the dimensions given in Figure 1(IA).

When pulling steadily by means of suitable test equipment, the withdrawal force *F* measured (see Figure 8(I)) shall be found to lie within the limits specified in Table J of section I.

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

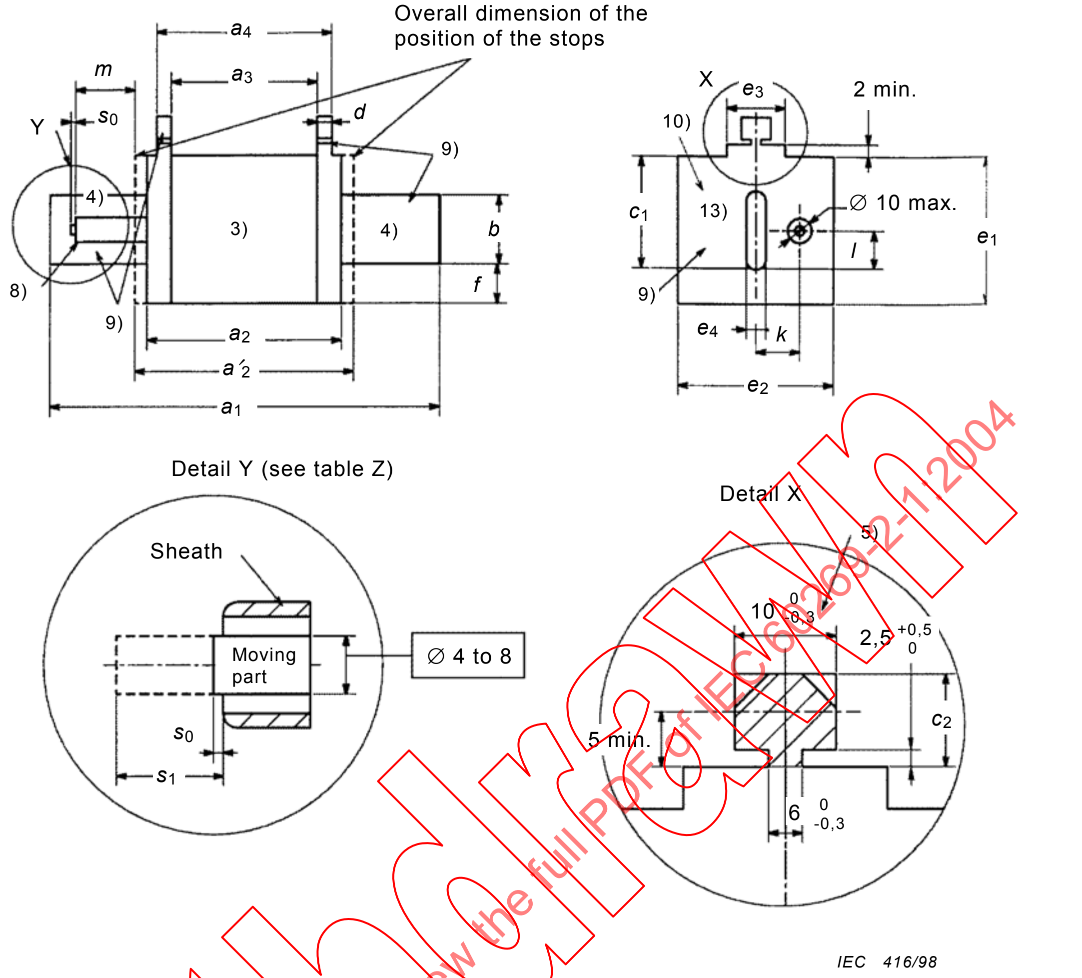
After this test, the contact pieces of the fuse-base shall not have moved to such an extent as to affect the further use of the fuse-base. The insulating mounting part of the fuse-base shall neither be broken nor show any cracks.

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

See 8.11.1.8 of section I.

**8.11.2.4.1 Test method**

See 8.11.2.4.1 of section I.



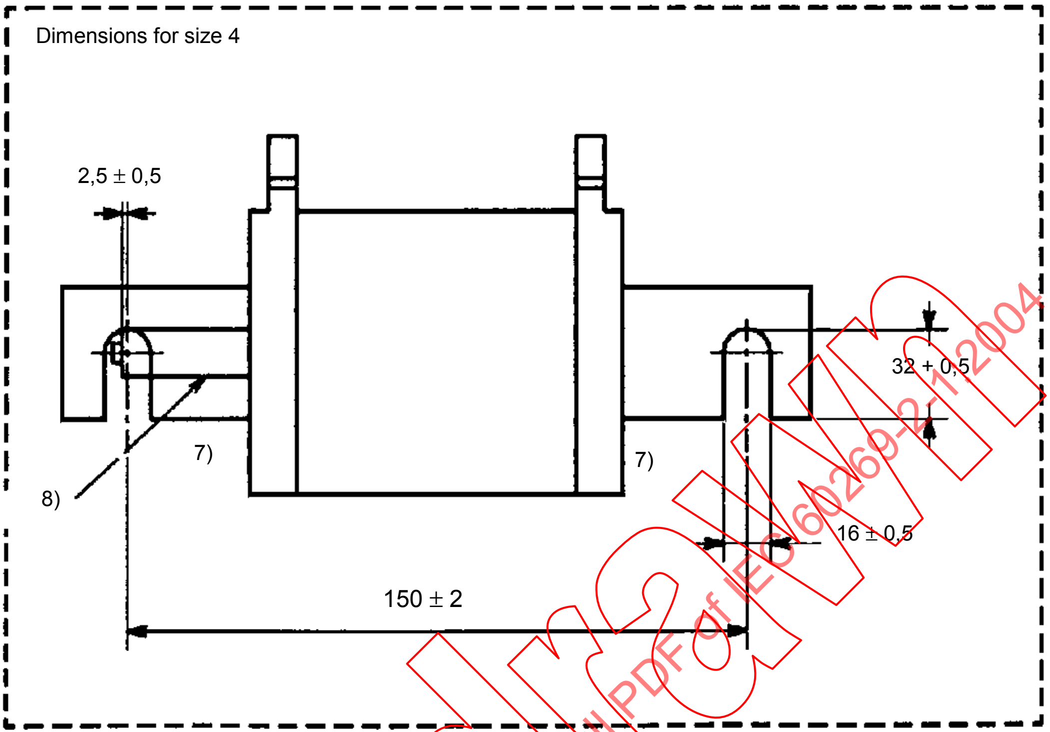

*Dimensions in millimetres*

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

**Figure 1(IA*) – Fuse-links with blade contacts with striker** *(continued)*



* Refers to section IA.




IEC 492/04

*Dimensions in millimetres*

Maximum values of the rated power dissipation $P_n$

| Size | gG | | | | aM | | | |
|---|---|---|---|---|---|---|---|---|
| | **AC 500 V** | | **AC 690 V** | | **AC 500 V** | | **AC 690 V** | |
| | $I_n$ A | $P_n$ W | $I_n$ A | $P_n$ W | $I_n$ A | $P_n$ W | $I_n$ A | $P_n$ W |
| 00 | 100/160 | 7,5/12 | 100 | 12 | 100 | 7,5 | 100 | 12 |
| 0 | 160 | 16 | 100 | 25 | 160 | 16 | 100 | 25 |
| 1 | 250 | 23 | 200 | 32 | 250 | 23 | 250 | 32 |
| 2 | 400 | 34 | 315 | 45 | 400 | 34 | 400 | 45 |
| 3 | 630 | 48 | 500 | 60 | 630 | 48 | 630 | 60 |
| 4 | 1 000 | 90 | 800 | 90 | 1 000 | 90 | 1 000 | 90 |
| 4a | 1 250 | 110 | 1 000 | 110 | 1 250 | 110 | 1 250 | 110 |

**Figure 1(IA*) – Fuse-links with blade contacts with striker** *(continued)*



* Refers to section IA.

Reference A:

| Size | $a_1$ 1) | $a_2$ 2) | $a'_2$ | $a_3$ 1) | $a_4$ 1) | $b$ min. 12) | $c_1$ ±0,8 | $c_2$ | $d$ 5) | $e_1$ max. 6) | $e_2$ max. 6) | $e_3$ | $e_4$ ±0,2 | $f$ max. | k | l | m |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 125 ± 2,5 | 68-8 | $73^{+0}_{-1,5}$ | $62^{+3}_{-1,5}$ | $68^{+1,5}_{-3}$ | 15 | 35 | 11-2 | $2^{+1,5}_{-0,5}$ | 48 | 45 | 20 ± 5 | 6 | 15 | 14,5 | 14 | 25 ± 0,5 |
| 1 | 135 ± 2,5 | 75-10 | $79^{+0}_{-1,5}$ | 62 ± 2,5 | 68 ± 2,5 | 20 | 40 | 11-2 | $2,5^{+1,5}_{-0,5}$ | 53 | 52 | $20^{+5}_{-2}$ | 6 | 15 | 16 | 14,5 | 25,5 ± 0,5 |
| 2 | 150 ± 2,5 | 75-10 | $79^{+0}_{-1,5}$ | 62 ± 2,5 | 68 ± 2,5 | 25 | 48 | 11-2 | $2,5^{+1,5}_{-0,5}$ | 61 | 60 | $20^{+5}_{-2}$ | 6 | 15 | 19 | 14,5 | 25,5 ± 05 |
| 3 | 150 ± 2,5 | 75-10 | $79^{+0}_{-1,5}$ | 62 ± 2,5 | 68 ± 2,5 | 32 | 60 | 11-2 | $2,5^{+1,5}_{-0,5}$ | 76 | 75 | $20^{+5}_{-2}$ | 6 | 18 | 24 | 14,5 | 25,5 ± 0,5 |
| 4 | 200 ± 3 | 90 max. | | 62 ± 2,5 | 68 ± 2,5 | 49 | 87 | 11-2 | $2,5^{+1,5}_{-0,5}$ | 110 | 105 | $20^{+5}_{-2}$ | 8 | 25 | 27,5 | 14,5 | |

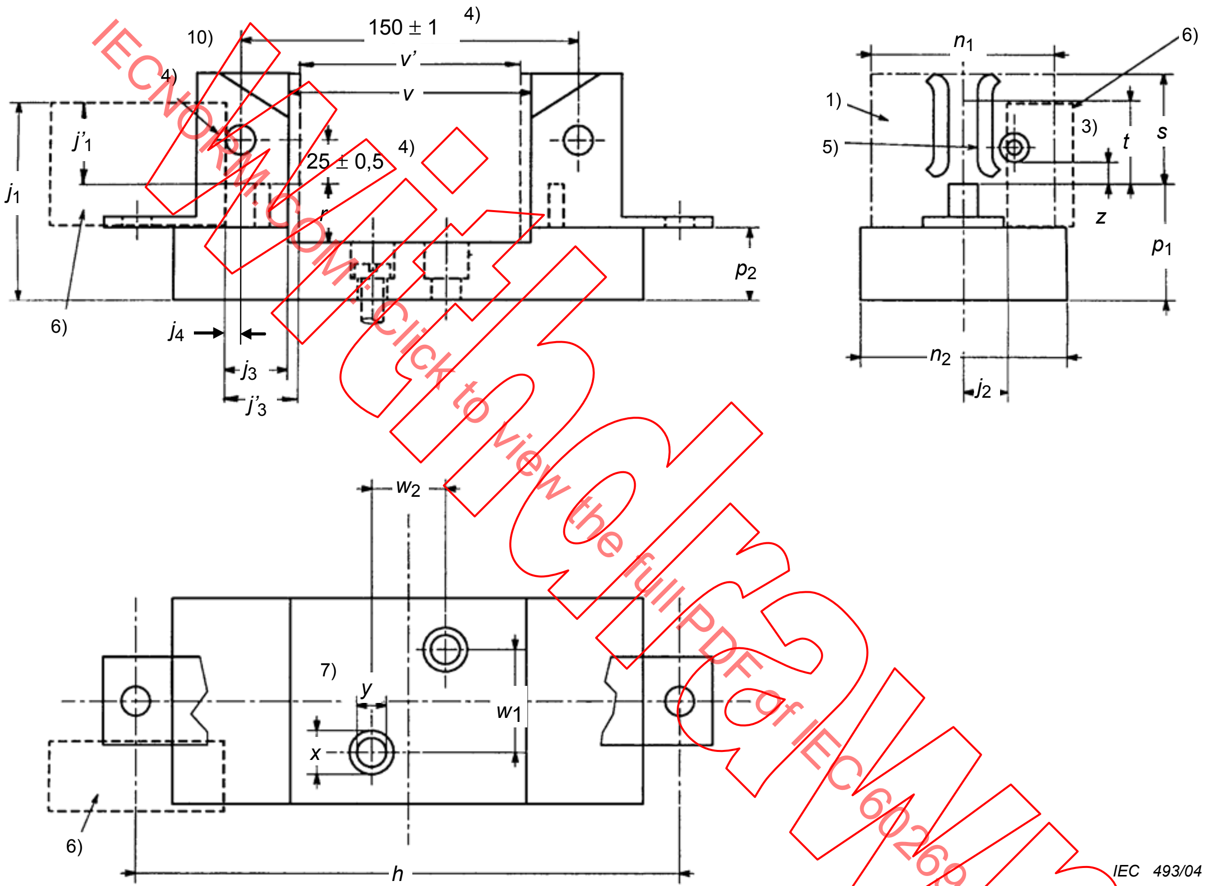
Reference B:

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

*Dimensions in millimetres*

1) The centres of the dimensions $a_1$, $a_3$ and $a_4$ shall not deviate from the centre of $a_2$ by more than 1,5 mm.
2) The dimension $a_2$ shall be observed within the total area $b_{min}/2$ measured from the lower edge of the blade over a width of at least 4 mm on both sides of the blade. Outside this area, the dimension may be less than the values indicated for $a_2$.
3) Insulating material.
4) The contact surfaces may be plane or provided with ribs.
5) Attachment for replacement handle (detail X).
6) Maximum dimensions of the enclosure of the fuse-link. Within these limits, the fuse-links may be of any form, for example, square, rectangular, circular, oval, polygonal, etc.
7) The slots are mandatory for size 4 fuse-links.
8) Striker.
9) Live parts, gripping-lugs can be insulated.
10) With the exception of the attachment for the replacement handle (detail X), the endplates shall not protrude radially from the insulation body.
11) Only to be used with a swivel unit that has an interlocking device.
12) As far as overlapping of rated currents exists within the sizes 0, 1, 2 and 3 the dimension of the smaller size is permitted.
13) The edge of blade contacts can be round or of any appropriate shape.

**Figure 1(IA) – Fuse-links with blade contacts with striker** *(concluded)*




*Dimensions in millimetres*

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

**Figure 2(IA) – Fuse-bases for fuse-links with blade contacts with striker** *(continued)*

Reference A:

| Size | *h* ±1,5 7) | *n₁* max. | *n₂* max. | *p₁* max. | *p₂* ±1,5 | *r* min. | *s* max. | *t* min. | *v* | *w₁* 7) | *w₂* 7) | *x* min. 7) | *y* ±0,5 7) | *z* max. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 150 | 44 | 52 | 48 | - | 17 | 25 | 15 | 74+3 | 0±0,7 | 25±0,7 | 14 | 7,5 | 3 |
| 1 | 175 | 52 | 60 | 55 | 35 | 17 | 38 | 21 | 80+3 | 30±0,7 | 25±0,7 | 20 | 10,5 | 5 |
| 2 | 200 | 60 | 68 | 60 | 35 | 17 | 46 | 27 | 80+3 | 30±0,7 | 25±0,7 | 20 | 10,5 | 5 |
| 3 | 210 | 75 | 83 | 68 | 35 | 20 | 58 | 33 | 80+3 | 30±0,7 | 25±0,7 | 20 | 10,5 | 5 |
| 4 | - | - | - | - | - | 27 | 84 | 50 | 97 min. | - | - | - | - | 5 |

*Dimensions in millimetres*

Reference B:

| Size | *h* ±1,5 7) | *n₁* max. | *n₂* max. | *p₁* max. | *p₂* ±1,5 | *r* min. | *s* max. | *t* min. | *v* | *v'* | *w₁* 7) | *w₂* 7) | *x* min. 7) | *y* ±0,5 7) | *z* max. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 00 | 100 | 30 | 38 | 40 | - | 17 | 21 | 15 | 56,5+1,5 | 55-1 | 0±0,7 | 25±0,7 | 14 | 7,5 | 3 |
| 1 | 175 | 52 | 60 | 55 | 35 | 17 | 38 | 21 | 80+3 | 76-1 | 30±0,7 | 25±0,7 | 20 | 10,5 | 5 |
| 2 | 200 | 60 | 68 | 60 | 35 | 17 | 46 | 27 | 80+3 | 76-1 | 30±0,7 | 25±0,7 | 20 | 10,5 | 5 |
| 3 | 210 | 75 | 83 | 68 | 35 | 20 | 58 | 33 | 80+3 | 76-1 | 30±0,7 | 25±0,7 | 20 | 10,5 | 5 |
| 4a 9) | 270 | 102 | 115 | - | 40 | 32 | 84 | 50 | 110±15 | - | 45±0,7 | 30±0,7 | 36 | 14 | 6 |

*Dimensions in millimetres*

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

**Figure 2(IA) – Fuse-bases for fuse-links with blade contacts with striker** *(continued)*

1) This area is considered to be live.

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

3) Height of contact surface. It shall also be possible to insert fuse-links with blade contacts according to figure 1(IA), even if the contact surface is not smooth but grooved or divided.

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

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

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

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

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

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

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

Reference A:

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

*Dimensions in millimetres*

Reference B:

| **Size** | $j_1'$ | $j_2$ | $j_3'$ | |
|---|---|---|---|---|
| | **min.** | **max.** | **min.** | **max.** |
| 00 | 21,5 | 0 | 17,5 | 19,5 |
| 1 | 30,5 | 13,7 | 24,5 | 26,5 |
| 2 | 27,3 | 16,2 | 24,5 | 26,5 |
| 3 | 35,3 | 17,0 | 24,5 | 26,5 |
| 4a | | 24,0 | | |

*Dimensions in millimetres*

**Figure 2(IA) – Fuse-bases for fuse-links with blade contacts with striker** *(concluded)*

## Section IB – Fuse-rails (NH fuse system)

### 1.1 Scope

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

### 2.1.13 Fuse-rails

Fuse-rails combine three single-pole fuse-bases longitudinally arranged in one unit. One terminal of each pole (generally called "busbar terminal") is directly connected with or without special clamps to one phase of a three-phase busbar system. The other terminals ("cable terminals") are prepared to receive outgoing or incoming conductors.

### 5.2 Rated voltage

Subclause 5.2 of section I applies.

### 5.3.2 Rated current

The rated current of the different sizes of the fuse-rails is given in Figure 1(IB).

### 5.5.1 Rated power acceptance

The rated power acceptance of a fuse-rail is given in Figure 1(IB).

### 6 Markings

Clause 6 of section I applies.

### 7.1 Mechanical design

The dimensions of fuse-rails are given in Figure 1(IB).

### 7.1.2 Connections, including terminals

Subclause 7.1.2 of section I applies.

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

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

| Size | Rated current of the fuse-rail<br>A | Cross-sectional area ranges<br>mm² | |
|---|---|---|---|
| | | Cu | Al |
| 00 | 160 | 6 to 70 | 25 to 95 |
| 1 | 250 | 25 to 120 | 35 to 150 |
| 2 | 400 | 50 to 240 | 70 to 300 |
| 3 | 630 | No values available | |

## 7.2 Insulating properties

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

### 8.1.6 Testing of fuse-holders

Fuse-rails shall be subjected to the tests according to Table VIII. This table replaces Table VIII in section I and Table 8 in IEC 60269-1.

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

| Test according to subclause | | Number of fuse-rails | | | |
|---|---|---|---|---|---|
| | | 1 | 1 | 1 | 2 |
| 8.1.4 | Dimensions | X | | | |
| 8.2 | Insulating properties | X | | | |
| 8.11.2.2 | Resistance to abnormal heat and fire | X | | | |
| 8.11.1.2 | Mechanical strength of the fuse-base<br>– withdrawal force of contacts | | X | | |
| 8.3 | Temperature rise and power acceptance | | | X | |
| 8.11.1.1 | Mechanical strength of fuse-holders<br>– 100 mechanical operations | | | X | |
| 8.3 | Temperature rise | | | X | |
| 8.10.1.1 | Non-deterioration of contacts | | X | | |
| 8.11.1.2 | Mechanical strength of the fuse-base<br>– withdrawal force of contacts | | X | | |
| 8.5.5.1 | Verification of the peak withstand current of a fuse-base[1)] | | X | | |
| 8.9.1 | Verification of resistance to heat[2)] | | | X | |
| 8.11.2.4 | Non-deterioration of insulating parts of fuse-link and fuse-base | | | X | |
| 8.11.1.2 | Mechanical strength of the fuse-base<br>– terminal strength | | | X | |
| 8.10.1.2 | Non-deterioration of direct terminal clamps (if applicable) | X | | | X |
| 8.11.2.3 | Resistance to rusting | | X | | |

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

## 8.3 Verification of temperature rise and power dissipation

Subclause 8.3 of section I applies with the following modifications.

### 8.3.1 Arrangement of the fuse

Subclause 8.3.1 of section I applies with the following modifications:

The test arrangement for fuse-rails is given in Figure 2(IB).

---

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

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

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

**8.5.5.1.1 Arrangement of the fuse**

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

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

The test set-up for fuse-rails is given in Figure 2(IB).

The cross-sections of the busbars are taken from Figure 2(IB) or corresponding to the manufacturer's instructions.

**8.5.5.1.2 Test method**

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

**8.10 Verification of non-deterioration of contacts and direct terminal clamps**

Subclause 8.10 of section I applies unless otherwise stated below.

**8.10.1 Arrangement of the fuse**

Subclause 8.10.1 of section I applies with the following additions:

The three phases of one fuse-base rail according to Figure 1(IB) are connected in series for the test. The test arrangement is given in Figure 2(IB).

**8.10.1.2 Direct terminal clamps**

Subclause 8.10.1.2 of section I applies with the following additions:

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

**8.11.1.2 Mechanical strength of the fuse-base**

Subclause 8.11.1.2 of section I applies with the following additions:

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

**8.11.2.4.1 Test method**

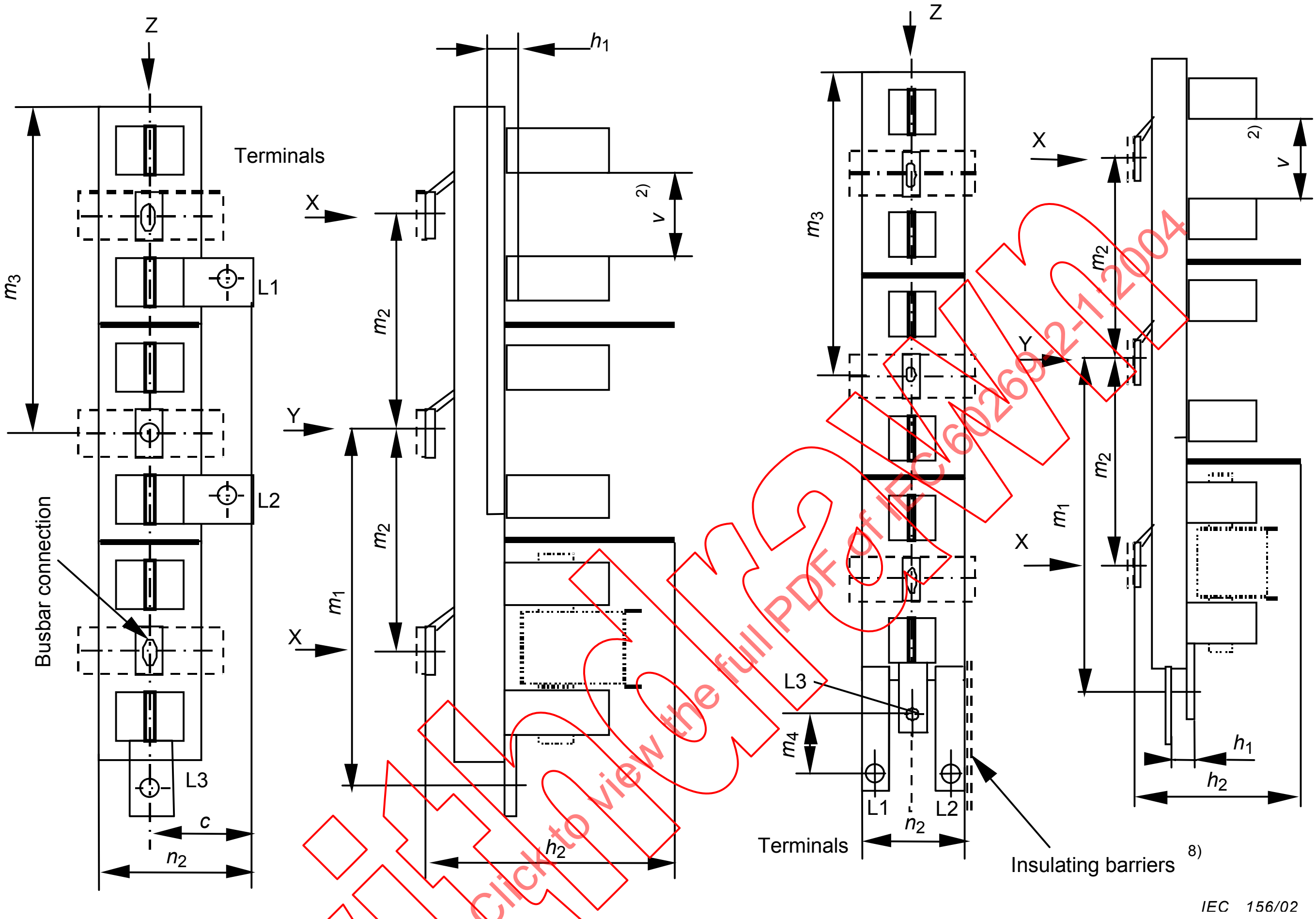
Subclause 8.11.2.4.1 of section I applies with the following clarification:

One fuse-rail is tested.

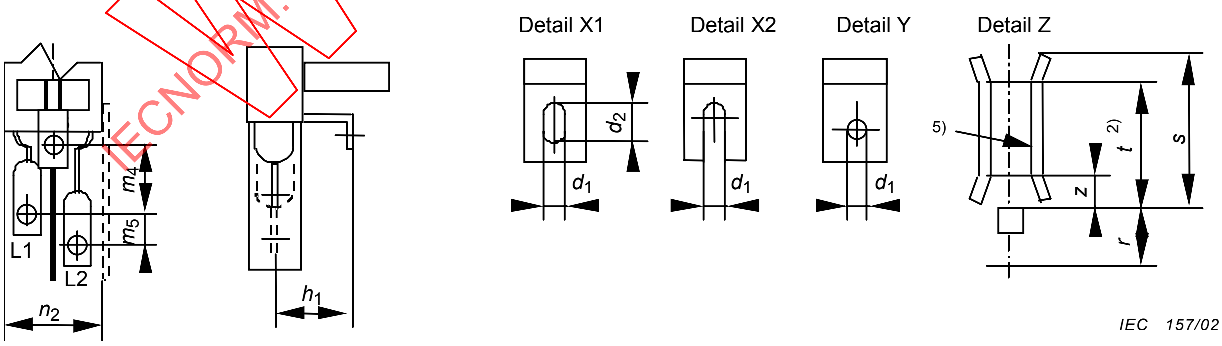
*Dimensions in millimetres*

Reference A fuse-rail
Terminals on the right

Reference B fuse-rail
Terminals at the bottom




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




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

**Figure 1(IB) – Fuse-rails for fuse-links with blade contacts** (*continued*)

*Dimensions in millimetres*

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

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

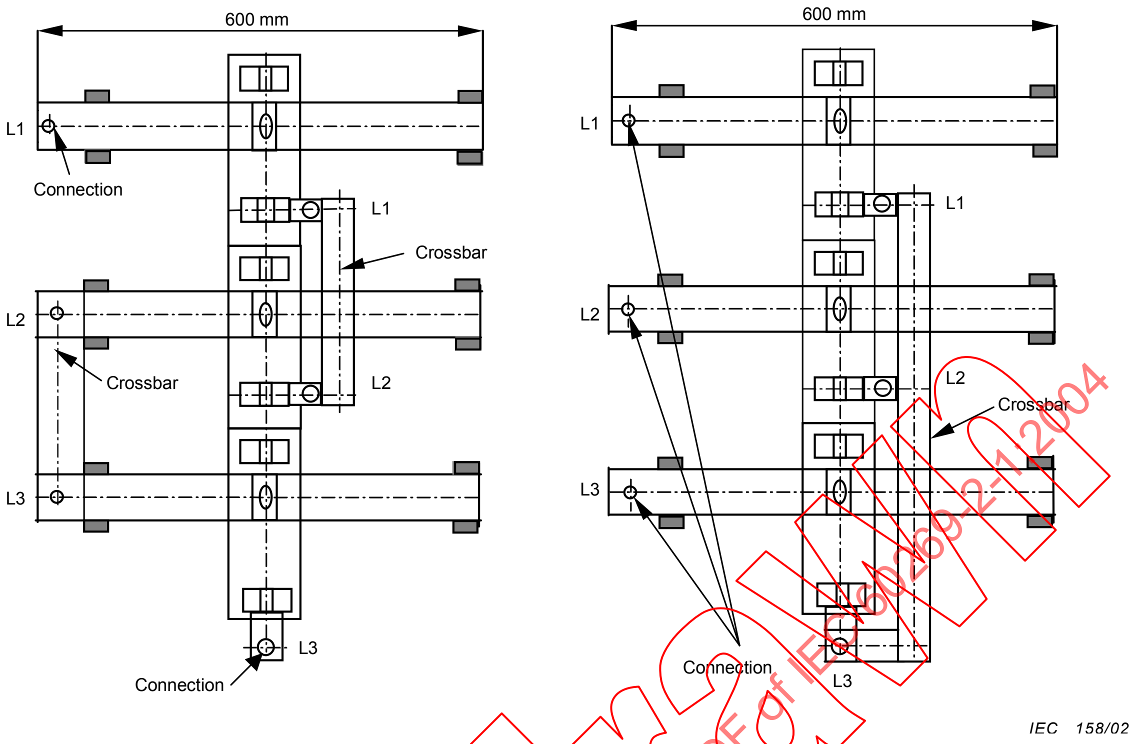
** Maximum overall dimensions.

| Size | Rated current per phase A | Rated power acceptance W |
|---|---|---|
| 00 | 160 | 12 |
| 1 | 250 | 32 |
| 2 | 400 | 45 |
| 3 | 630 | 60 |

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

Addition to footnote 2) – Dimension *v* may also be met between insulating contact covers.

**Figure 1(IB) – Fuse-rails for fuse-links with blade-contacts** *(concluded)*




Single-phase Three-phase

Design reference A

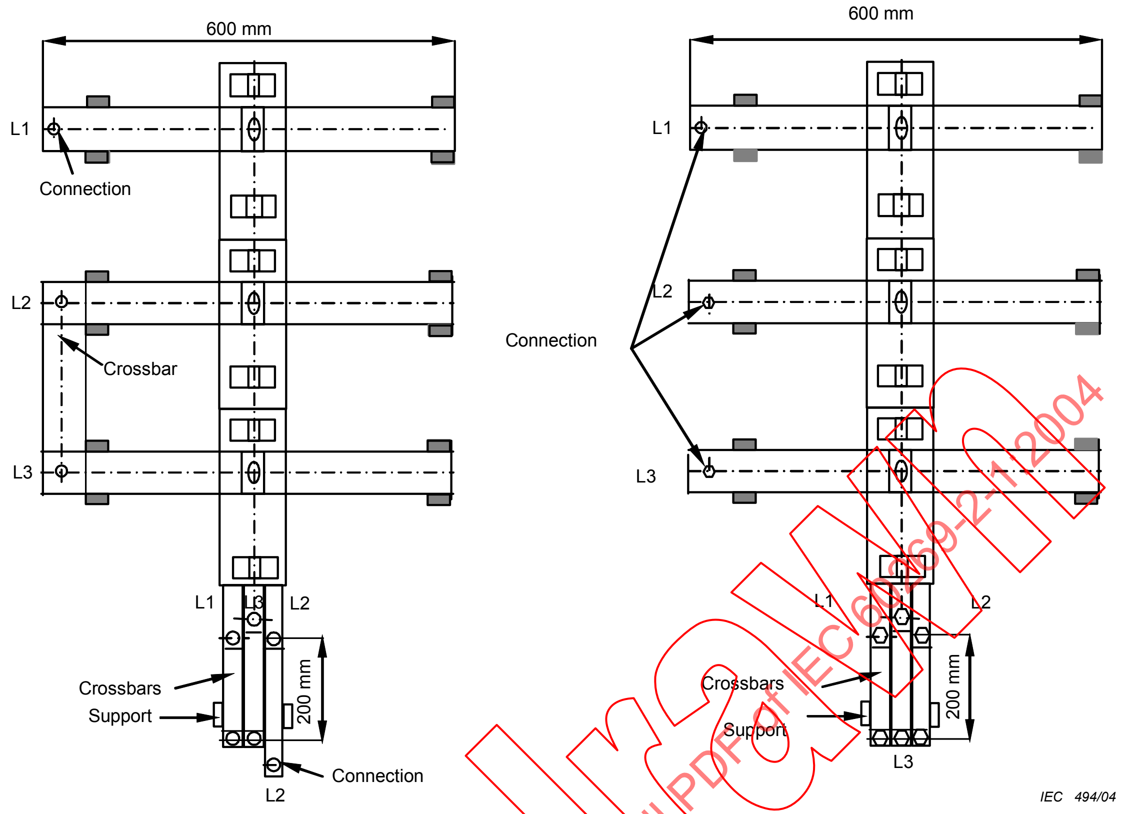
Cross-section of copper busbars: 30 mm or 32 mm × 5 mm for sizes 00 and 1
30 mm or 32 mm × 10 mm for size 2
40 mm × 10 mm for size 3

For tests according to 8.3.4.1 and 8.10: connections according to 8.3.1 of IEC 60269-1

For test according to 8.5.5.1: suitable crossbars and connections

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

**Figure 2(IB) – Test arrangement for fuse-rails** *(continued)*




Single-phase Three-phase

Design reference B and C

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

**Figure 2(IB) – Test arrangement for fuse-rails** *(concluded)*

## Section IC – Fuse-bases for busbar mounting (40 mm system) (NH fuse system)

### 1.1 Scope

The following additional requirements apply to combined single-pole fuse-bases sizes 00 for busbar systems having a centre distance of 40 mm, insofar as they are not adequately covered by section I. Single-pole fuse-bases sizes 00 up to 4a for mounting on other busbar systems shall be treated like fuse-bases according to Figure 2(I).

### 2.1.12 Fuse-base for 40 mm busbar systems

Combined single-pole fuse-bases (Figure 1(IC)) that are fixed on a 40 mm busbar system by the use of special clamping means. Such fuse-bases may be fitted together for a three-pole version (Figure 2(IC)) or a three-pole version with two outlets per pole, the latter named "tandem fuse-base" (Figure 3(IC)).

### 5.2 Rated voltage

Subclause 5.2 of section I applies.

### 5.3.2 Rated current

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

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

### 5.5.2 Rated power acceptance of tandem fuse-bases

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

## 6 Markings

Clause 6 of section I applies.

### 7.1 Mechanical design

Dimensions of fuse-bases for 40 mm busbar system are given in Figures 1(IC), 2(IC) and 3(IC).

### 7.1.2 Connections, including terminals

Subclause 7.1.2 of section I applies.

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

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

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

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

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

| Size | Rated currents of the fuse-bases A | Cross-sectional area ranges mm² | |
|---|---|---|---|
| | | Cu | Al |
| 00 | 63 | 2,5 to 25 | – |

### 7.1.5 Construction of a fuse-base for busbar mounting

Busbar mounted fuse-bases according to Figures 1(IC), 2(IC) and 3(IC) shall have partition walls between adjacent live parts. Fuse-bases should be designed in such a way that partition walls can subsequently be fixed. Measures shall be taken to fix outer walls if necessary.

It shall be possible to insert fuse-links into the fuse-bases and to pull them out by means of a replacement handle according to Figure 3(I).

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

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

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

The contact pieces shall be capable of accepting the blade contacts of fuse-links according to Figure 1(I). The contact pressure has to be guaranteed by spring loaded contact pieces or other adequate means.

Dimensions not given in Figures 1(IC), 2(IC) and 3(IC) can be found in Figure 2(I).

## 8.3 Verification of temperature rise and power dissipation

Subclause 8.3 of section I applies with the following modifications.

### 8.3.1 Arrangement of the fuse

Subclause 8.3.1 of section I applies with the following modifications:

The test arrangements including the conductors are given in Figures 4a(IC) and 4b(IC). The cross-section of the busbar fitting with the contact system of the sample shall not be smaller than 12 mm × 5 mm. If the contact-making fastening of the fuse-base is achieved by screws, the torques given in Table GG shall be applied.

**Table GG – Torques to be applied to contact making screws**

| $I_n$ A | Size | Torque Nm |
|---|---|---|
| 2 × 63 | 00 | 6 |

#### 8.3.4.1 Temperature rise of the fuse-holder

Subclause 8.3.4.1 of section I applies except that the dummy fuse-link size 00 63 A is described in Figure 6(IC).

#### 8.5.5.1.1 Arrangement of the fuse

The test arrangement in Figure 5(IC) applies for fuse-bases for 40 mm busbar systems. These fuse-bases are always tested in a single-pole arrangement.

The cross-sections of the busbars are taken from Figure 5(IC) or corresponding to the manufacturer's instructions.

For tandem fuse-bases the following ranges of cut-off currents apply:

**Table HH – Test currents**

| Size | Cut-off current<br>kA |
|---|---|
| 00 | 4 … 5 * |

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

#### 8.9.1 Fuse-base

Subclause 8.9.1 of section I applies as far as not otherwise stated below.

#### 8.9.1.1 Test arrangement

The test arrangement for tandem fuse-bases is given in Figure 4b(IC). The dummy fuse-link is described in Figure 6(IC). When tandem fuse-bases are tested, the measuring equipment is suspended in the middle upper current path. The tests are generally performed on busbars. The support insulators of the busbars are aligned with the width of the samples in such a way that bending of the busbars is avoided. The cross-section of the busbar shall correspond to the fastening means of the test sample, and the cross-section shall not be smaller than 12 mm × 5 mm. If the contact making fastening is achieved by a screw, Table GG applies.

#### 8.9.1.3 Acceptability of test results

Subclause 8.9.1.3 of section I applies with references to Figures 1(IC) and 3(IC).

### 8.10 Verification of non-deterioration of contacts and direct terminal clamps

Subclause 8.10 of section I applies as far as not otherwise stated below.

#### 8.10.1 Arrangement of the fuse

Subclause 8.10.1 of section I applies with the following additions:

The dummy fuse-link for size 00 63 A is described in Figure 6(IC).

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

#### 8.10.2 Test method

Subclause 8.10.2 of section I applies with the following addition:

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

### 8.11 Mechanical and miscellaneous tests

Subclause 8.11 of section I applies.

#### 8.11.1.2 Mechanical strength of the fuse-base

Subclause 8.11.1.2 of section I applies with the following additions:

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

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

| Size | Rated current<br>A | Withdrawal force<br>$F_{min}$<br>N | <br>$F_{max}$<br>N |
|---|---|---|---|
| 00 | 63 * | 80 | 200 |

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

#### 8.11.2.4.1 Test method

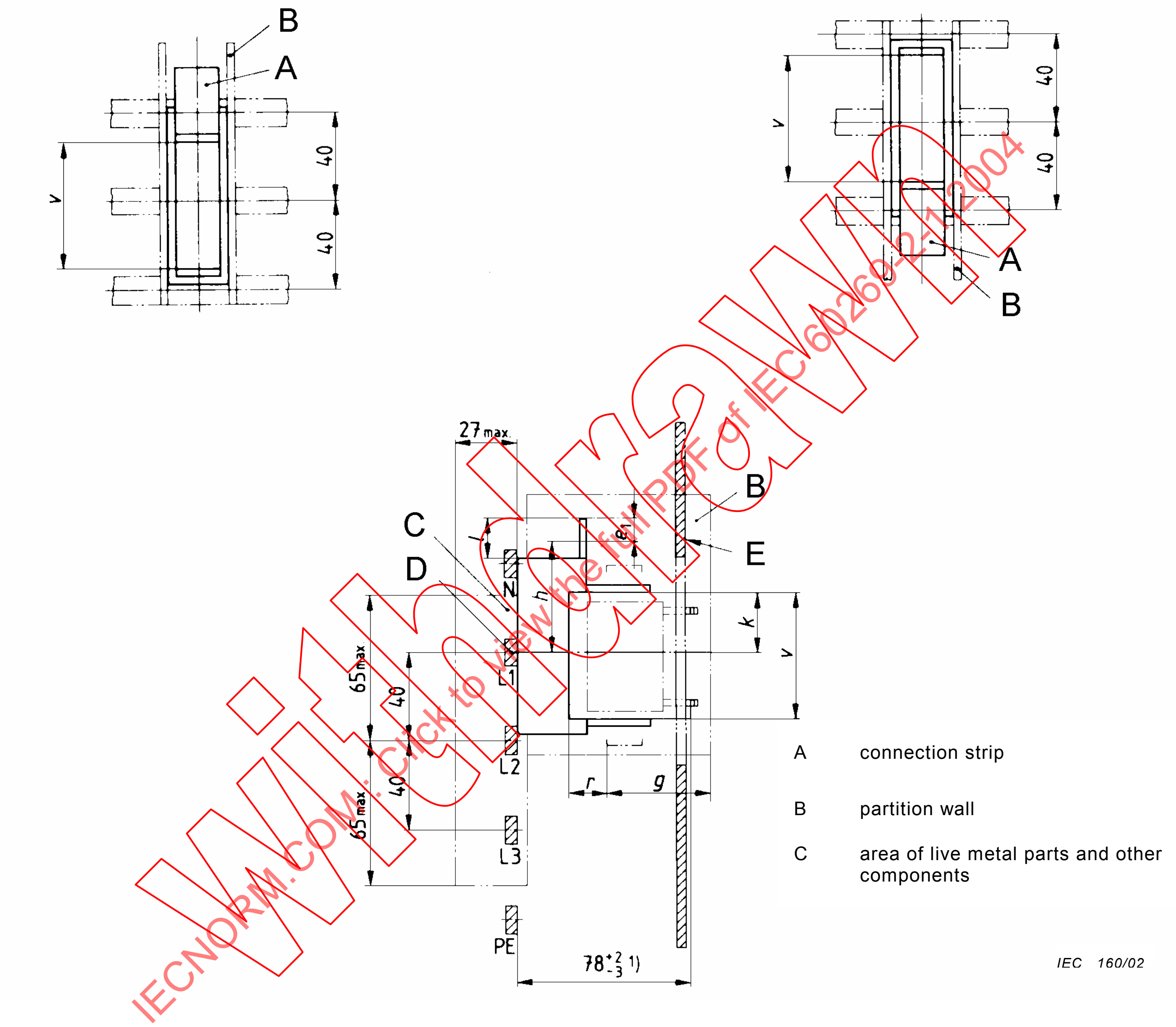
Subclause 8.11.2.4.1 of section I applies with the following clarification:

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

*Dimensions in millimetres*

Version O for top connection

Version U for bottom connection






| Size | *a* ±1 | *v* | *r* min. | *g* ±1 | *h* 3) $^{+2}_{-4}$ | *k* ±2,5 | $e_1$ 4) | *l* 4) |
|---|---|---|---|---|---|---|---|---|
| 00 | 33 | 56,5 ± 1,5 | 17 | 47 | 50 | 26,5 | 10 | 18 |

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

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

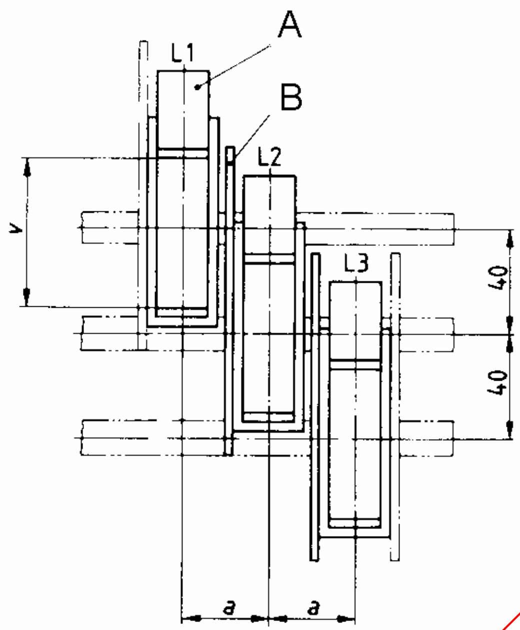
3) Preferred dimension for the use in meter boards.

4) Only for flat connections.

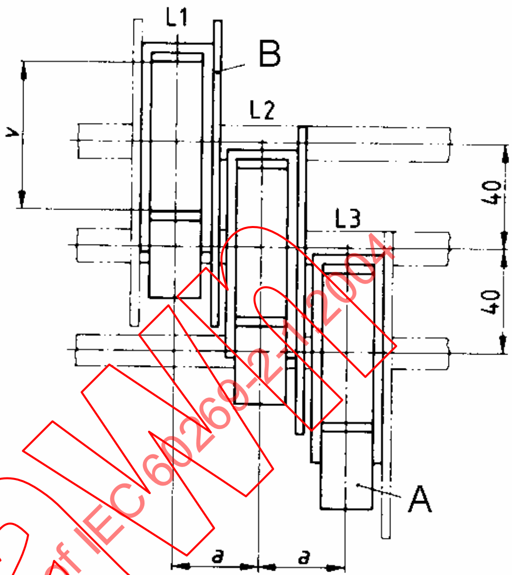
**Figure 1(IC) – Busbar mounting bases, 1 pole**

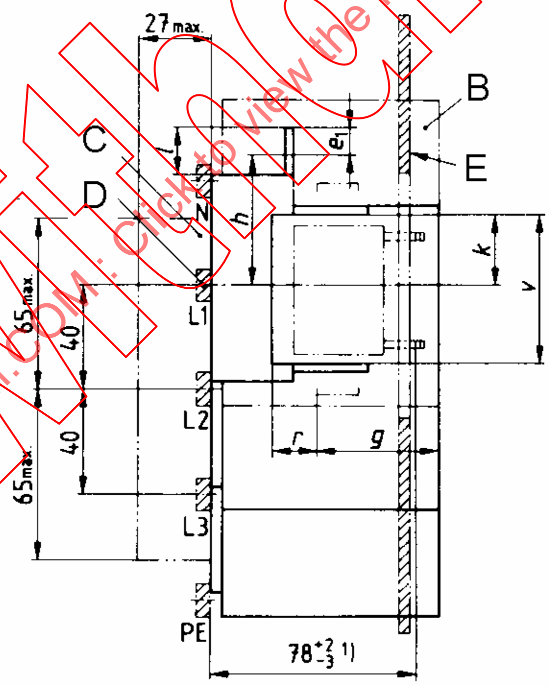
*Dimensions in millimetres*

Version O for top connection




Version U for bottom connection




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

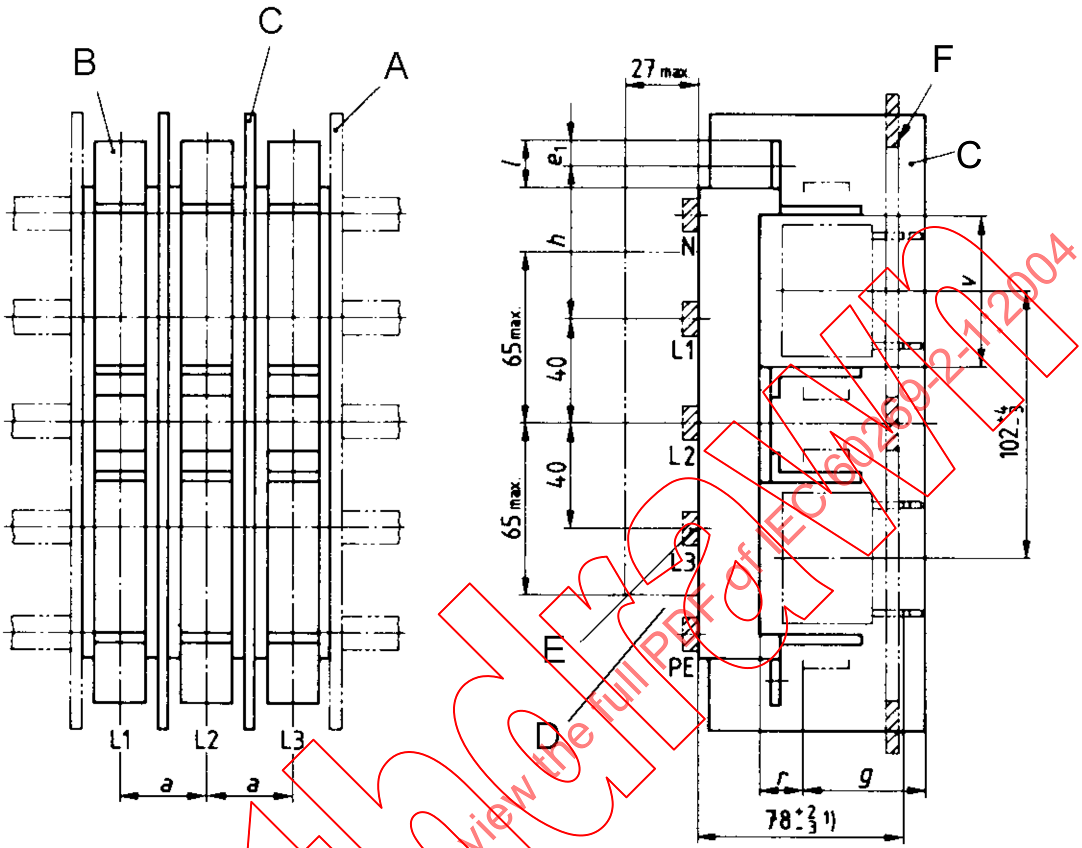
IEC 161/02

| Size | *a* ±1 | *v* | *r* min. | *g* ±1 | *h* 3) +2 −4 | *k* ±2,5 | $e_1$ 4) | *l* 4) |
|---|---|---|---|---|---|---|---|---|
| 00 | 33 | 56,5 ± 1,5 | 17 | 47 | 50 | 26,5 | 10 | 18 |
| For footnotes 1) to 4) see figure 1(IC). | | | | | | | | |

**Figure 2(IC) – Busbar mounting bases, 3 poles**

*Dimensions in millimetres*

Versions O and U for top and bottom connection

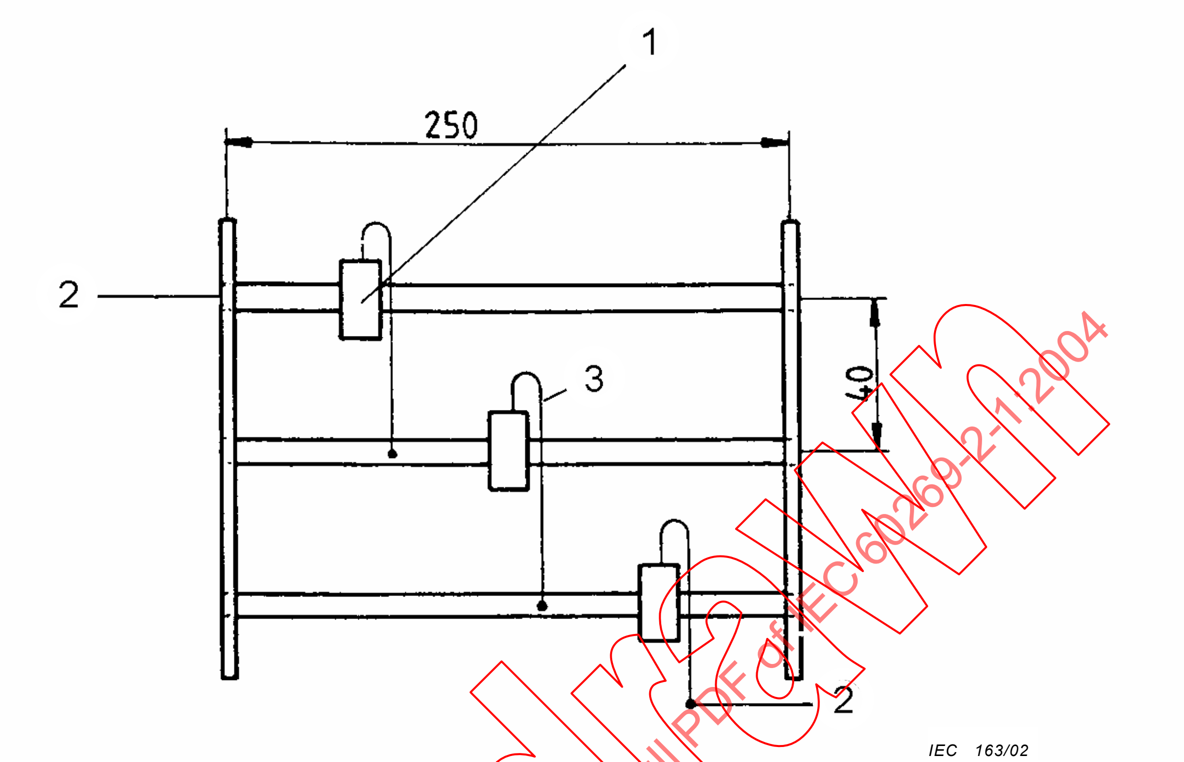



A outer partition wall
B connection strip
C partition wall
D area of live metal parts and other components
E contact area, see footnote 2)
F protection cover

| **Size** | ***a***<br>±1 | ***v***<br>±1,5 | ***r***<br>min. | ***g***<br>±1 | ***h*** 3)<br>+2 –4 | ***e*₁** 4) | ***l*** 4) |
|---|---|---|---|---|---|---|---|
| 00 | 33 | 56,5 ± 1,5 | 17 | 47 | 50 | 10 | 18 |
| For footnotes 1) to 4), see figure 1(IC). | | | | | | | |

**Figure 3(IC) – Busbar mounting base, size 00, 2 × 3 poles (tandem fuse-base)**

*Dimensions in millimetres*



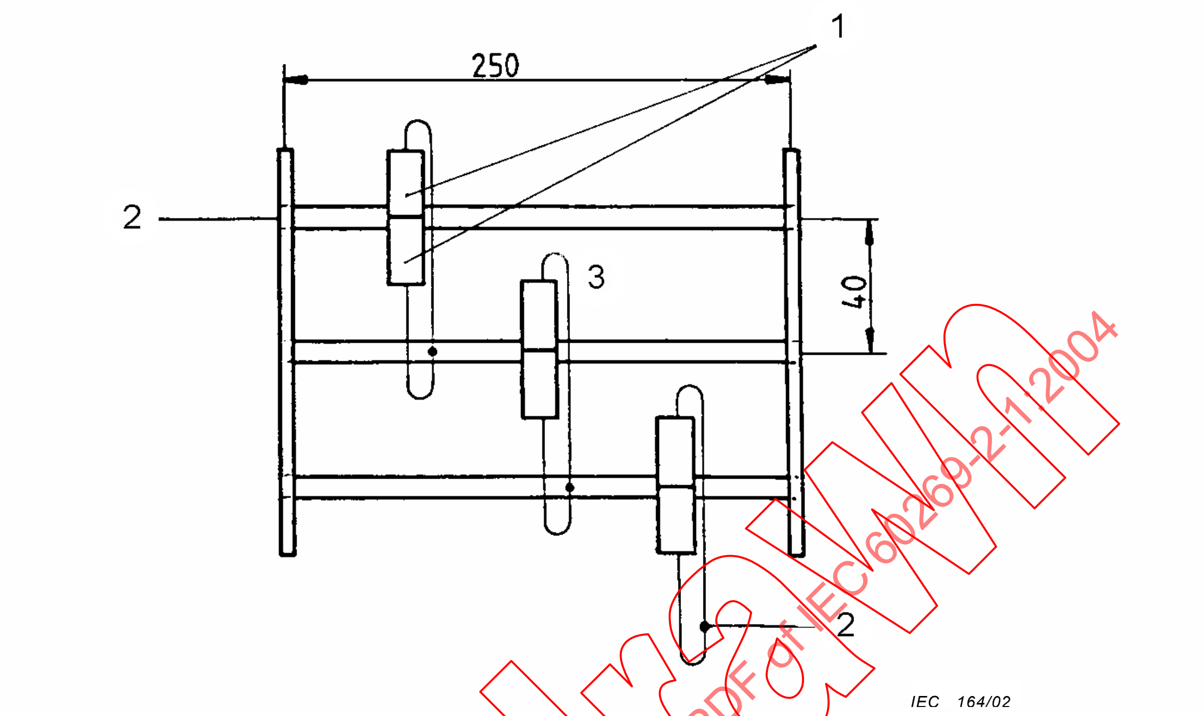

1 single pole (the three poles may be a unit)

2 connection

3 cable length of each cable 1 m

**Figure 4a(IC) – Test arrangement for single-pole and triple-pole fuse-bases for busbar-mounting according to 8.3.1**

*Dimensions in millimetres*



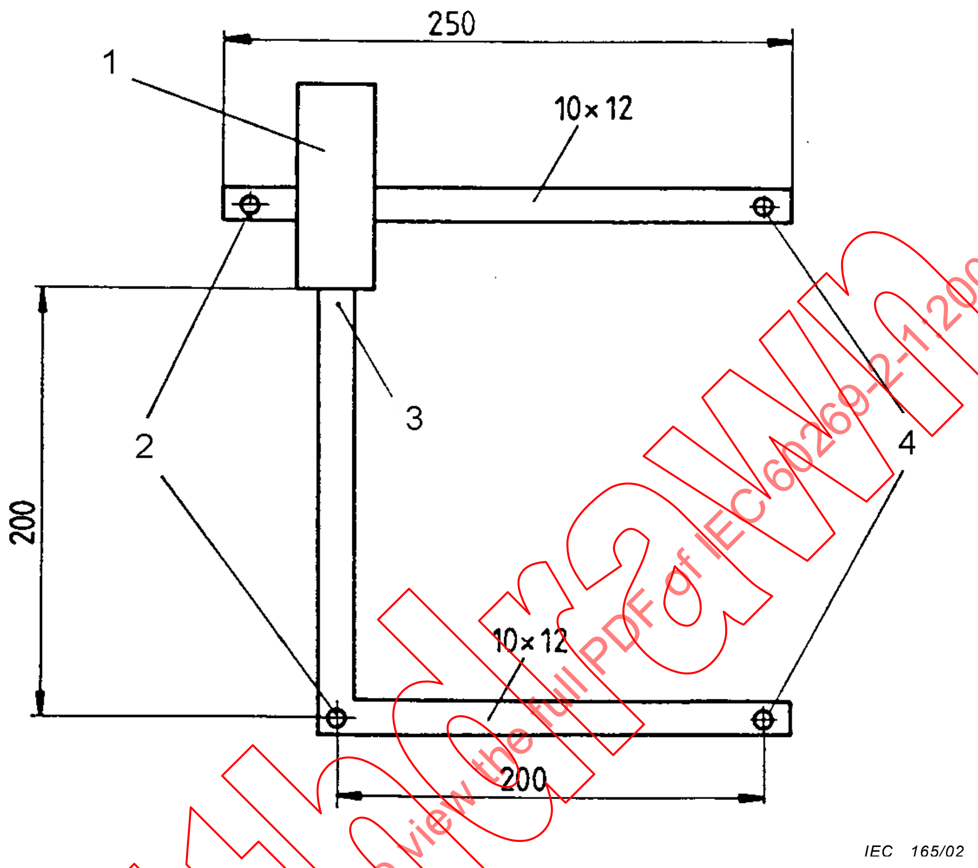

1 two single-pole fuse-bases in tandem arrangement
(6 single poles = 2 × 3 poles may be a unit)

2 connection

3 cable, length of each cable 1 m

**Figure 4b(IC) – Test arrangement for two single-pole and six single-pole fuse-bases in tandem arrangement for busbar-mounting according to 8.3.1**

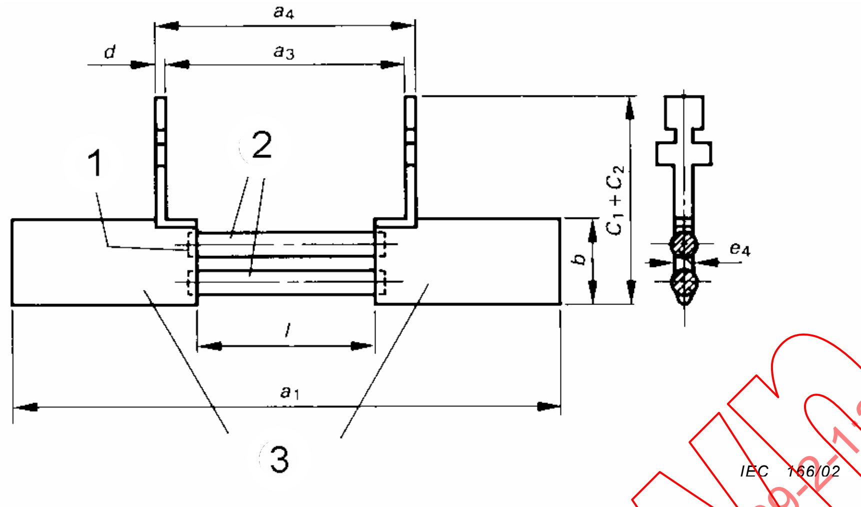
*Dimensions in millimetres*




1 single-pole sample (or one pole of a multi-pole sample)
2 support
3 for clamp terminal an adaptor is demanded
4 source

**Figure 5(IC) – Test arrangement for the verification of the peak withstand current**

*Dimensions in millimetres*




1 soldered

2 CuMn12Ni

3 copper alloy, silver-plated

For the dimensions of the gripping lugs and other dimensions see Figure 1(I), in section I.

| **Size** | $I_n$ A | *l* | *P* * W | *R* ** mΩ | **Bars** Number | Diameter |
|---|---|---|---|---|---|---|
| 00 | 63 | $30,5\ ^{+0}_{-3}$ | 7,5 | 1,88 | 1 | 3,5 |

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

**Figure 6(IC) – Dummy fuse-link**

# Section II – Fuses with fuse-links for bolted connections (BS bolted fuse system)

## 1.1 Scope

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

### 5.3.1 Rated current of the fuse-link

The maximum preferred rated currents are given in Figures 1(II*) and 1a(II*).

### 5.3.2 Rated current of the fuse-holder

The maximum preferred rated currents for the fuse-holder are given in Figure 2(II).

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

The maximum values of power dissipation of fuse-links are given in Figure 1(II).

The values of rated acceptable power dissipation of fuse-holders at rated current when tested in accordance with 8.3.1 are given in Figure 2(II).

## 5.6 Limits of time-current characteristics

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

In addition to the limits of pre-arcing time given by the gates and the conventional times and currents, the time-current zones, excluding manufacturing tolerances, are given in Figures 3(II) and 4(II). The tolerance on time-current characteristics shall not deviate by more than ±10 % in terms of current.

### 5.6.2 Conventional times and currents

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



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

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

* Refers to section II.

### 5.6.3 Gates

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

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

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

### 5.7.2 Rated breaking capacity

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

### 7.1 Mechanical design

The dimensions of fuse-links and fuse-bases are given in Figures 1(II) and 2(II).

### 7.1.2 Connections including terminals

Under consideration.

### 7.9 Protection against electric shock

Where standardized fuse-holders according to Figure 2(II) are used, the degree of protection against electric shock shall be at least IP2X for all three stages.

### 8.3 Verification of temperature rise and power dissipation

### 8.3.1 Arrangement of the fuse

The test arrangement for fuse-links is given in Figure 5(II). The test arrangement shall be mounted vertically.

### 8.3.3 Measurement of the power dissipation of the fuse-link

The points of measurement of power loss are given in Figure 5(II).

### 8.4 Verification of operation

### 8.4.1 Arrangement of the fuse

The test arrangement of the fuse-link is given in Figure 5(II). The test arrangement shall be mounted vertically.

### 8.5 Verification of breaking capacity

#### 8.5.1 Arrangement of the fuse

The test arrangement of the fuse-link is given in Figure 6(II).

#### 8.5.8 Acceptability of test results

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

### 8.10 Verification of non-deterioration of contacts

Subclause 8.10 of IEC 60269-1 applies.

#### 8.10.1 Arrangement of the fuse

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

The dummy fuse-links shall have dimensions that comply with Figure 1(II) for those references that are accommodated in the standardized fuse-holders in Figure 2(II).

The power dissipation of the dummy fuse-links shall be the rated acceptable power dissipation of the fuse-holders given in Figure 2(II) when tested in the standardized power dissipation test rig given in Figure 5(II).

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

The following test values have to be applied:

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

Load period: 25 % of the conventional time

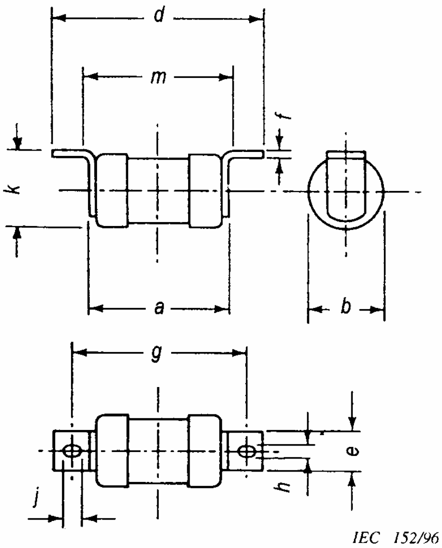
No-load period: 10 % of the conventional time.

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

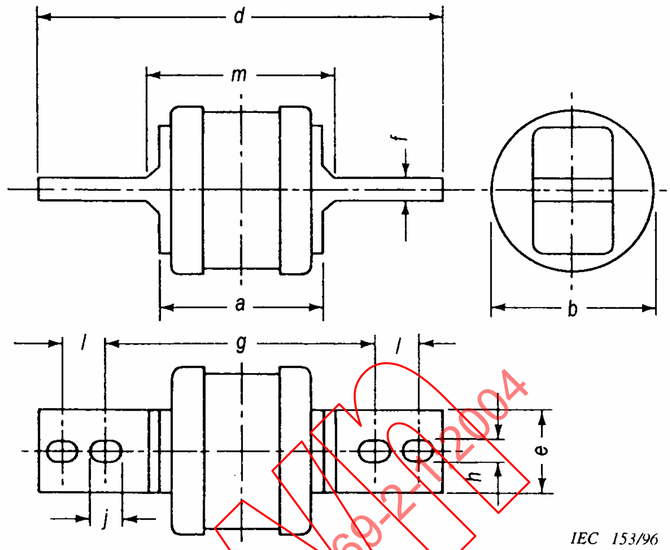
#### 8.10.3 Acceptability of the results

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

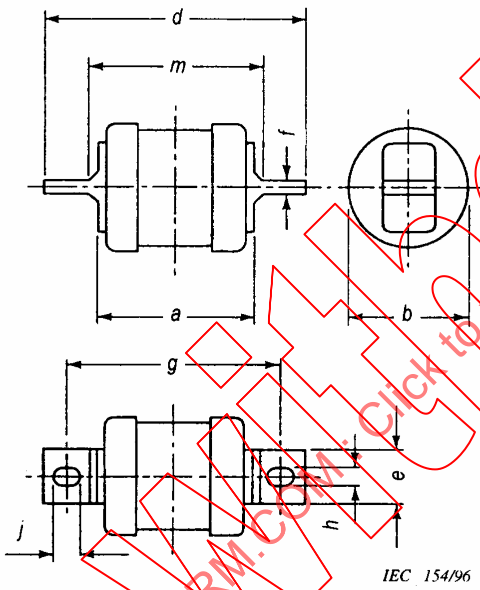
After 750 cycles, if necessary, the temperature shall not exceed the values measured before the beginning of the tests by more than 20 K.



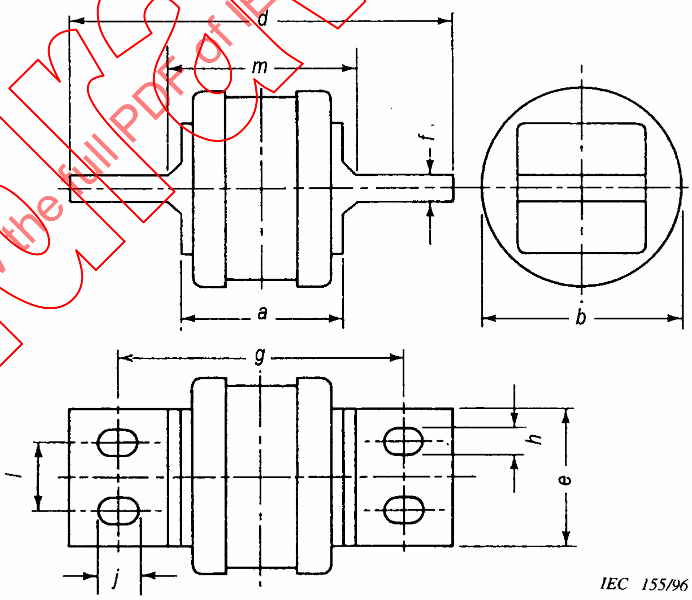

Size A fuse-link




Size C fuse-link




Size B fuse-link




Size D fuse-link



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

**Figure 1(II*) – Fuse-links for bolted connection – Sizes A, B, C and D** *(continued)*

* Refers to section II.

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

*Dimensions in millimetres*

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

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

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

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

**Figure 1(II*) – Fuse links for bolted connection – Sizes A, B, C and D** *(concluded)*)

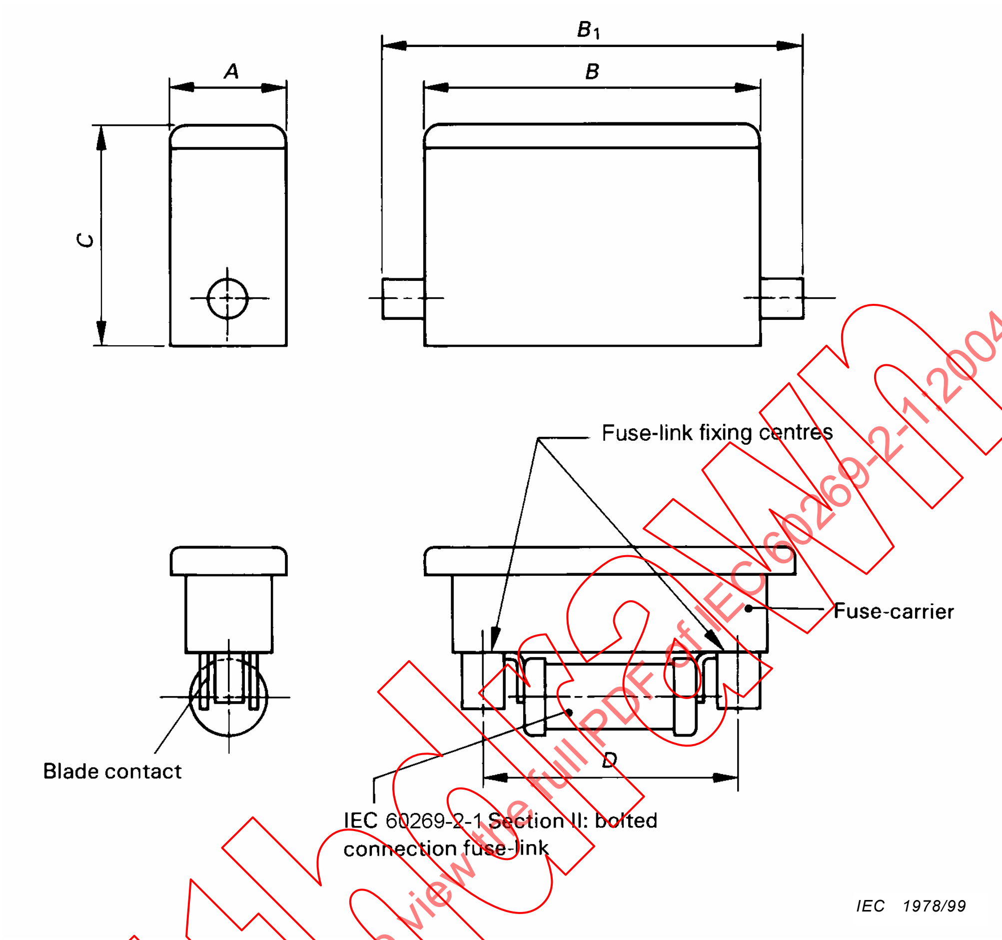
**Standardized "gM" fuse-links**

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

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

**Figure 1a(II*) – Fuse-links for bolted connection – Sizes A and B**

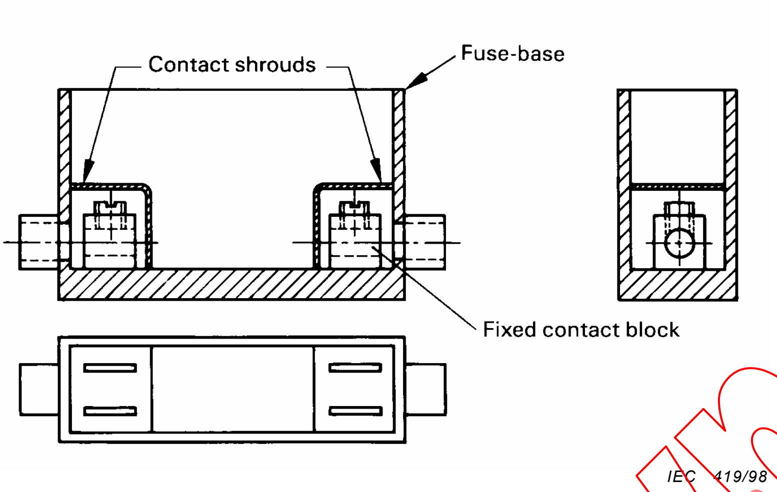
* Refers to section II.




*Dimensions in millimetres*

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

**Figure 2(II) – Typical fuse-holder** *(continued)*




*Dimensions in millimetres*

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

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

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

**Figure 2(II) – Typical fuse-holder** *(concluded)*

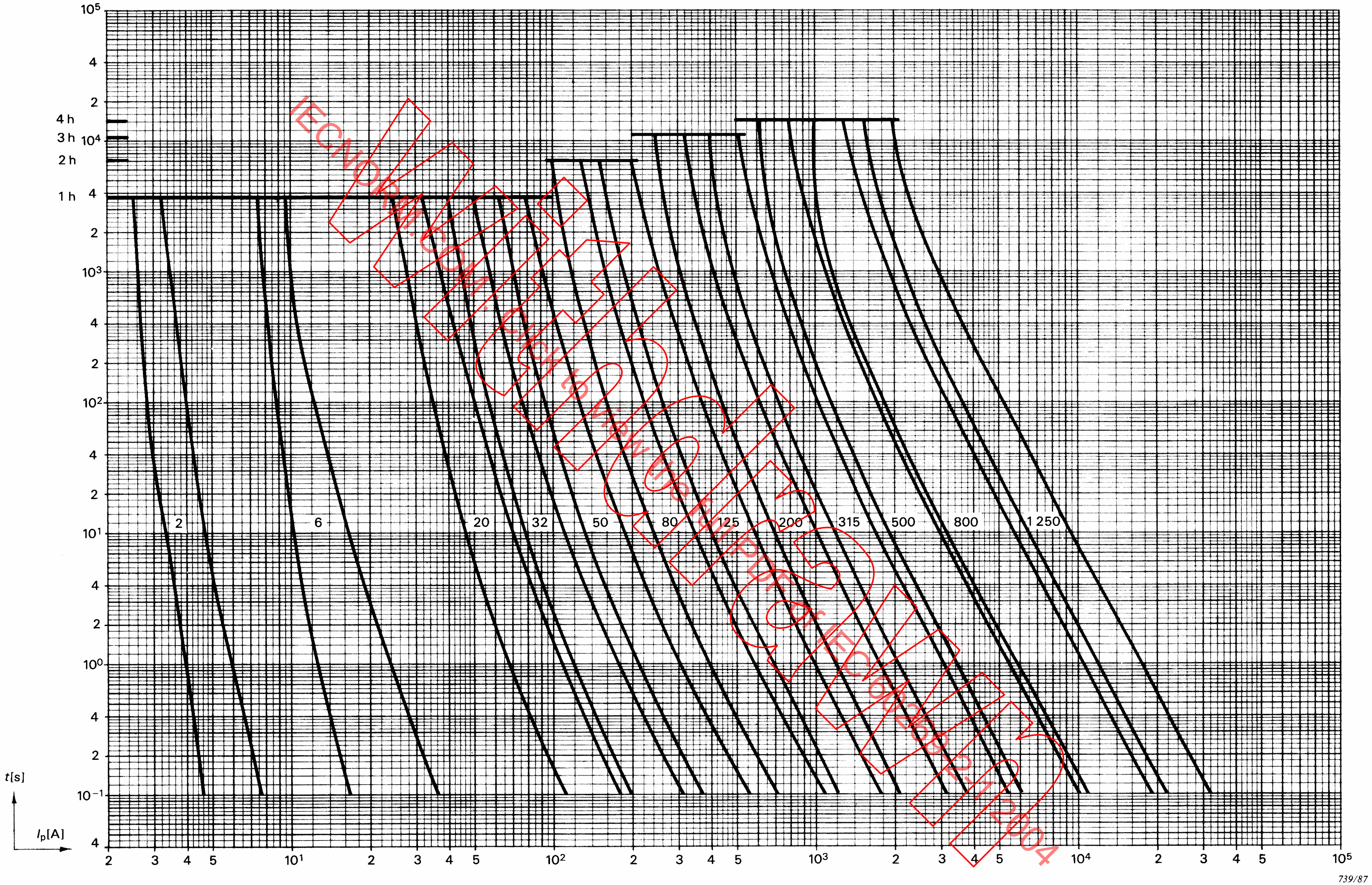



**Figure 3(II) – Time-current zones for "gG" fuse-link**

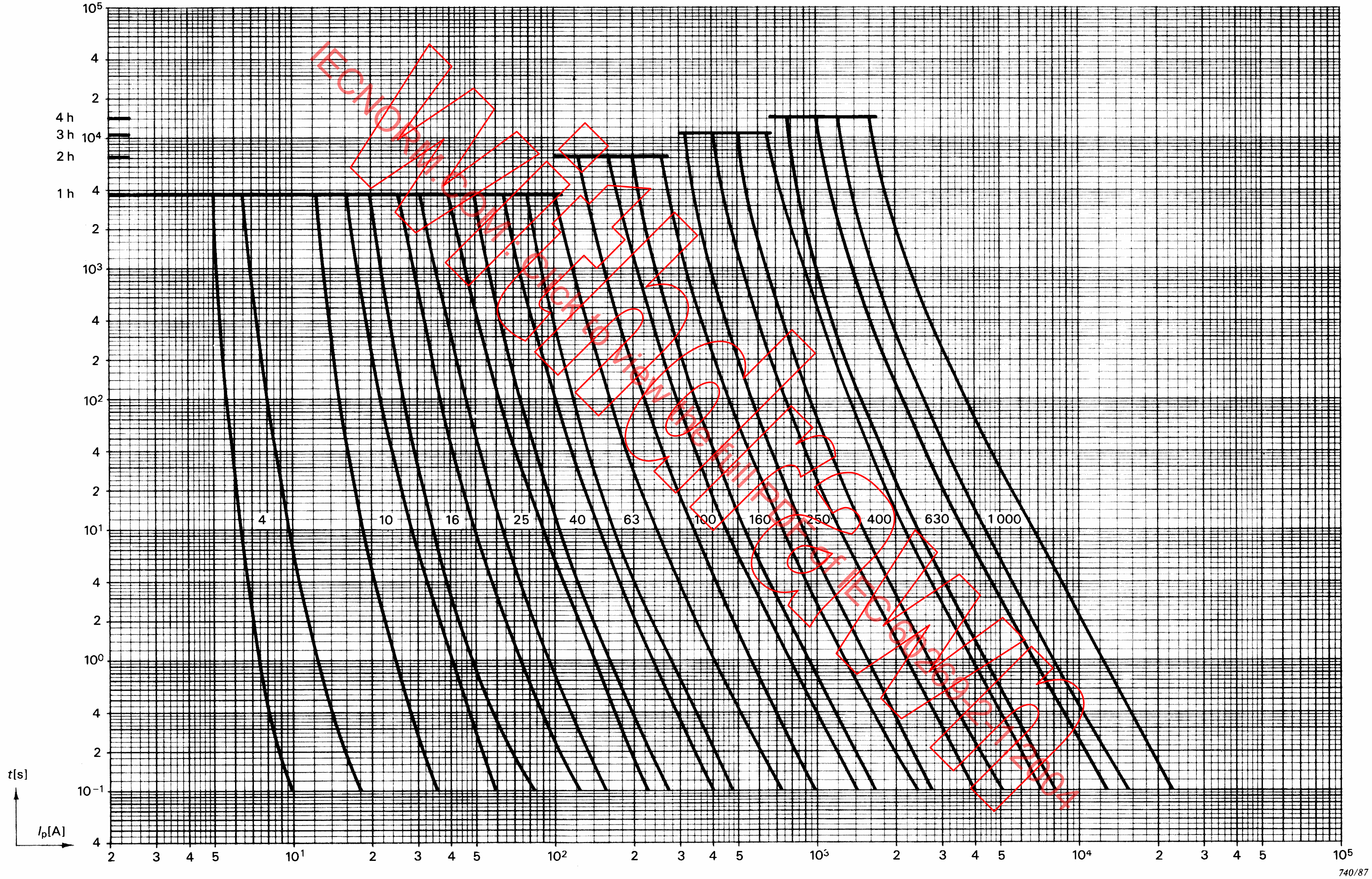
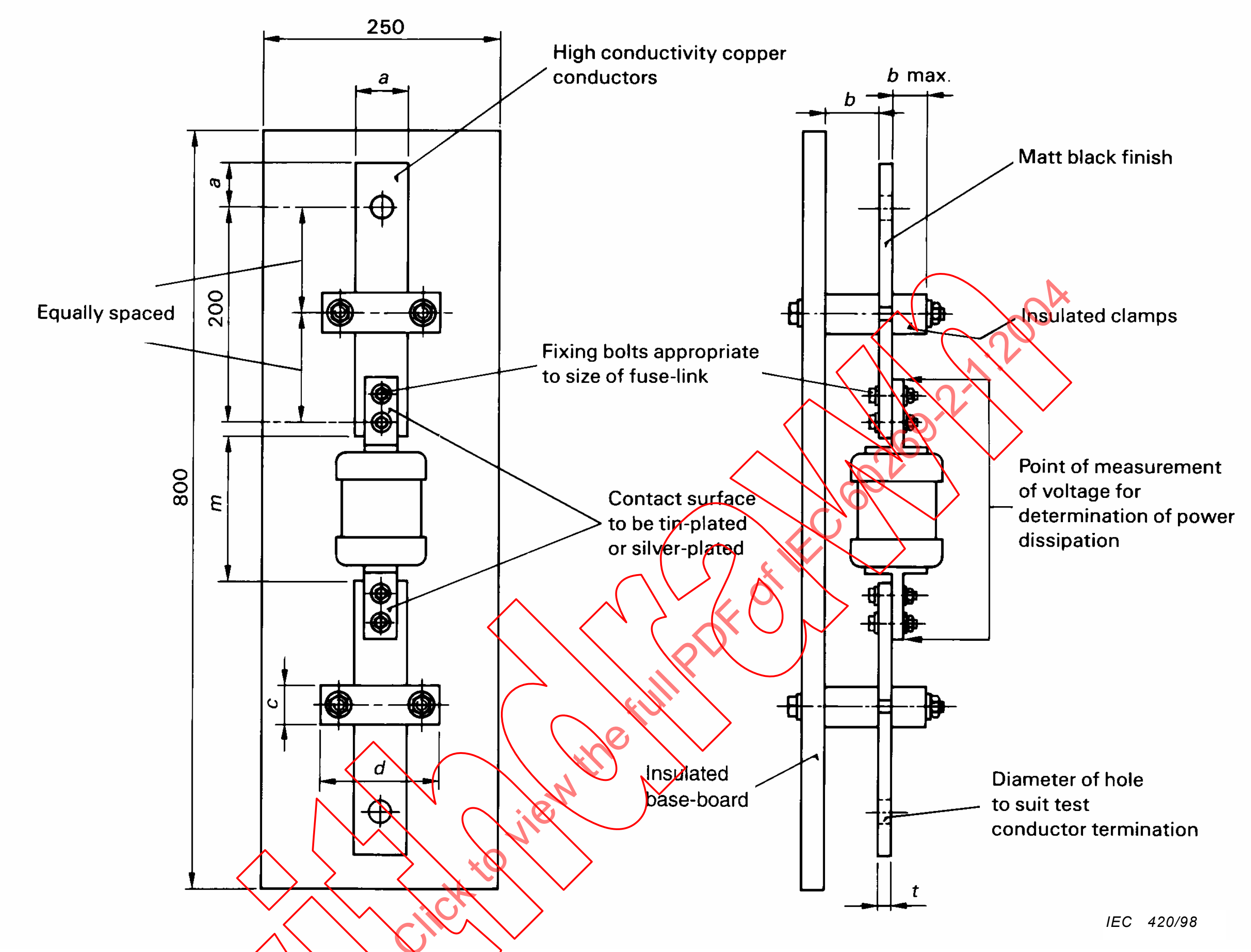



**Figure 4(II) – Time-current zones for "gG" fuse-link** *(end)*

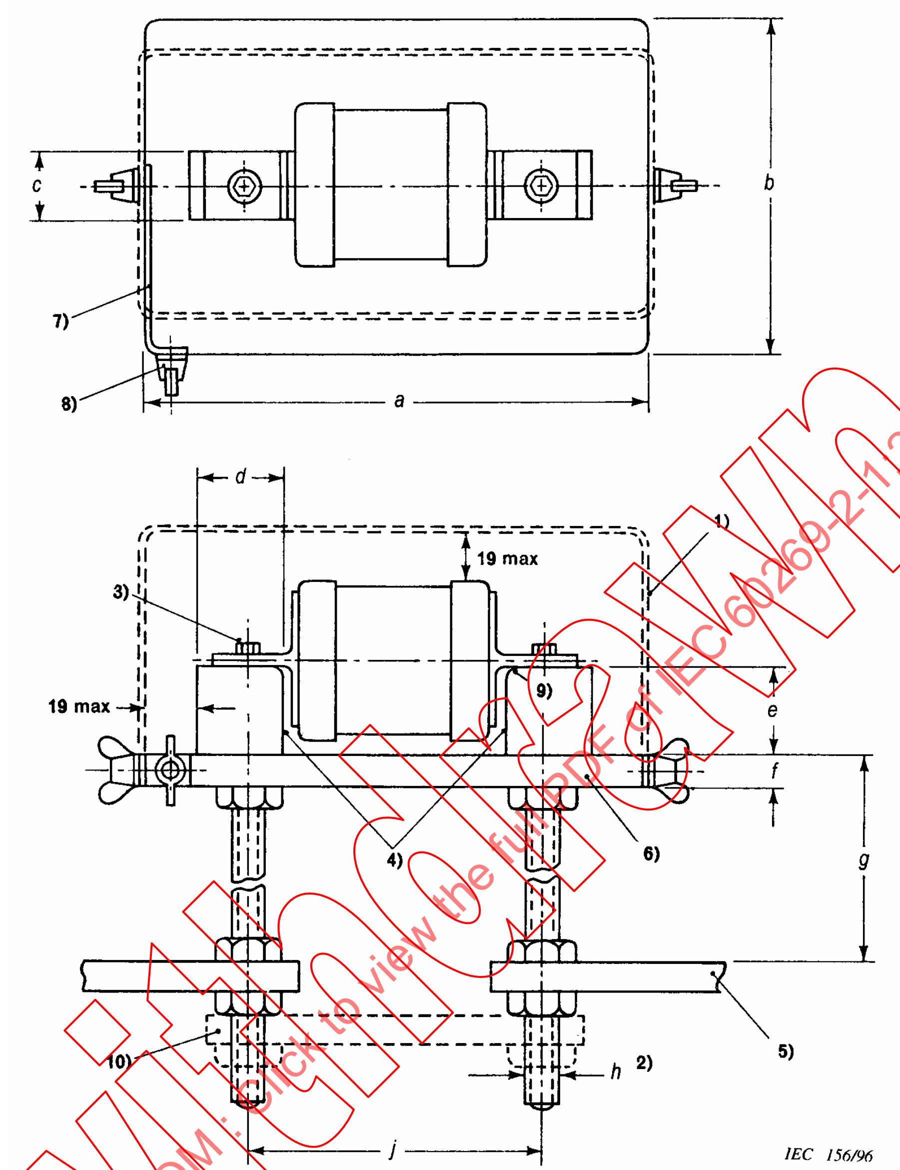



*Dimensions in millimetres*

NOTE Approximate dimensions are acceptable.

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

**Figure 5(II) – Power dissipation test rig**






*Dimensions in millimetres*

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

**Figure 6(II) – Breaking capacity test rig for fuse-links for bolted connection** *(continued)*

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 mm² in area. The cover may differ in section from that shown on the drawings provided that the clearance of 19 mm between the cover and live metal parts is not exceeded.

2) Connecting studs of high-conductivity copper.

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

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

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

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

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

7) Copper strip.

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

9) Chamfer.

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

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

**Figure 6(II) – Breaking capacity test rig for fuse-links for bolted connection** *(concluded)*

## Section III – Fuses with fuse-links having cylindrical contact caps (NF cylindrical fuse system)

### 1.1 Scope

The following additional requirements apply to fuses with fuse-links having cylindrical caps with or without striker, complying with the dimensions specified in Figures 1 (III) and 2 (III) for rated currents not exceeding 125 A and for rated voltages up to and including 690 V a.c. or 440 V d.c.

### 5.2 Rated voltage

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

### 5.3.1 Rated current of the fuse-link

The maximum rated currents of the fuse-link are given in Table K.

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

| Size | 500 V a.c. | | 690 V a.c. | |
|---|---|---|---|---|
| | gG | aM | gG | aM |
| | $I_n$ A | $I_n$ A | $I_n$ A | $I_n$ A |
| 10 x 38 | 25 | 16 | 10 | - |
| 14 x 51 | 50 | 40 | 25 | 25 |
| 22 x 58 | 100 | 100 | 50 | 50 |
| Fuse-links with higher rated currents may exist. | | | | |

| Size | 400 V a.c. | |
|---|---|---|
| | gG | aM |
| | $I_n$ A | $I_n$ A |
| 8 x 32 | 16 | 10 |

### 5.3.2 Rated current of the fuse-holder

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

**Table L – Maximum rated current of fuse-holders**

| Size | $I_n$<br>A |
|---|---|
| 8 x 32 | 16 |
| 10 x 38 | 25 |
| 14 x 51 | 50 |
| 22 x 58 | 100 |
| The use of fuse-links having higher rated currents should be as agreed by the manufacturer and the user. | |



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

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

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

| Size | 8 x 32 | 10 x 38 | 14 x 51 | 22 x 58 |
|---|---|---|---|---|
| gG | 2,5 W | 3 W | 5 W | 9,5 W |
| aM | 0,9 W | 1,2 W | 3 W | 7 W |

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

**Table N – Rated acceptable power dissipation of a fuse-holder**

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

## 5.6 Limits of time-current characteristics

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

When applicable, the time-current zones given in Figure 4(I) of section I of this standard, including manufacturing tolerances shall be met by all pre-arcing and operating times measured during the tests.

### 5.6.2 Conventional times and currents

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

**Table II – Conventional time and current for “gG” fuse-links with rated current lower than 16 A**

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

### 5.6.3 Gates

For “gG” fuse-links the gates given in Table III apply, in addition to the gates of IEC 60269-1.

**Table III – Gates for specified pre-arcing and operating times of “gG” fuse-links with rated current lower than 16 A**

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

## 6 Marking

Fuse-links and fuse-holders which meet the requirements and tests of section III of this standard may be marked with IEC 60269-2-1.

### 6.2 Marking of fuse-links

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

**Table CC – Colours of marking**

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

### 7.1 Mechanical design

The dimensions of fuse-links and fuse-bases are given in Figures 1(III) and 2(III).

The fuse-links with strikers shall also comply with the dimensions given in Figure 1a(III).

### 7.1.2 Connections including terminals

The terminals are to be capable of accepting the following cross-sections in Table P.

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

| Size | 8 × 32 | 10 × 38 | 14 × 51 | 22 × 58 |
|---|---|---|---|---|
| Cross-section mm² | 1,5 to 4 | 1,5 to 6 | 2,5 to 16 | 4 to 50 |

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

### 7.7 $I^2t$ characteristics

For the fuse-links covered by this section the maximum pre-arcing $I^2t$ values given in Table 6 of IEC 60269-1 apply for the maximum operating $I^2t$ values. Values of rated currents lower than 16 A are given below in Table VI.

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

| $I_n$ A | Pre-arcing $I^2t_{min}$ A²s | Operating $I^2t_{max}$ A²s |
|---|---|---|
| 2 | 1 | 23 |
| 4 | 6 | 90 |
| 6 | 24 | 225 |
| 8 | 49 | 420 |
| 10 | 100 | 576 |
| 12 | 160 | 750 |

### 7.8 Overcurrent discrimination of "gG" fuse-links

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

### 7.9 Protection against electric shock

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

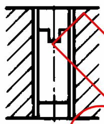
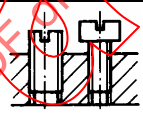
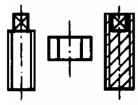
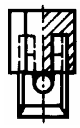
### 8.1.6 Testing of fuse-holders

See 8.1.6 of section I.

### 8.3.1 Arrangement of the fuse

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

**Table Q – Torque to be applied to the terminal screws**

| **Nominal diameter of thread** mm | Torque (Nm) I | II | III | IV | V |
|---|---|---|---|---|---|
| |  |  |  |  |  |
| Up to and including 2,8 | 0,2 | – | 0,4 | 0,4 | – |
| Over 2,8 up to and including 3,0 | 0,25 | – | 0,5 | 0,5 | – |
| Over 3.0 up to and including 3,2 | 0,3 | – | 0,6 | 0,6 | – |
| Over 3,2 up to and including 3,6 | 0,4 | – | 0,8 | 0,8 | – |
| Over 3,6 up to and including 4,1 | 0,7 | 1,2 | 1,2 | 1,2 | 1,2 |
| Over 4,1 up to and including 4,7 | 0,8 | 1,2 | 1,8 | 1,8 | 1,8 |
| Over 4,7 up to and including 5,3 | 0,8 | 1,4 | 2,0 | 2,0 | 2,0 |
| Over 5,3 up to and including 6,0 | 1,2 | 1,8 | 2,5 | 3,0 | 3,0 |
| Over 6,0 up to and including 8,0 | 2,5 | 2,5 | 3,5 | 6,0 | 4,0 |
| Over 8,0 up to and including 10,0 | – | 3,5 | 4,0 | 10,0 | 6,0 |
| Over 10,0 up to and including 12,0 | – | 4,0 | – | – | 8,0 |
| Over 12,0 up to and including 15,0 | – | 5,0 | – | – | 10,0 |

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

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

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

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

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

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

#### 8.3.4.1 Temperature-rise of the fuse-holder

The dummy fuse shall have the dimensions indicated in Figure 1(III) and have the rated power dissipation indicated in Table N.

#### 8.3.4.2 Power dissipation of a fuse-link

The points between which the power dissipation of a fuse-link is preferably measured are marked with S in Figure 1 (III).

#### 8.4.3.6 Operation of indicating devices and strikers, if any

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

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

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

After operation, the striker shall remain captive.

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

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

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

#### 8.5.5.1.1 Arrangement of the fuse

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

#### 8.5.5.1.2 Test method

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

**Table G - Test currents**

| Size | Cut-off current<br>kA |
|---|---|
| 8 x 32 | 3 … 4 |
| 10 x 38 | 5 … 6 |
| 14 x 51 | 13 … 16 |
| 22 x 58 | 17 … 21 |

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

If the cut-off current range cannot be attained with the highest rating for the size, correspondingly higher series connected fuse shall be used. In this case the test specimen shall be equipped with a dummy fuse-link. Its external dimensions correspond to the dimension given in Figure 1 (III).

#### 8.5.5.1.3 Acceptability of test results

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

### 8.7.4 Verification of overcurrent discrimination

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

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

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

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

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



**Table H – Test currents and $I^2t$ limits for discrimination test**

| $I_n$ A | Minimum pre-arcing $I^2t$ | | Maximum operating $I^2t$ | | Discrimination ratio |
|---|---|---|---|---|---|
| | Prospective $I$ r.m.s. kA | $I^2t$ A²s | Prospective $I$ r.m.s. kA | $I^2t$ A²s | |
| 2 | 0,013 | 0,67 | 0,064 | 16 | Can be calculated |
| 4 | 0,035 | 4 | 0,130 | 67 | |
| 6 | 0,064 | 16 | 0,220 | 193 | |
| 8 | 0,100 | 40 | 0,310 | 390 | |
| 10 | 0,130 | 67 | 0,400 | 640 | |
| 12 | 0,180 | 130 | 0,450 | 820 | |
| 16 | 0,270 | 291 | 0,550 | 1 210 | 1:1,6 |
| 20 | 0,400 | 640 | 0,790 | 2 500 | |
| 25 | 0,550 | 1 210 | 1,000 | 4 000 | |
| 32 | 0,790 | 2 500 | 1,200 | 5 750 | |
| 40 | 1,000 | 4 000 | 1,500 | 9 000 | |
| 50 | 1,200 | 5 750 | 1,850 | 13 700 | |
| 63 | 1,500 | 9 000 | 2,300 | 21 200 | |
| 80 | 1,850 | 13 700 | 3,000 | 36 000 | |
| 100 | 2,300 | 21 200 | 4,000 | 64 000 | |
| 125 | 3,000 | 36 000 | 5,100 | 104 000 | |

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

### 8.10 Verification of non-deterioration of contacts and direct terminal clamps

Subclause 8.10 of IEC 60269-1 applies.

#### 8.10.1 Arrangement of the fuse

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

The dummy fuse shall have the dimensions indicated in Figure 1(III) and have the rated power dissipation equal to the values given for the relevant dimensions in Table N.

#### 8.10.2 Test method

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

The following test values shall be applied:

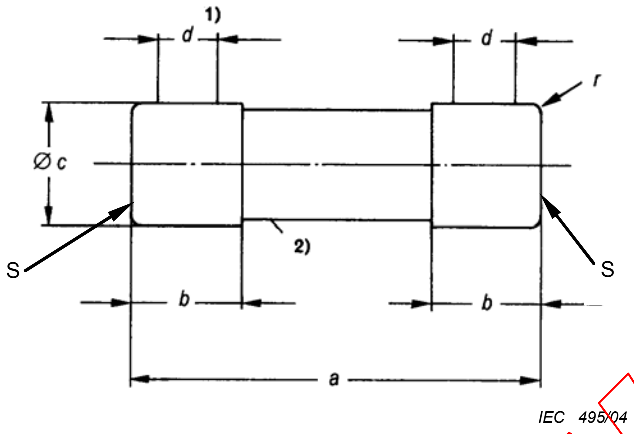
| | |
|---|---|
| Test current : | conventional non-fusing current $I_{nf}$ |
| Load period : | 25 % of the conventional time |
| No-load period : | 10 % of the conventional time. |

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

#### 8.10.3 Acceptability of test results

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

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




Measuring points S according to 8.3.4.2

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

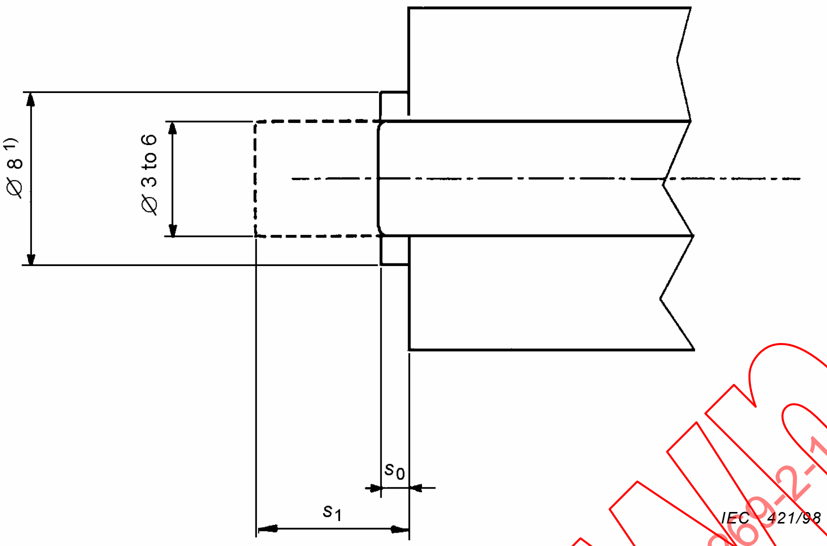
| Size | Rated power dissipation 3)<br>W | *a* | *b*<br>max. | *c* | *d*<br>min. | *r* |
|---|---|---|---|---|---|---|
| 8 × 32 | 2,5 | 31,5 ± 0,5 | 6,7 | 8,5 ± 0,1 | 4 | 1 ± 0,5 |
| 10 × 38 | 3 | 38 ± 0,6 | 10,5 | 10,3 ± 0,1 | 6 | 1,5 ± 0,5 |
| 14 × 51 | 5 | $51^{+0,6}_{-1}$ | 13,8 | 14,3 ± 0,1 | 7,5 | 2 ± 1 |
| 22 × 58 | 9,5 | $58^{+0,1}_{-2}$ | 16,2 | 22,2 ± 0,1 | 11 | 2 ± 1 |

*Dimensions in millimètres*

**Figure 1(III*) – Fuse-links with cylindrical caps**



* Refers to section III.



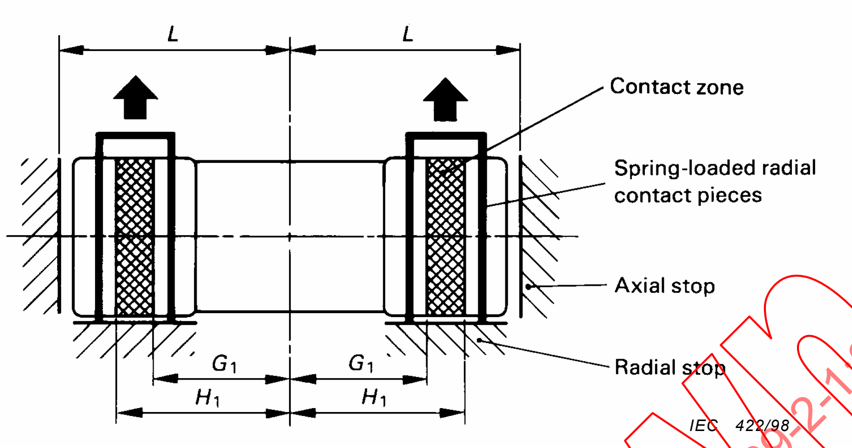

*Dimensions in millimetres*

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

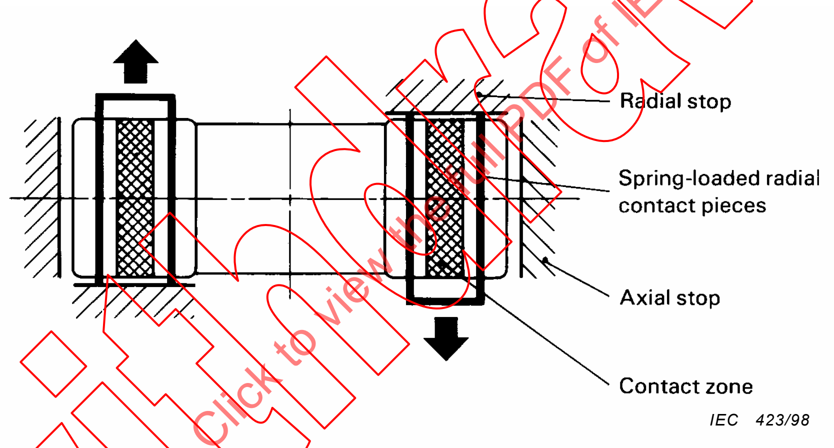
1) Diameter of cylinder in which the striker must stay

**Figure 1a(III) – Fuse-links with cylindrical contact caps with striker Additional dimensions for sizes 14 × 51 and 22 × 58 only**

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




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

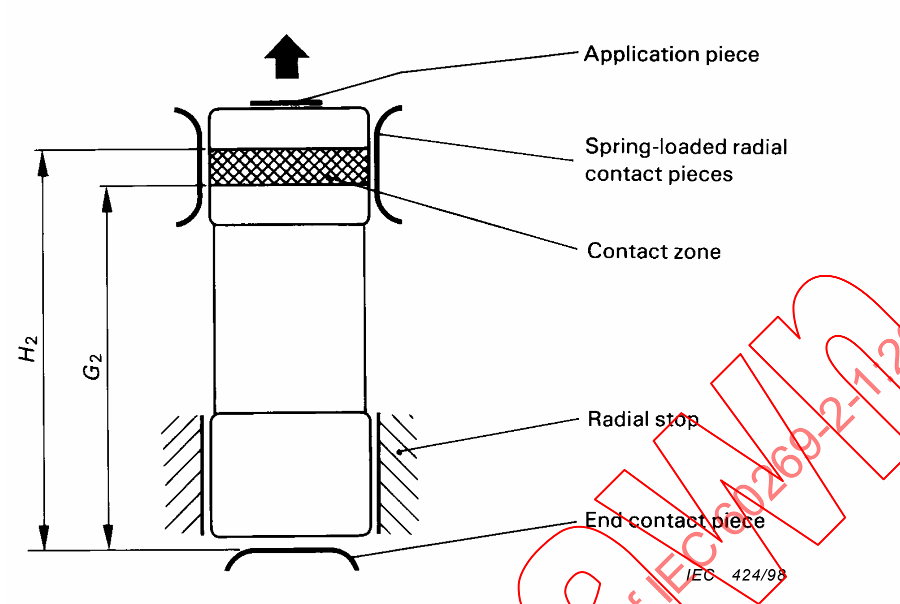



*Dimensions in millimetres*

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

**Figure 2(III) – Base for fuse-links with cylindrical caps** *(continued)*

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






*Dimensions in millimetres*

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

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

*Notes on the drawings*

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

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

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

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

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

**Figure 2(III) – Base for fuse-links with cylindrical caps** *(concluded)*

## Section IV – Fuses with fuse-links with offset blade contacts (BS clip-in fuse system)

### 1.1 Scope

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

NOTE These fuses are intended for use on systems employing the future standardized voltage of 230/400 V a.c. However, many countries are still using the higher voltage of 240/415 V in the interim period, and therefore these fuses will continue to be supplied and tested as 240 V a.c. or 415 V a.c. rating until such time as all supplies are brought down to the lower level of voltage.

### 5.2 Rated voltage

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

| | |
|---|---|
| Fuse-link size E1 | 230 V a.c. |
| Fuse-link sizes F1, F2, F3 | 400 V a.c. |

(Refer also to the note in 1.1).

### 5.3.1 Rated current of the fuse-link

For each size, the maximum rated currents are given in Figure 1(IV). Ratings of 8 A and 12 A are not included in this section.

### 5.3.2 Rated current of the fuse-holder

Maximum rated currents for the fuse-holder are given in Figure 2(IV).

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

The maximum values of power dissipation permitted for fuse-links when tested in accordance with 8.3.1 are specified in Figure 1(IV) when measured on the standard rig shown in Figure 5(IV).

The values of rated acceptable power dissipation of fuse-holders at rated current when tested in accordance with 8.3.1 are given in Figure 2(IV).

NOTE The point of measurement of voltage for the determination of the acceptable power dissipation of a fuse-holder is shown in Figure 2(IV).

### 5.6.1 Time-current characteristics, time-current zones

In addition to the limits of pre-arcing time given by the gates and the conventional times and currents, the time-current zones, excluding manufacturing tolerances, are given in Figures 3(IV) and 4(IV). The tolerance on time-current characteristics shall not deviate by more than 10 % in terms of current.

### 5.6.2 Conventional times and currents

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

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

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

### 5.6.3 Gates

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

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

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

### 5.7.2 Rated breaking capacity

The rated breaking capacities shall be:

a) 50 kA for size E1 fuse-links;

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

### 7.1 Mechanical design

Dimensions of fuse-links and fuse-holders are given in Figures 1(IV) and 2(IV).

### 7.1.2 Connections including terminals

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

**Table U – Sizes of copper conductors**

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

### 7.7 $I^2t$ characteristics

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

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

| $I_n$<br>A | $I^2t_{min}$<br>$A^2s$ | $I^2t_{max}$<br>$A^2s$ |
|---|---|---|
| 2 | 0,30 | 2,5 |
| 4 | 2,0 | 15 |
| 6 | 5 | 45 |
| 10 | 25 | 200 |

### 7.9 Protection against electric shock

Where standardized fuse-holders according to Figure 2(IV) are used, the degree of protection against electric shock shall be at least IP2X for all three states.

### 8.3.3 Measurement of the power dissipation of the fuse-link

The fuse-link shall be mounted on the test rig shown in Figure 5(IV). The points of measurement of power loss are given in Figure 5(IV).

#### 8.3.4.1 Temperature rise of the fuse-holder

The dummy fuse-links shall have dimensions that comply with Figure 1(IV) for testing in the corresponding fuse-holder of Figure 2(IV). The power dissipation of the dummy fuse-links shall be the rated acceptable power dissipation of the fuse-holder as given in Figure 2(IV) when tested in the standardized power dissipation test rig given in Figure 5(IV).

### 8.4.1 Arrangement of the fuse

The test arrangement of the fuse-link is given in Figure 5(IV).

### 8.5.1 Arrangement of the fuse

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

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

### 8.7.4 Verification of overcurrent discrimination

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

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

### 8.10 Verification of non-deterioration of contacts

Subclause 8.10 of IEC 60269-1 applies.

### 8.10.1 Arrangement of the fuse

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

The dummy fuse-links shall have dimensions that comply with Figure 1(IV) for testing in the corresponding fuse-holder of Figure 2(IV).

The power dissipation of the dummy fuse-links shall be the maximum rated acceptable power dissipation of the fuse-holder as given in Figure 2(IV) when tested in the standardized power dissipation test rig given in Figure 5(IV).

### 8.10.2 Test method

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

The following test values shall be applied:

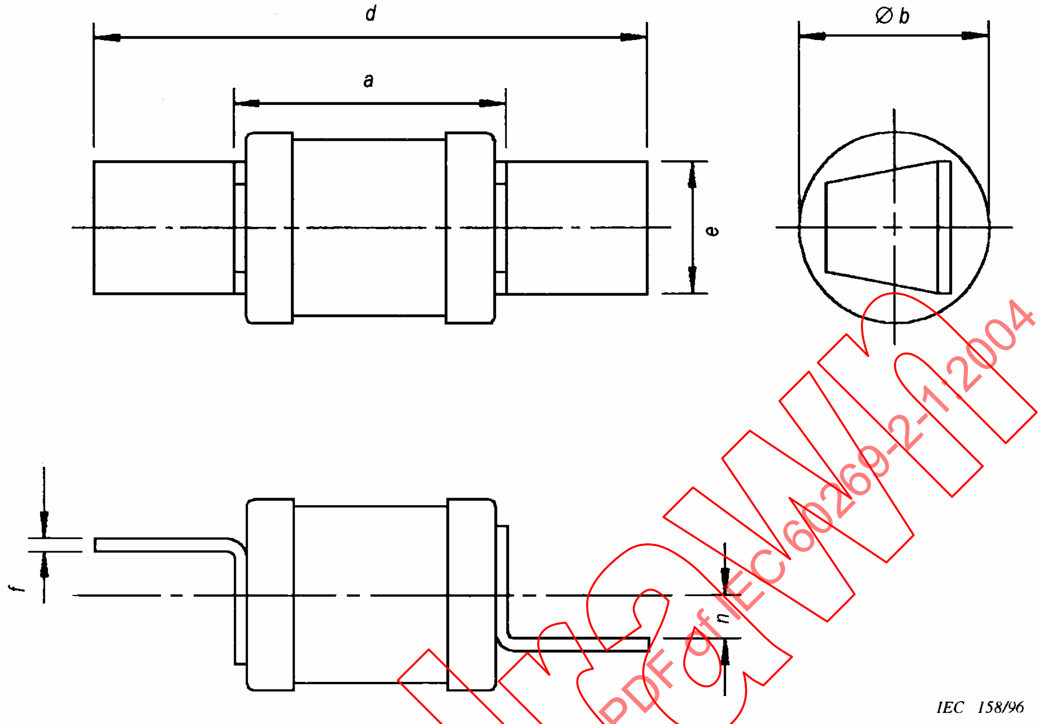
– Test current non-fusing current $I_{nf}$
– Load period 25 % of the conventional time
– No-load period 10 % of the conventional time.

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

### 8.10.3 Acceptability of test results

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

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

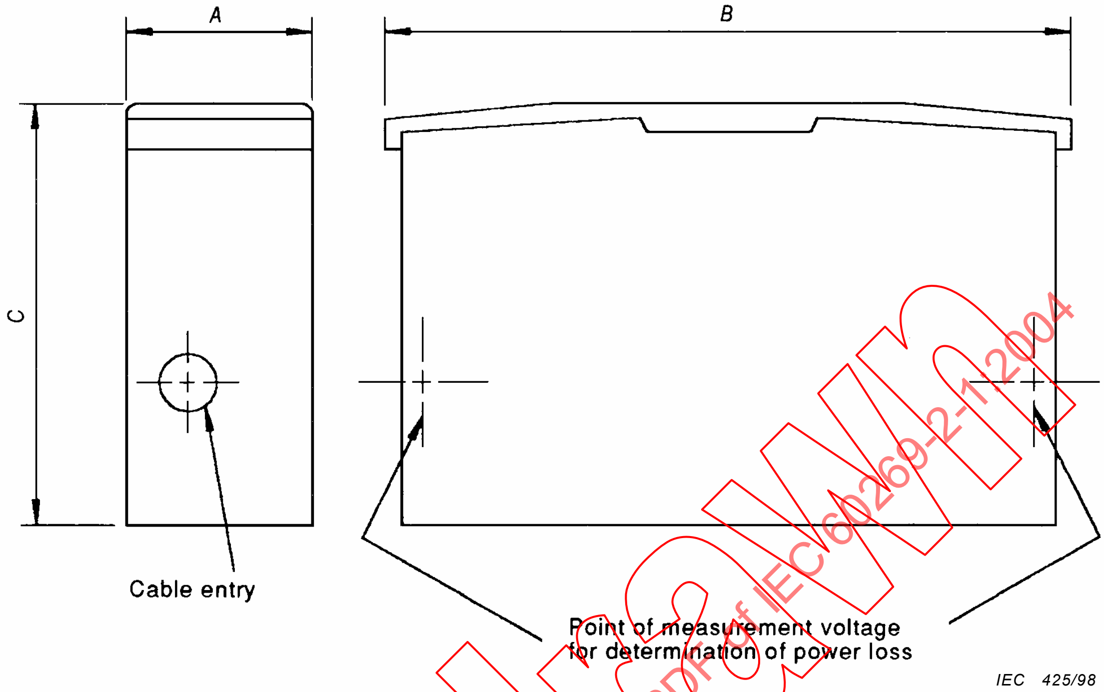



*Dimensions in millimetres*

| **Size** | **Maximum rated current** A | **Maximum power dissipation** W | ***a**** Max. | ***b*** Max. | ***d*** Max. | Min. | ***e*** Max. | Min. | ***f*** Max. | Min. | ***n*** Max. | Min. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E1 | 20 | 1,8 | 25 | 14,5 | 51 | 47 | 13 | 11 | 1,5 | 0,8 | 3,8 | 3,2 |
| F1 | 32 | 3,2 | 35,5 | 14,5 | 62 | 58 | 131 | 11 | 1,5 | 0,8 | 3,8 | 3,2 |
| F2 | 63 | 4,8 | 39 | 17,5 | 69 | 65 | 15,5 | 14,5 | 1,6 | 1,2 | 3,8 | 3,2 |
| F3 | 125 | 7,5 | 39 | 27 | 80 | 76 | 20 | 19 | 2,0 | 1,6 | 3,8 | 3,2 |

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

**Figure 1(IV) – Fuse-links having offset blade contacts, sizes E1, F1, F2 and F3**




*Dimensions in millimetres*

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

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

**Figure 2(IV) – Typical fuse-holder**

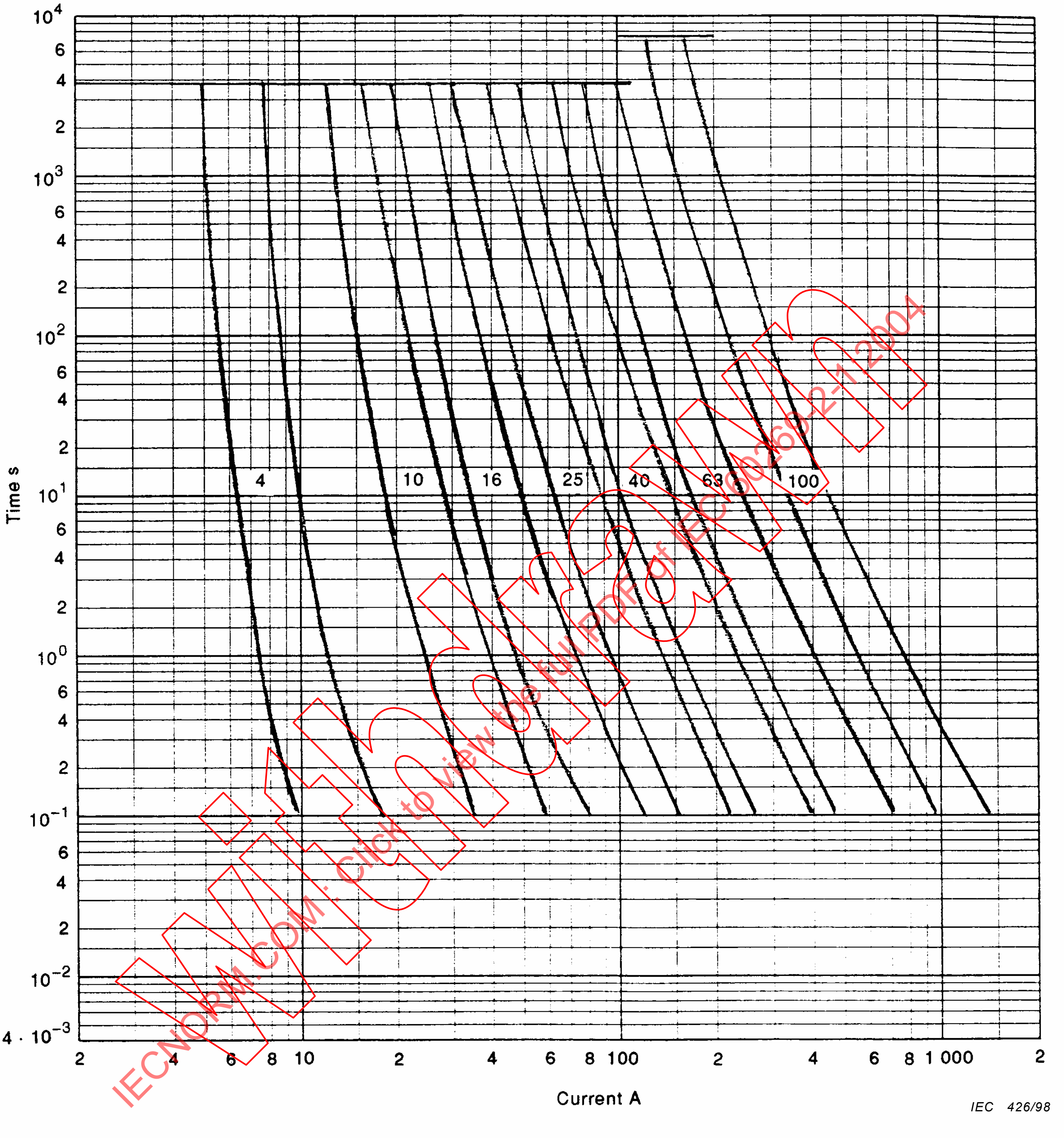
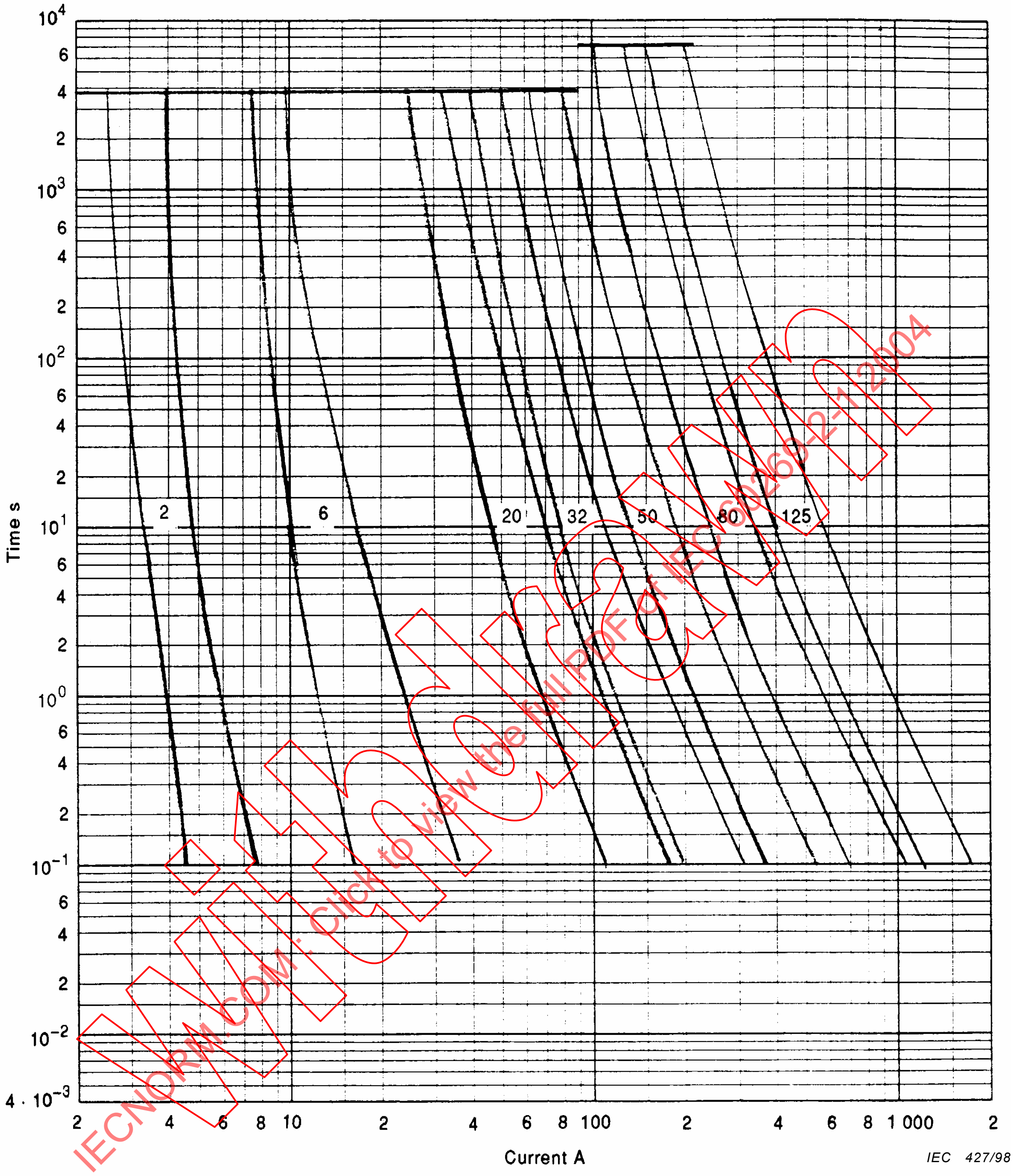


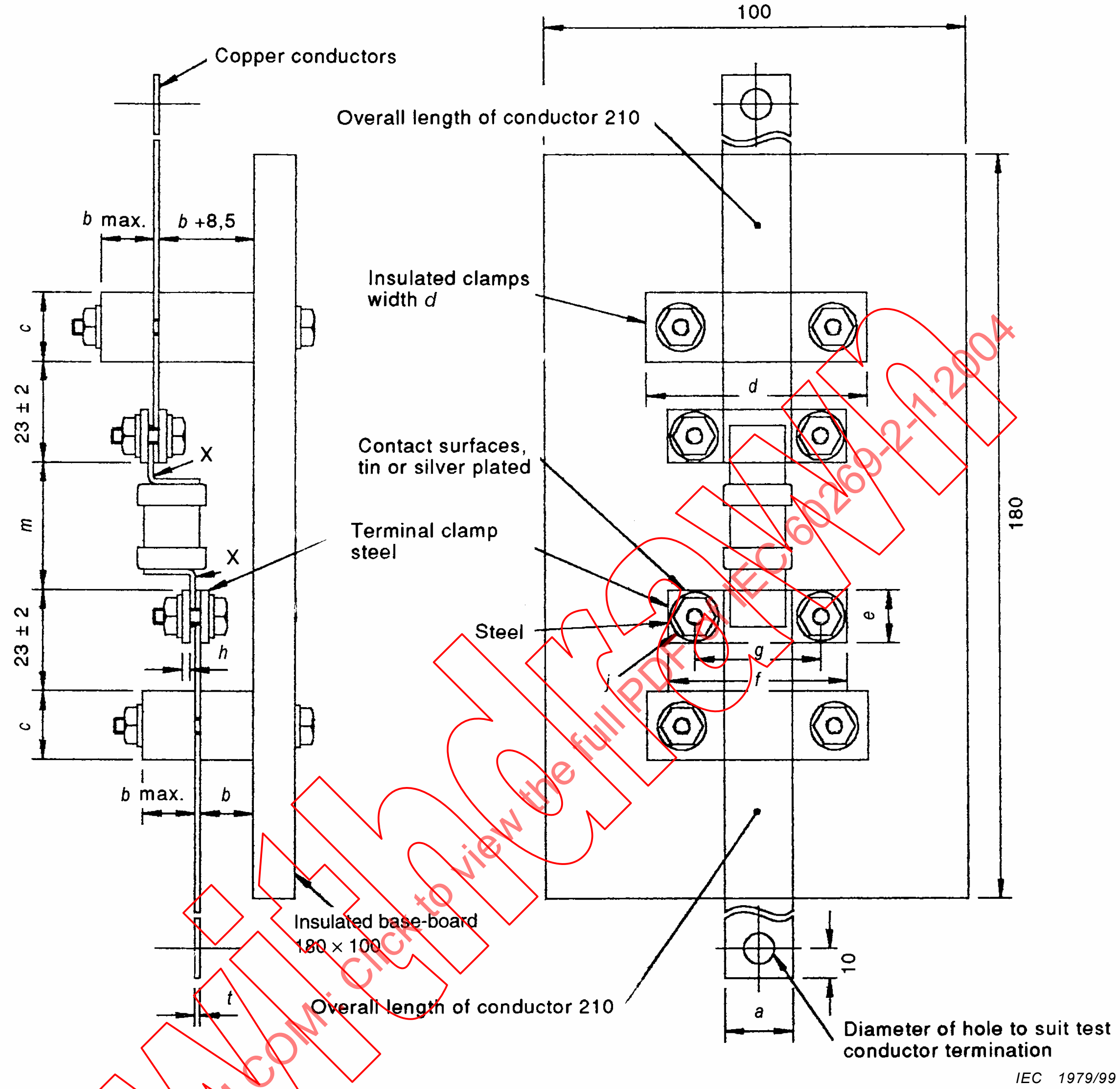



**Figure 3(IV) – Time-current zones for "gG" fuse-links**




*Dimensions in millimetres*

**Figure 4(IV) – Time-current zones for "gG" fuse-links**






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

*Dimensions in millimetres*

**Figure 5(IV) – Power dissipation test rig**

## Section V – Fuses with fuse-links having "gD" and "gN" characteristics (class J and class L time delay and non-time-delay fuse types)

### 1.1 Scope

The following additional requirements apply to "gD" and "gN" fuses which comply with the dimensions specified in Figures 1a(V), 1b(V), 2a(V) and 2b(V). Such fuses have rated currents up to and including 60 A for cylindrical contacts, 600 A for blade/bolted connections and 6 000 A for bolted connections. Rated voltage is a.c. 600 V and the interrupting rating is 200 kA.

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

### 5.2 Rated voltage

The rated voltage is a.c. 600 V.

### 5.3.1 Rated current of the fuse-link

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

For each size, the maximum rated current is given in Figures 1a(V) and 1b(V).

### 5.3.2 Rated current of the fuse-holder

The maximum rated currents for the fuse-holders are given in Figures 2a(V) and 2b(V).

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

The maximum values of rated power dissipation are given in Figures 1a(V) and 1b(V). The rated acceptable power dissipation of the fuse-base shall be not less than the maximum value of rated power dissipation for the fuse-link of the same rating.

### 5.6 Limits of the time-current characteristics

### 5.6.1 Time-current characteristics, time-current zones

In addition to the limits of pre-arcing time given by the gates and the conventional times and currents, the time current zones, excluding manufacturing tolerances, are given in Figures 5a(V), 5b(V), 5c(V), 6a(V), 6b(V) and 6c(V). The tolerance on time-current characteristics shall not deviate by more than ±10 % in terms of current.

### 5.6.2 Conventional times and currents

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

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

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

### 5.6.3 Gates

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

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

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

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

### 5.7.2 Rated breaking capacity

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

### 7.1 Mechanical design

The dimensions of fuse-links and fuse-bases are given in Figures 1a(V), 1b(V), 2a(V) and 2b(V).

### 7.6 Cut-off current characteristics

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

### 7.7 $I^2t$ characteristics

The pre-arcing $I^2t$ values at 0,01 s for "gD" and "gN" fuse-links shall lie within the limits indicated in Table VI below. For 1,6:1 discrimination between "gD" and "gN" fuse-links, the "gD" fuse-link shall have the higher rated current.

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

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

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



### 7.9 Protection against electric shock

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

### 8.3 Verification of temperature rise and power dissipation

#### 8.3.1 Arrangement of the fuse

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

The cross-sectional area of the cable or bus bar shall be selected in accordance with the values given in Table X below.

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

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



#### 8.3.4.1 Temperature rise of the fuse-holder

The dummy fuse-link is given in Figure 3(V). The point at which the temperature rise is measured is marked by the letter A in Figure 4(V).

#### 8.3.4.2 Power dissipation of a fuse-link

The measurement points for power dissipation are marked by the letter B in Figure 4(V).

## 8.4 Verification of operation

### 8.4.1 Arrangement of the fuse

The test arrangement shall be as specified in 8.3.1.

#### 8.4.3.3.2 Verification of gates

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

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

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

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

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

## 8.6 Verification of cut-off current characteristics

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

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

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

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

## 8.7 Verification of $I^2t$ characteristics and overcurrent discrimination

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

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

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

### 8.10 Verification of non-deterioration of contacts

Subclause 8.10 of IEC 60269-1 applies.

#### 8.10.1 Arrangement of the fuse

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

The dummy fuse-links are given in Figure 3(V) and shall have the dimensions and the maximum power dissipation, $P_n$(W), indicated in Figures 1a(V) and 1b(V).

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 following test values shall be applied:

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

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

#### 8.10.3 Acceptability of test results

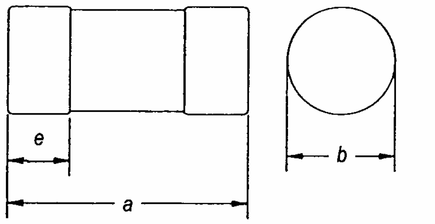
After 250 cycles, the measured temperature-rise values shall not exceed the temperature rise measured at the beginning of the tests by more than 15 K.

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

#### 8.11.2 Miscellaneous tests

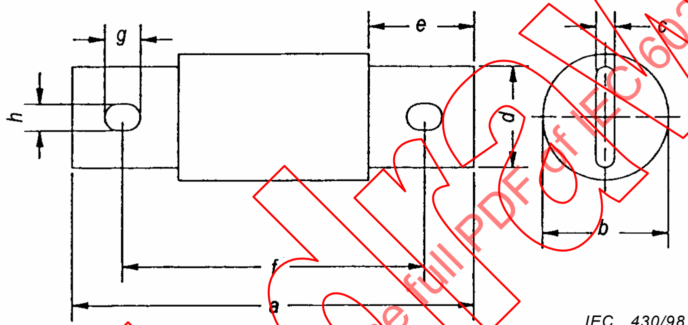
##### 8.11.2.2 Verification of resistance to abnormal heat and fire

Under consideration.




IEC 429/98

A (1-60 A)




IEC 430/98

B (70-600 A)



| Drawing | AC 600 V | | Dimensions mm | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $I_n$ (A) | $P_n$ (W) | **a**[1] | **b**[2] | **c** **±0,08** | **d** **±0,9** | **e** **min.** | **f** **±1,6** | **g** **±1,5** | **h** **±0,13** |
| A | 1-30 | 8 | 57,1 | 20,6 | – | – | 12,7 | – | – | – |
| | 35-60 | 12 | 60,3 | 27,0 | – | – | 15,9 | – | – | – |
| B | 70-100 | 18 | 118 | 28,6 | 3,18 | 19,1 | 24,6 | 92,1 | 9,52 | 7,14 |
| | 125-200 | 34 | 146 | 41,3 | 4,78 | 28,6 | 34,1 | 111 | 9,52 | 7,14 |
| | 250-400 | 64 | 181 | 54,0 | 6,35 | 41,3 | 46,8 | 133 | 13,5 | 10,3 |
| | 500-600 | 92 | 203 | 66,7 | 9,52 | 50,8 | 53,2 | 152 | 17,5 | 13,5 |

NOTES

1) 1-60 A: ±0,8
70-600 A: ±2,4

2) 1-60 A: ±0,20
70-600 A: max.

**Figure 1a(V) – Fuse-links (1-600 A)**