

INTERNATIONAL STANDARD

Miniature fuses – Part 7: Miniature fuse-links for special applications



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IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

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IEC 60127-7

Edition 2.0 2015-09

INTERNATIONAL STANDARD

**Miniature fuses –
Part 7: Miniature fuse-links for special applications**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 29.120.50

ISBN 978-2-8322-2913-2

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CONTENTS

FOREWORD	3
INTRODUCTION	5
1 Scope	6
2 Normative references	6
3 Terms and definitions	7
4 General requirements	8
5 Standard ratings	8
6 Marking	8
7 General notes on tests	9
8 Dimensions and construction	14
9 Electrical requirements	15
10 Standard sheets	25
Annex A (informative) Guidance on ratings to be specified by the manufacturer or to be agreed upon with the testing house	28
Bibliography	29
Figure 1 – Standard test board for fuse-links with wire terminations	11
Figure 2 – Test board for surface mount fuse-links	12
Figure 3 – Test fuse base	13
Figure 4 – Test circuits for breaking capacity tests	16
Table 1 – Power factor and time constant	17
Table 2 – Testing schedule for individual ampere ratings for a.c. or d.c. breaking capacity fuse-links	20
Table 3 – Testing schedule for individual ampere ratings for a.c. and d.c. breaking capacity fuse-links	21
Table 4 – Testing schedule for maximum ampere rating of a homogeneous series (a.c. or d.c. breaking capacity fuse-links)	22
Table 5 – Testing schedule for maximum ampere rating of a homogeneous series (a.c. and d.c. breaking capacity fuse-links)	23
Table 6 – Testing schedule for minimum ampere rating of a homogeneous series	24
Table 7 – Testing schedule for all intermediate ampere ratings of a homogeneous series	24
Table A.1 – Guidance on ratings to be specified by the manufacturer or to be agreed upon with the testing house	28

INTERNATIONAL ELECTROTECHNICAL COMMISSION

MINIATURE FUSES –

Part 7: Miniature fuse-links for special applications

FOREWORD

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International Standard IEC 60127-7 has been prepared by subcommittee 32C: Miniature fuses, of IEC technical committee 32: Fuses.

This second edition cancels and replaces the first edition published in 2013.

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

- a) defining a test board for surface mount fuse-links, Figure 2;
- b) defining test schedules for homogenous series.

The text of this standard is based on the following documents:

CDV	Report on voting
32C/507/CDV	32C/513/RVC

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

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

A list of all parts in the IEC 60127 series, published under the general title *Miniature fuses*, can be found on the IEC website.

This International Standard is to be used in conjunction with IEC 60127-1:2006, *Miniature fuses – Part 1: Definitions for miniature fuses and general requirements for miniature fuse-links* and its Amendment 1 (2011).

The clauses of this standard supplement, modify or replace the corresponding clauses in IEC 60127-1.

Where there is no corresponding clause or subclause in this standard, the clause or subclause of IEC 60127-1 applies without modification as far as is reasonable. When this standard states “addition” or “replacement”, the relevant text in IEC 60127-1 is to be adapted accordingly.

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

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website 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.

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

According to the wish expressed by the users of miniature fuses, all standards, recommendations and other documents relating to miniature fuses should have the same publication number in order to facilitate reference to fuses in other specifications, for example, equipment specifications.

Furthermore, a single publication number and subdivision into parts would facilitate the establishment of new standards, because clauses containing general requirements need not be repeated.

The IEC 60127 series, under the general heading *Miniature fuses*, is thus subdivided as follows:

IEC 60127-1, *Miniature fuses – Part 1: Definitions for miniature fuses and general requirements for miniature fuse-links*

IEC 60127-2, *Miniature fuses – Part 2: Cartridge fuse-links*

IEC 60127-3, *Miniature fuses – Part 3: Sub-miniature fuse-links*

IEC 60127-4, *Miniature fuses – Part 4: Universal modular fuse-links (UMF) – Through-hole and surface mount types*

IEC 60127-5, *Miniature fuses – Part 5: Guidelines for quality assessment of miniature fuse-links*

IEC 60127-6, *Miniature fuses – Part 6: Fuse-holders for miniature fuse-links*

IEC 60127-7, *Miniature fuses – Part 7: Miniature fuse-links for special applications*

IEC 60127-8, (Free for further documents)

IEC 60127-9, (Free for further documents)

IEC 60127-10, *Miniature fuses – Part 10: User guide for miniature fuses*

MINIATURE FUSES –

Part 7: Miniature fuse-links for special applications

1 Scope

This part of IEC 60127 covers requirements for miniature fuse-links for special applications.

This part of IEC 60127 is applicable to fuse-links with a rated voltage not exceeding 1 000 V, a rated current not exceeding 20 A and a rated breaking capacity not exceeding 50 kA.

It does not apply to fuses completely covered by the subsequent parts of IEC 60269-1.

It does not apply to miniature fuse-links for appliances intended to be used under special conditions, such as in corrosive or explosive atmospheres.

This part of IEC 60127 applies in addition to the requirements of IEC 60127-1.

Miniature fuse-links for special applications are not intended to be replaced by the end-user of an electrical / electronic appliance.

The object of this part of IEC 60127 is to establish uniform test methods for miniature fuse-links for special applications, so as to allow verification of the values (for example melting time and breaking capacity values) specified by the manufacturer.

2 Normative references

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

IEC 60068-2-21:2006, *Environmental testing – Part 2-21: Tests – Test U: Robustness of terminations and integral mounting devices*

IEC 60127-1:2006, *Miniature fuses – Part 1: Definitions for miniature fuses and general requirements for miniature fuse-links*

IEC 60127-1:2006/AMD1:2011

IEC 60127-1:2006/AMD2:2015

IEC 60127-4:2005, *Miniature fuses – Part 4: Universal modular fuse-links (UMF) – Through-hole and surface mount types*

IEC 60127-4:2005/AMD1:2008

IEC 60127-4:2005/AMD2:2012

IEC 60127-6:2014, *Miniature fuses – Part 6: Fuse-holders for miniature fuse-links*

IEC 60664-1:2007, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 60695-2-12:2010, *Fire hazard testing – Part 2-12: Glowing/hot-wire based test methods – Glow-wire flammability index (GWFI) test method for materials*
IEC 60695-2-12:2010/AMD1:2014

IEC 60695-2-13:2010, *Fire hazard testing – Part 2-13: Glowing/hot-wire based test methods – Glow-wire ignition temperature (GWIT) test method for materials*
IEC 60695-2-13:2010/AMD1:2014

IEC 60695-4:2012, *Fire hazard testing – Part 4: Terminology concerning fire tests for electrotechnical products*

IEC 61249-2-7:2002, *Materials for printed boards and other interconnecting structures – Part 2-7: Reinforced base materials clad and unclad – Epoxide woven E-glass laminated sheet of defined flammability (vertical burning test), copper-clad*

ISO 3:1973, *Preferred numbers – Series of preferred numbers*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in Clause 3 of IEC 60127-1:2006, except 3.5, as well as the following apply.

3.1

miniature fuse-link for special applications

enclosed fuse-link which is not covered in IEC 60127-2, IEC 60127-3 or IEC 60127-4 and of rated breaking capacity not exceeding 50 kA, with a width and height not exceeding 12 mm and a length not exceeding 50 mm

Note 1 to entry: Special precautions may be necessary to ensure that the fuse-links will be replaced by a fuse-link with the same technical parameters.

Note 2 to entry: For fuse-links having a metallic cap at each end, any member of terminals or terminations other than the metallic cap such as wire terminations, pins and bolt-in contacts may not be included in the total length of 50 mm and the width and height of 12 mm.

3.2

t_1 to t_8

limit values for time/current characteristic

3.3

I_{70}

test current for testing at elevated temperature of 70 °C

Note 1 to entry: Preferred values are 0,8 I_N or 1,0 I_N or 1,1 I_N .

3.4

I_{test} (A)

test current for endurance testing according to method A

Note 1 to entry: Preferred values are 1,0 I_N or 1,05 I_N or 1,2 I_N .

3.5

I_{test} (B)

test current for endurance testing according to method B

Note 1 to entry: Preferred values are 0,8 I_N or 1,0 I_N .

3.6

I_{OVL} (A)

test current for measuring the maximum sustained dissipation according to method A

Note 1 to entry: Preferred values are 1,25 I_N or 1,35 I_N or 1,5 I_N .

3.7

I_{ovL} (B)

test current for measuring the maximum sustained dissipation according to method B

Note 1 to entry: Preferred values are 1,0 I_N or 1,25 I_N .

4 General requirements

Clause 4 of IEC 60127-1:2006 applies.

5 Standard ratings

Clause 5 of IEC 60127-1:2006 does not apply.

Replacement:

The following ratings shall be agreed upon between the testing house and the manufacturer:

- rated voltage;
- rated current (see standard sheet 1 for preferred ratings);
- rated breaking capacity (a.c. and/or d.c.);
- time/current characteristic (at least at 2,0 I_N or 2,1 I_N and 10 I_N).

The following may be agreed upon on an optional basis:

- test at elevated temperature;
- time/current characteristic (additionally at 2,75 I_N and 4 I_N).

Any additional specified values are given in standard sheet 1.

6 Marking

Clause 6 of IEC 60127-1:2006 applies except as follows.

6.1

Replacement:

d) Not applicable.

NOTE A symbol denoting the time/current characteristic cannot be stated, because this part of IEC 60127 does not specify any values for this parameter.

Addition:

- e) Type designation.
- f) Rated breaking capacity in amperes (A) or in kilo amperes (kA).

6.2

Deletion of NOTE 2.

6.3

Addition after first paragraph:

Furthermore the rated breaking capacity in amperes (A) or in kilo amperes (kA) shall be marked on the package label.

6.4

Addition of heading title and replacement of text:

6.4 Colour coding for miniature fuse-links for special applications

Marking of fuse-links by means of colour bands according to IEC 60127-1:2006, Annex A, is not permitted. It is, however, possible to use colour markings that clearly differ from this colour band system. In this case, the manufacturer shall provide the relevant information, for example colour key.

Additional subclause:

6.101 Where marking is impracticable due to space limitations, the relevant information should appear on the smallest package and in the manufacturer's technical literature.

7 General notes on tests

Clause 7 of IEC 60127-1:2006 applies except as follows.

7.2 Type tests

7.2.1

Replacement:

For testing the individual current ratings of fuses with a.c. or d.c. breaking capacity, the number of fuse-links required is 51, of which 12 are kept as spares. For fuse-links with wire terminations six extra samples (E1 to E6) have to be taken by random and not sorted according to voltage drop. If necessary, these samples can be used as additional spares after performing the tests according to 8.3.

The testing schedule is shown in Table 2.

For testing the individual current ratings of fuses with a.c. and d.c. breaking capacity, the number of fuse-links required is 63, of which 9 are kept as spares. For fuse-links with wire terminations six extra samples (E1 to E6) have to be taken by random and not sorted according to voltage drop. If necessary, these samples can be used as additional spares after performing the tests according to 8.3. The testing schedule is shown in Table 3.

For testing the maximum ampere rating of a homogenous series with a.c. or d.c. breaking capacity the number of fuse-links required is 51, of which 22 are kept as spares. For fuse-links with wire terminations six extra samples (E1 to E6) have to be taken by random and not sorted according to voltage drop. If necessary, these samples can be used as additional spares after performing the tests according to 8.3.

The testing schedule is shown in Table 4.

For testing the maximum ampere rating of a homogenous series with a.c. and d.c. breaking capacity the number of fuse-links required is 66, of which 32 are kept as spares. For fuse-links with wire terminations six extra samples (E1 to E6) have to be taken by random and not sorted according to voltage drop. If necessary, these samples can be used as additional spares after performing the tests according to 8.3.

The testing schedule is shown in Table 5.

For testing the minimum ampere rating of a homogenous series with a.c. and / or d.c. breaking capacity the number of fuse-links required is 38, of which 16 are kept as spares.

The testing schedule is shown in Table 6.

For testing all of the intermediate ampere rating of a homogenous series with a.c. and / or d.c. breaking capacity the number of fuse-links required is 38, of which 16 are kept as spares.

The testing schedule is shown in Table 7.

7.3 Fuse-bases for tests

Addition after first paragraph:

For fuse-links designed for use in a special type of fuse-holder, testing shall be performed in that fuse-holder.

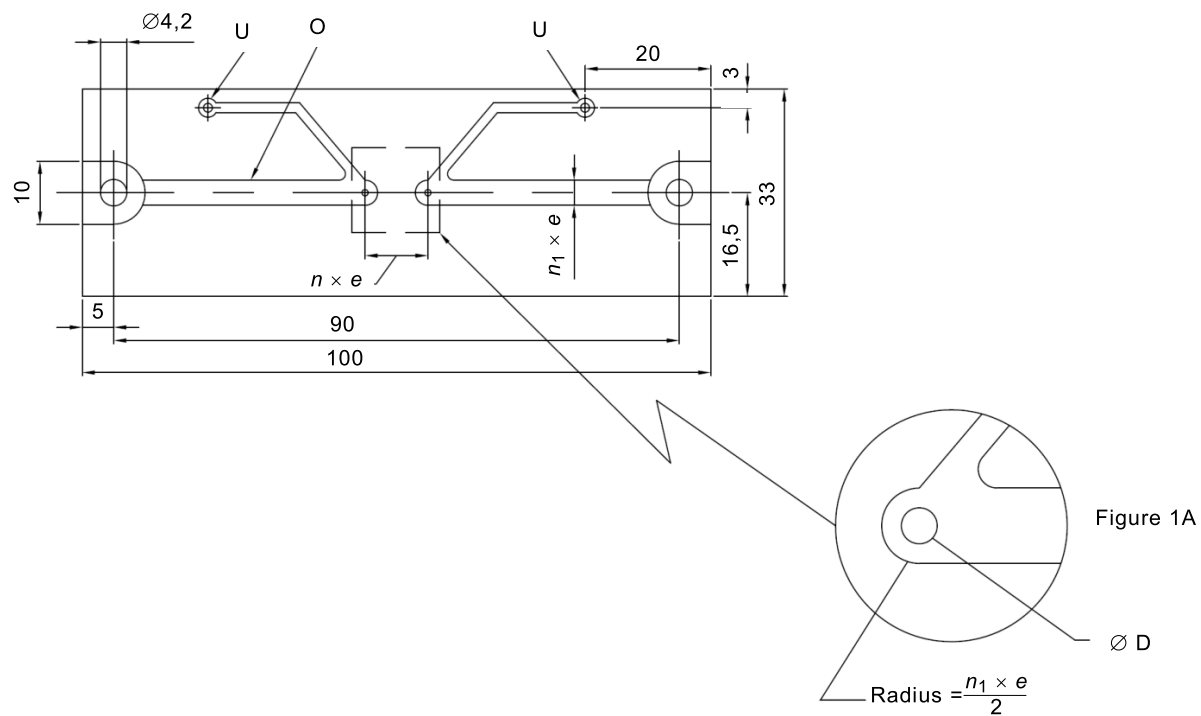
For tests that require a printed circuit board for mounting and connection of the fuse-links, a test board according to Figure 1 or Figure 2 shall be used.

The test board according to Figure 1 shall be used for fuse links with wire terminations intended for insertion in suitably designed holes or sockets.

The test board according to Figure 2 shall be used for surface mount fuse-links.

When two or more fuse-links are tested in series, the fuse-bases shall be located so that there will be a spacing of not less than 50 mm between any two fuse-links under testing. The conductor connecting the fuse-bases together, and connecting the fuse-bases to the ammeter and the source of supply shall be insulated copper wire. The length of each conductor shall be 500 mm and the cross-sectional area of the wire shall be approximately 1 mm² for fuse-links with rated currents up to and including 6,3 A, and 6 mm² for rated currents exceeding 6,3 A.

Dimensions in millimetres



IEC

Key

- O copper layer; thickness 0,035 mm or 0,070 mm
- U connection for voltage drop measurement
- D diameter of 1 mm for rated currents up to and including 6,3 A;
diameter of 1,5 mm for rated currents exceeding 6,3 A.
- e 2,5 mm
- n_1 1, 2, 3, 4
- n 1, 2, 3 ... (to be adapted depending on the length of the fuse-link)

U connection for voltage drop measurement

D diameter of 1 mm for rated currents up to and including 6,3 A;
diameter of 1,5 mm for rated currents exceeding 6,3 A.

e 2,5 mm

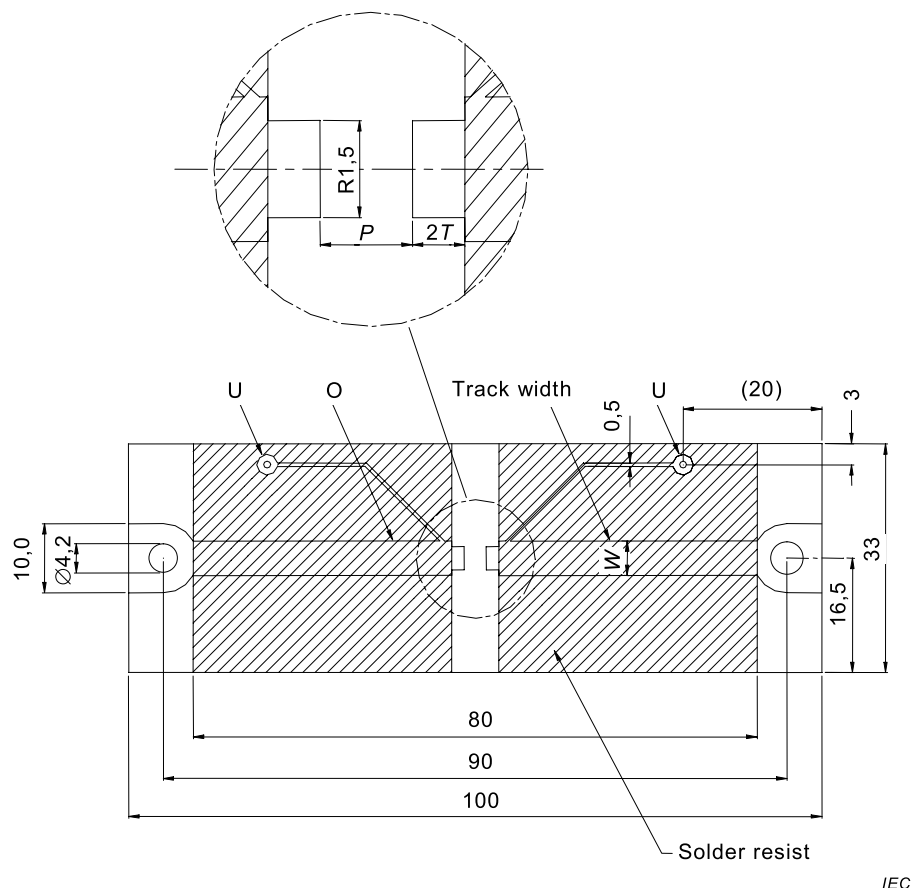
$$n_1 \quad 1, 2, 3, 4$$

$n = 1, 2, 3 \dots$ (to be adapted depending on the length of the fuse-link)

Figure 1 – Standard test board for fuse-links with wire terminations

This test board shall be mounted on the fuse-base according to Figure 3a.

Dimensions in millimetres



Key

○ copper layer, thickness 0,035 mm or 0,070 mm

U connection for voltage drop measurement

W tracking width equals $n_1 \times e$ referring to Figure 1. For small devices, it may be necessary to use reduced track widths, representing normal use of these devices. This should be recorded in the test report and in the manufacturer's literature.

P terminal spacing

R refer to standard sheet 1, page 1

T refer to standard sheet 1, page 1

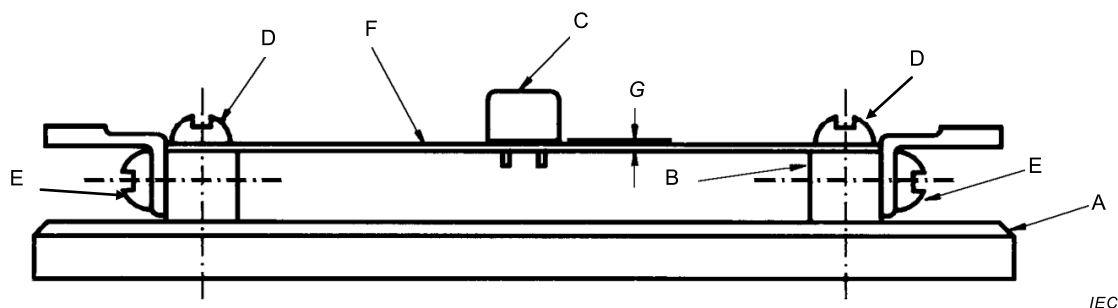
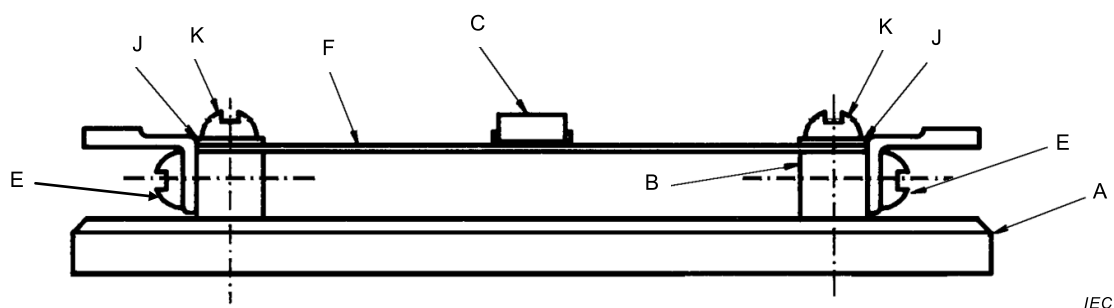
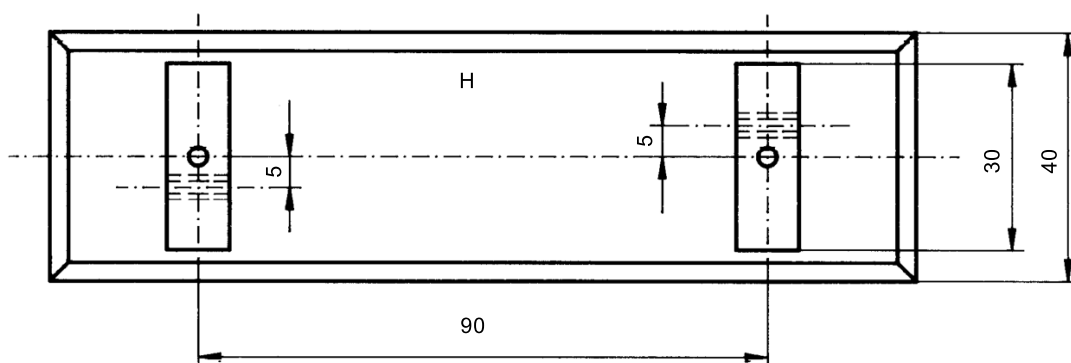
NOTE 1 Solder resist to be applied in hatched areas.

Figure 2 – Test board for surface mount fuse-links

This test board shall be mounted on the fuse-base according to Figure 3b.

The land areas should be suitably prepared for soldering.

A mechanical device may be used as long as it is demonstrated that the results are the same (not applicable to 9.7).

Dimensions in millimetres**Figure 3a – Fuse-links with wire terminations (printed circuit track underneath)****Figure 3b – Surface mount fuse-link (printed circuit track on top)***Dimensions in millimetres*

IEC

- | | | | |
|---|---|---|--|
| A | base of low heat conducting material, thickness 10 mm | F | printed circuit board (see Figure 1 and Figure 2) |
| B | brass electrodes 10 mm × 10 mm | G | space between fuse body and board equals $(0,5 \pm 0,25)$ mm |
| C | Fuse-link soldered in place | H | top view of base with brass electrodes |
| D | fixing screws | J | silver-plated brass washer (two places) |
| E | contact screws holding solder terminal | K | silver-plated brass screw to make contact with the conducting surface on top of the printed circuit board (two places) |

Figure 3 – Test fuse base

The test board shall be made of epoxide woven glass fabric copper-clad laminated sheet, as defined in IEC 61249-2-7.

The nominal sheet thickness shall be 1,6 mm.

The nominal thickness of copper layer may be 0,035 mm or 0,070 mm.

The nominal width of copper layer may be 2,5 mm, 5 mm, 7,5 mm or 10 mm.

The nominal thickness and nominal width of applied copper layer shall be stated in the test report.

Metal parts of the fuse-base shall be made of brass with a copper content between 58 % and 70 %. Contact parts shall be silver-plated.

7.4 Nature of supply

Addition, after second paragraph:

Schedule for testing fuse-links with a.c. or d.c. breaking capacity according to Standard Sheet 1, see Table 2.

Schedule for testing fuse-links with a.c. and d.c. breaking capacity according to Standard Sheet 1, see Table 3.

8 Dimensions and construction

Clause 8 of IEC 60127-1:2006 applies except as follows.

8.2 Construction

Replacement:

The fuse-element shall be completely enclosed.

The fuse-links shall be resistant to heat according to 9.7, and to fire according to IEC 60695-2-12 and IEC 60695-2-13.

This is not applicable for fuse-links which represent small parts according to IEC 60695-4:2012, 3.78.

For fuse bodies made of plastic material or of material containing organic substances the following minimum requirements apply:

- Glow-wire ignition temperature (GWIT) = 775 °C
- Glow-wire flammability index (GWFI) = 850 °C

NOTE 1 Dimensions for the material plates for the glow wire tests are given in IEC 60695-2-12:2010, 4.2 or in IEC 60695-2-13:2010, 4.2.

NOTE 2 For materials such as glass and ceramic whose GWIT and GWFI are thought to be higher than 775 °C and respectively 850 °C the glow-wire tests do not apply.

8.3 Fuse-link terminations

Replacement:

Subclause 8.3 applies only to fuse-links with wire terminations.

Fuse-link contacts shall be made of non-corroding material or of material suitably protected against corrosion, and shall be effectively free from flux or other non-conducting substance on their outer surfaces.

Nickel or silver plating is deemed to be adequate protection for brass end caps.

The fuse-link terminations shall be reliably attached.

The samples shall be immersed in water for 24 h at a temperature of between 15 °C and 35 °C.

Terminations shall withstand the mechanical forces likely to be encountered during normal use. With the fuse-link held in a fixed position, each terminal in turn is subjected at ambient temperature to the forces laid down in this standard. The test samples shall be equally divided among the specific termination tests.

Present test methods shall be performed in accordance with IEC 60068-2-21.

- For the tensile test (U_{a1}), the force applied shall be 10 N.
- For the thrust test (U_{a2}), the force applied shall be 2 N.
- For the bending test (U_b), if applicable, the force applied shall be 5 N and the number of bends shall be one.

After the conclusion of testing, the fuse-link terminations shall remain firmly attached and the voltage drop shall not exceed the maximum allowed value in standard sheet 1.

9 Electrical requirements

Clause 9 of IEC 60127-1:2006 applies except as follows.

9.1 Voltage drop

Addition, after Note 2:

The use of a high impedance voltmeter is recommended for measuring the voltage drop. The voltage drop shall be measured directly at the fuse-link terminations or, where this is not possible, in the immediate vicinity of the fuse body.

If the test board according to Figure 1 or Figure 2 is used, the voltage drop may be measured at the points marked with U.

9.2 Time/current characteristic

9.2.1 Time/current characteristic at normal ambient temperature

Addition, after 4th paragraph:

Limit values t_1 to t_8 given in standard sheet 1 shall be defined by the manufacturer.

Limit values t_2 (maximum value at $2,1 I_N$ or $2,0 I_N$) and t_8 (maximum value at $10 I_N$) are required to be specified. Limit values t_1 , t_3 , t_4 , t_5 , t_6 and t_7 are optional.

The value t_2 shall be not more than 1 h.

The value t_8 shall be not more than 1 s.

9.2.2 Test at elevated temperature

Replacement:

If declared by the manufacturer, this test shall be carried out according to IEC 60127-1:2006, 9.2.2, using the test current (I_{70}) specified by the manufacturer.

9.3 Breaking capacity

9.3.1 Operating conditions

Addition:

In the case of fuse-links in which any component is organic (such as with a moulded body), the recovery voltage shall be maintained for 5 min after the fuse has operated.

Typical test circuits for a.c. and d.c. are given in Figure 4.

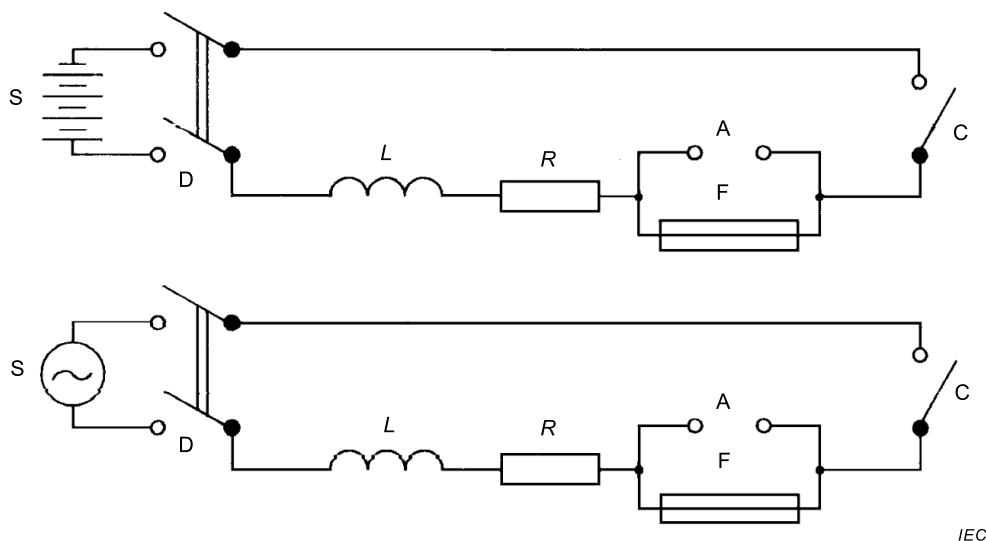


Figure 4a – Typical test circuit for breaking capacity tests for fuse-links with breaking capacity greater than 100 A

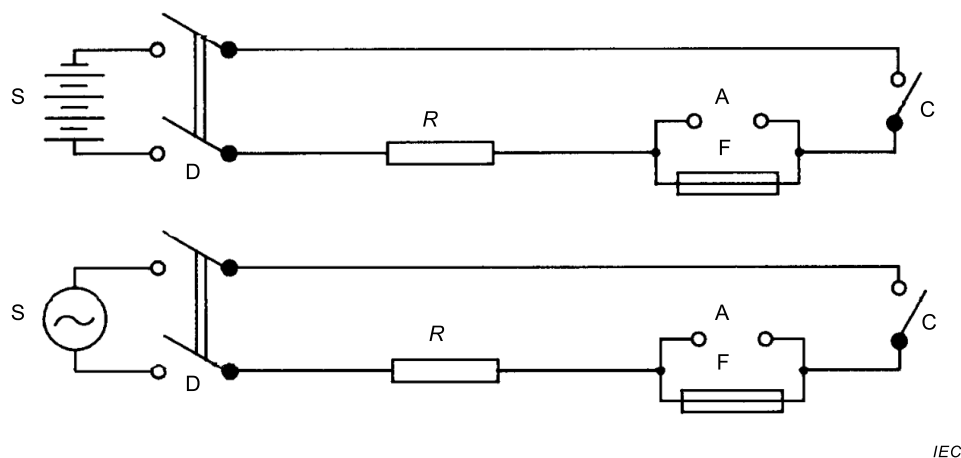


Figure 4b – Typical test circuit for breaking capacity tests for fuse-links with breaking capacity less or equal than 100 A

Components

A	removable link used for calibration	S	source of supply, impedance less than 10 % of the total impedance of the circuit
C	contactor that makes the circuit	L	air-cored inductance
D	switch to disconnect the source of supply	R	series resistor, adjusted to obtain correct prospective current
F	fuse-link under test		

Figure 4 – Test circuits for breaking capacity tests

In principle, the rated breaking capacity (a.c. and/or d.c.) and associated power factor or time constant, respectively, shall be specified by the manufacturer. The values given in the table below are reference values only.

The specified rated breaking capacity shall not be less than 35 A or 10 times the rated current, whichever is greater.

Unless otherwise stated by the manufacturer, the power factor and time constant of the test circuit shall be chosen from Table 1.

Table 1 – Power factor and time constant

Test current	Power factor	Time constant
up to 100 A	>0,95	<1 ms
above 100 A up to 500 A	0,8 to 0,9	1 ms to 1,7 ms
above 500 A up to 1 500 A	0,7 to 0,8	2 ms to 2,5 ms
above 1 500 A up to 10 000 A	0,5 to 0,6	4,5 ms to 5 ms
above 10 000 A up to 25 000 A	0,3 to 0,4	9 ms to 10 ms
above 25 000 A up to 50 000 A	0,2 to 0,3	12,5 ms to 15 ms

For tests at lower prospective currents ($5 I_N$, $10 I_N$, $50 I_N$, $250 I_N$), the inductance of the circuit shall remain constant and the current shall be adjusted by changing the resistance only.

9.3.2 Criteria for satisfactory performance

Addition, after third paragraph:

In addition to the failure criteria described in IEC 60127-1, the fuse-link shall operate satisfactorily in all tests without any of the following phenomena:

- fusing together of the contacts;
- illegibility of marking after test;
- piercing of end caps (if applicable), visible to the naked eye;
- piercing of the external surfaces, visible to the naked eye;
- scorching or melting of organic substances on the external surfaces.

The following phenomena are neglected:

- black spots or other marks on the fuse-link terminations;
- small deformations of the fuse-link;
- cracking of the fuse-link, unless it causes the fuse-link to fall apart during replacement.

9.3.4 Type test for fuse-links of homogenous series

Addition, after second paragraph:

Fuse-links having an intermediate rated current shall be tested according to the relevant testing schedule for intermediate ampere ratings of a homogenous series given in Table 7.

9.4 Endurance tests

a) *Replacement of the first sentence as follows:*

The test current I_{test} (A) is passed through the fuse-link for a period of 1 h. The minimum value for I_{test} (A) is $1,0 I_N$.

b) *Replacement of the first sentence as follows:*

The test current I_{OVL} (A) is then passed through the fuse-link for a period of 1 h.

c) *Addition:*

The voltage drop shall not exceed the maximum value specified in standard sheet 1.

Additional subclauses:

9.4.101 Endurance test at normal ambient temperature

Compliance is checked by subjecting the fuse-links to test method A or test method B.

Choice of either method A or method B shall be as agreed upon with the manufacturer. This also applies to the test currents to be selected among I_{test} (A), I_{test} (B), I_{OVL} (A) and I_{OVL} (B).

9.4.102 Test method A

As specified in IEC 60127-1:2006, 9.4 a) to d), with test current I_{test} (A) for 9.4 a) and I_{OVL} (A) for 9.4 b).

9.4.103 Test method B

The test sequence has to be as follows:

- a) The d.c. current I_{test} (B) is passed through the fuse-link for a period of 100 h. The minimum value for I_{test} (B) is $0,8 I_N$.

The current stability during the test shall be maintained within ± 1 % of the adjusted value. The d.c. current I_{OVL} (B) is then passed through the fuse-link for a period of 1 h.

- b) At the end of this test the voltage drop across the fuse-link is measured and used for the calculation of the maximum sustained dissipation.
- c) Finally, the voltage drop across the fuse-link is measured again according to 9.1. The voltage drop shall not have increased by more than 10 % of the value measured before the test and shall not exceed the maximum value specified in standard sheet 1.
- d) After the test, the marking shall still be legible and soldered joints on the fuse-link terminations shall not show any appreciable changes.

NOTE Changes in colour are not considered a failure.

9.5 Maximum sustained dissipation

Subclause 9.5 of IEC 60127-1:2006 applies.

9.6 Pulse tests

Replacement:

None specified.

9.7 Fuse-link temperature

Additional subclauses:

9.7.101 Fuse-links for use on printed circuit boards

For fuse-links designed to be mounted on circuit boards, compliance is checked by subjecting the fuse-links to test method I or method II as requested by the manufacturer.

Test method I

As specified in IEC 60127-1:2006, 9.7, with replacement of the maximum temperature rise of 135 K by 150 K for terminals and 135 K for plastic body materials. The initial current shall be I_{OVL} (A) or I_{OVL} (B) depending on which test method of 9.4 has been chosen.

The temperature during the last 30 s prior to opening shall be ignored.

Test method II

The temperature rise above ambient temperature shall be measured on the terminals of the fuse-links soldered to the relevant test board, using a fine-wire thermocouple not larger than 0,21 mm².

The measurement shall be done during the final 5 min of the endurance test at I_{OVL} (A) or I_{OVL} (B) depending on which test method of 9.4 has been chosen. The temperature rise shall not exceed 95 K.

Fuse-link numbers 1, 2, 3, 4, 5 and 6 shall be used for this test and fuse-link numbers 43, 44 and 45 in Table 2, or 58, 59 and 60 in Table 3, shall be kept as additional spares.

9.7.102 Fuse-links for use in fuse-holders

For fuse-links intended to be inserted in specifically designed fuse-holders, the test according to IEC 60127-6:1994, Clause 14, shall be carried out using the fuse-links to be tested instead of the required dummy fuse-links.

After the test in 14.1 of IEC 60127-6:1994, the inspection according to IEC 60127-6:1994, 12.2, shall not be performed.

Table 2 – Testing schedule for individual ampere ratings for a.c. or d.c. breaking capacity fuse-links

Subclause	Description	Fuse-link number																	
		1	4	7	10	13	16	19	22	25	28	31	34	37	40	43	46	49	E1 ^b
		2	5	8	11	14	17	20	23	26	29	32	35	38	41	44	47	50	E2 ^b
		3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	E3 ^b
9.7	Fuse-link temperature															X			
9.4	Endurance tests	X	X																
9.2.2	Test at elevated temperature				X														
9.2.1	Time/current characteristic 10 I_N at normal ambient temperature							X											
	10 I_N																		
	4,0 I_N									X									
	2,75 I_N														X				
	2,0 I_N or 2,1 I_N																	X	
9.3	Breaking capacity																		
	Rated breaking capacity					X													
	5 times the rated current						X												
	10 times the rated current										X								
	50 times the rated current ^a											X							
	250 times the rated current ^a													X					
9.3.3	Insulation resistance					X	X				X	X		X					
8.3	Fuse-link terminations																		X
8.5	Soldered joints	X	X					X		X					X	X		X	
6.2	Legibility and indelibility of marking							X		X					X	X		X	
^a Applicable only when the rated breaking capacity is not exceeded.																			
^b The extra samples for termination test (E1 to E6) have to be chosen by random and not sorted by voltage drop.																			

Table 3 – Testing schedule for individual ampere ratings for a.c. and d.c. breaking capacity fuse-links

Subclause	Description	Fuse-link number																									
		1	4	7	10	13	16	19	22	25	28	31	34	37	40	43	46	49	52	55	58	61	E1 ^b	E4 ^b			
		2	5	8	11	14	17	20	23	26	29	32	35	38	41	44	47	50	53	56	59	62	E2 ^b	E5 ^b			
		3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60	63	E3 ^b	E6 ^b			
9.7	Fuse-link temperature																				X						
9.4	Endurance tests	X	X																								
9.2.2	Test at elevated temperature				X																						
9.2.1	Time/current characteristic 10 I _N									X																	
	at normal ambient temperature 4,0 I _N											X															
	2,75 I _N																		X								
	2,0 I _N or 2,1 I _N																				X						
9.3	Breaking capacity																										
	Rated breaking capacity a.c.					X																					
	Rated breaking capacity d.c.						X																				
	5 times the rated current 5 I _N – a.c.							X																			
	5 times the rated current 5 I _N – d.c.								X																		
	10 times the rated current 10 I _N – a.c.												X														
	10 times the rated current 10 I _N – d.c.													X													
	50 times the rated current ^a 50 I _N – a.c.														X												
	50 times the rated current ^a 50 I _N – d.c.															X											
250 times the rated current ^a 250 I _N – a.c.																	X										
250 times the rated current ^a 250 I _N – d.c.																		X									
9.3.3	Insulation resistance					X	X	X	X				X	X	X	X		X	X								
8.3	Fuse-link terminations																					X	X				
8.5	Soldered joints	X	X							X		X							X	X	X						
6.2	Legibility and indelibility of marking									X		X							X	X	X						
^a Applicable only when the rated breaking capacity is not exceeded.																											
^b The extra samples for termination test (E1 to E6) have to be chosen by random and not sorted by voltage drop.																											

**Table 4 – Testing schedule for maximum ampere rating of a homogeneous series
(a.c. or d.c. breaking capacity fuse-links)**

Sub-clause	Description		Fuse-link numbers in decreasing value of voltage drop													
			1-6	7 8 9	10 11 12	13-17	18-27	28 29 30	31 32 33	34 35 36	37 38 39	40 41 42	43 44 45	46 47 48	49 50 51	E1 ^a E2 ^a E3 ^a
9.7	Fuse-link temperature											X				
9.4	Endurance test		X													
9.2.2	Test at elevated temperature				X											
9.2.1	Time/current characteristic	10 <i>I_N</i>					X									
		4 <i>I_N</i>							X							
		2,75 <i>I_N</i>									X					
		2,1 <i>I_N</i>												X		
9.3	Rated breaking capacity					X										
9.3.3	Insulation resistance					X										
8.3	Terminations														X	X
8.5	Soldered joints		X				X		X		X	X		X		
6.2	Legibility and indelibility of marking						X		X		X	X		X		
^a The extra samples for termination test (E1 to E6) have to be chosen by random and not sorted by voltage drop.																

**Table 5 – Testing schedule for maximum ampere rating of a homogeneous series
(a.c. and d.c. breaking capacity fuse-links)**

Sub-clause	Description		Fuse-link numbers in decreasing value of voltage drop															
			1-6	7 8 9	10 11 12	13-17	18-27	28-32	33-42	43 44 45	46 47 48	49 50 51	52 53 54	55 56 57	58 59 60	61 62 63	64 65 66	E1 ^a E2 ^a E3 ^a
9.7	Fuse-link temperature													X				
9.4	Endurance test		X															
9.2.2	Test at elevated temperature				X													
9.2.1	Time/current characteristic	10 I_N							X									
		4 I_N									X							
		2,75 I_N											X					
		2,1 I_N														X		
9.3	Rated breaking capacity a.c.					X												
9.3	Rated breaking capacity d.c.							X										
9.3.3	Insulation resistance					X		X										
8.3	Terminations																X	X
8.5	Soldered joints		X						X		X		X	X		X		
6.2	Legibility and indelibility of marking								X		X		X	X		X		
^a The extra samples for termination test (E1 to E6) have to be chosen by random and not sorted by voltage drop.																		

Table 6 – Testing schedule for minimum ampere rating of a homogeneous series

Sub-clause	Description	Fuse-link numbers in decreasing value of voltage drop							
		1-6	7 8 9	10 11 12	13-17	18-22	23-32	33 34 35	36 37 38
9.4	Endurance test	X							
9.2.1	Time/current characteristic	10 I_N	X						
		2.0 I_N or 2.1 I_N						X	
9.3	Rated breaking capacity	a.c.			X				
		d.c. (if applicable)				X			

Table 7 – Testing schedule for all intermediate ampere ratings of a homogeneous series

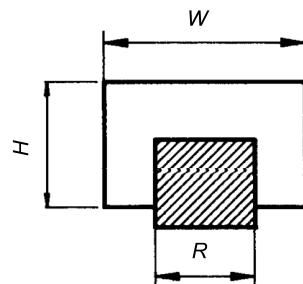
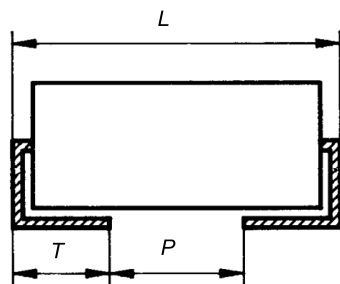
Sub-clause	Description	Fuse-link numbers in decreasing value of voltage drop							
		1-6	7 8 9	10 11 12	13-17	18-22	23-32	33 34 35	36 37 38
9.4b / 9.5	Maximum sustained dissipation ^a	X							
9.2.1	Time/current characteristic	10 I_N	X						
		2.0 I_N or 2.1 I_N						X	
9.3	Rated breaking capacity	a.c.			X				
		d.c. (if applicable)				X			

^a The tests have to be performed with new samples; the 100 test cycles of 9.4.102 and 100h current test of 9.4.103 a) will not be performed

10 Standard sheets

10.1 Standard sheet 1 – Fuse-links for special applications

	Fuse-links for special applications	Standard sheet 1 Page 1
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IEC

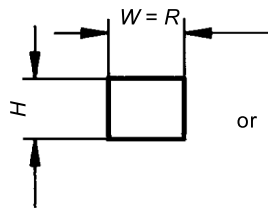
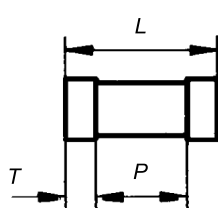
Rated voltage ^a V	Minimum terminal spacing <i>P</i> mm	Maximum dimensions mm		
		<i>W</i> (width)	<i>H</i> (height)	<i>L</i> (length)
12,5	0,4	12	12	50
25	0,45	12	12	50
32	0,48	12	12	50
50	0,53	12	12	50
63	1,1	12	12	50
125	1,3	12	12	50
250	2,5	12	12	50
500	to be determined	12	12	50
1 000	to be determined	12	12	50

^a Intermediate values are possible. The respective minimum terminal spacing *P* shall be chosen according to IEC 60664-1.

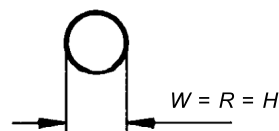
Any shape is allowed; the point at which the terminations protrude from the body is optional and the termination may vary.

NOTE The following drawings are mainly for surface mount fuse-links. For the other types of fuse-links additional components of terminations or terminals such as wire terminations, pins and bolt-in terminals etc. may not be included in the total length of 50 mm and the width and height of 12 mm.

Some alternative shapes are shown below:



or



IEC

Remark: The terminal spacing *P* has been chosen according to IEC 60664-1 taking into account pollution degree 2 and overvoltage category II (stress less than 1 500 h).

Dimensions *T* and *R* are not specified, but are required to calculate the land areas for the test board for surface mount fuse-links.

	Fuse-links for special applications	Standard sheet 1 Page 2
Maximum values of voltage drop and sustained dissipation		
Rated current	Maximum voltage drop mV	Maximum sustained dissipation mW
32 mA	7 000	1 600
50 mA	5 000	1 600
63 mA	4 400	1 600
80 mA	3 800	1 600
100 mA	3 500	1 600
125 mA	2 500	1 600
160 mA	2 200	1 600
200 mA	1 800	1 600
250 mA	1 400	1 600
315 mA	1 300	1 600
400 mA	1 000	1 600
500 mA	900	1 600
630 mA	800	1 600
800 mA	600	1 600
1,0 A	500	2 500
1,25 A	400	2 500
1,6 A	300	2 500
2,0 A	300	2 500
2,5 A	300	2 500
3,15 A	300	4 000
4,0 A	300	4 000
5,0 A	300	4 000
6,3 A	300	4 000
8,0 A	220	4 000
10,0 A	220	4 000
12,5 A	180	4 000
16 A	140	4 000
20 A	100	4 000
If intermediate rated currents are required, they shall be chosen from the series R20 or R40 according to ISO 3.		
If lower values are stated by the manufacturer, these values shall be used.		

Marking

Fuse-links shall be marked according to the requirements of Clause 6.

Pre-arcing time/current characteristic

The pre-arcing time shall be within the following limits:

2,0 I_N or 2,1 I_N		2,75 I_N		4 I_N		10 I_N	
min.	max.	min.	max.	min.	max.	min.	max.
t_1	t_2	t_3	t_4	t_5	t_6	t_7	t_8

	Fuse-links for special applications	Standard sheet 1 Page 3
<p>Test at a temperature of $(70 \pm 2)^\circ\text{C}$ (if requested by the manufacturer)</p> <p>A test current I_{70} shall be passed through the fuse-links for 1 hour and they shall not operate.</p> <p>NOTE The manufacturer can additionally specify a higher test temperature than 70°C or a longer test duration than 1 h.</p> <p>Breaking capacity</p> <p>Fuse-links shall be tested as appropriate to their a.c., d.c or a.c./d.c. rating as specified in 9.3.</p> <p>Endurance test</p> <p>Fuse-links shall be tested according to either method A or method B as specified in 9.4.</p> <p>Maximum sustained dissipation</p> <p>The maximum sustained dissipation shall be measured at test current I_{OVL} (A) or I_{OVL} (B) during the last 10 min of the endurance test and shall not exceed the values specified in this standard sheet.</p> <p>Temperature rise test</p> <p>Fuse-links shall be tested according to method I or method II of 9.7.101, as specified by the manufacturer, or according to 9.7.102.</p> <p>9.7.101 Method I</p> <p>The temperature rise shall not exceed 150 K (except 135 K for plastic body materials).</p> <p>(The temperature during the last 30 s prior to opening shall be ignored).</p> <p>9.7.101 Method II</p> <p>The temperature rise shall not exceed 95 K.</p> <p>9.7.102</p> <p>If a fuse-holder is used, the temperature rise of the plastic material shall not exceed the respective RTI value.</p>		

Annex A

(informative)

**Guidance on ratings to be specified by the manufacturer
or to be agreed upon with the testing house**

A.1

Table A.1 gives guidance on ratings to be specified by the manufacturer or to be agreed upon with the testing house.

Table A.1 – Guidance on ratings to be specified by the manufacturer or to be agreed upon with the testing house

Subclause	Rating	Remark
9.2	t_1 to t_8	t_2 and t_8 are mandatory; the values t_2 and t_8 shall be not more than 1 h ($t_{2\max} = 1$ h) and 1 s ($t_{8\max} = 1,00$ s) respectively t_1, t_3, t_4, t_5, t_6 and t_7 are optional 2,0 I_N or 2,1 I_N to be chosen for t_1 and t_2
9.2.2	I_{70}	test current for an optional test at 70 °C preferred values: 0,8 I_N or 1,0 I_N or 1,1 I_N NOTE The manufacturer can additionally specify a higher test temperature than 70 °C or a longer test duration than 1 hour.
9.3	Breaking capacity	may be specified for a.c. or d.c or a.c./d.c.; the specified rated breaking capacity shall be not less than 35 A or 10 times the rated current whichever is greater
9.4 and 9.5	I_{test} (A) or I_{test} (B) I_{OVL} (A) or I_{OVL} (B)	specification of cyclic test current according to test method A; the minimum value for I_{test} (A) is 1,0 I_N (I_{test} (A)min = 1,0 I_N) or of continuous current according to method B; the minimum value for I_{test} (B) is 0,8 I_N (I_{test} (B)min = 0,8 I_N) specification of overload current for endurance test
9.7.101	Method I: initial current is I_{OVL} (A) or I_{OVL} (B) Method II: test current is I_{OVL} (A) or I_{OVL} (B)	for fuse-links for use on printed circuit boards: test method I (step test) or test method II (1 hour overload) as determined by the manufacturer
9.7.102	test current is I_N	for fuse-links for use in fuse-holders

Bibliography

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

3, rue de Varembé
PO Box 131
CH-1211 Geneva 20
Switzerland

Tel: + 41 22 919 02 11
Fax: + 41 22 919 03 00
info@iec.ch
www.iec.ch