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REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

Miniature fuses –
Part 6: Fuse-holders for miniature fuse-links

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IEC Secretariat
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

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

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MINIATURE FUSES –

Part 6: Fuse-holders for miniature fuse-links

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.
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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 60127-6:2014. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

IEC 60127-6 has been prepared by subcommittee 32C: Miniature fuses, of IEC technical committee 32: Fuses. It is an International Standard.

This third edition cancels and replaces the second edition published in 2014. This edition constitutes a technical revision.

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

a) enhanced maximum rated current from 16 A to 25 A in Clause 1;
b) adding of IEC 60127-4 and IEC 60127-7 in Clause 1;
c) modification of marking position in Clause 6;
d) modification of rated voltage, rated current and rated power acceptance in Table 2;
e) modification of Table 5, Table 6, Table 7, Table 9, Table 16 and Table A.1.

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

Draft	Report on voting
32C/620/FDIS	32C/623/RVD

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

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

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

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

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

- reconfirmed,
- withdrawn, or
- revised.

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

INTRODUCTION

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 and subclauses containing general requirements need not be repeated.

To this day, the IEC 60127 series, 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 ~~cartridge~~ fuse-links*

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

~~IEC 60127-8 (free for further documents)~~

IEC 60127-8, *Miniature fuses – Part 8: Fuse resistors with particular overcurrent protection*

~~IEC 60127-9 (free for further documents).~~

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

This part of IEC 60127 covers requirements, test equipment and test methods for fuse-holders. It is a self-standing document, which refers back to IEC 60127-1 with regard to certain definitions and the atmospheric conditions for test. It also makes reference to other parts of the IEC 60127 series with regard to dimensions and maximum power losses of fuse-links.

MINIATURE FUSES –

Part 6: Fuse-holders for miniature fuse-links

1 Scope

This part of IEC 60127 is applicable to fuse-holders for miniature cartridge fuse-links according to IEC 60127-2, sub-miniature fuse-links according to IEC 60127-3, universal modular fuse-links to IEC 60127-4 and miniature fuse-links for special applications to IEC 60127-7 for the protection of electric appliances, electronic equipment and component parts thereof, normally intended for use indoors.

NOTE Requirements for fuse-holders for miniature fuse-links complying with IEC 60127-4 and IEC 60127-7 are under consideration.

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

This document applies to fuse-holders with:

– a maximum rated current of ~~16~~ 25 A and
– a maximum rated voltage of 1 500 V DC or 1 000 V AC; and
– for use up to 2 000 m above sea-level, unless otherwise specified.

The object of this document is to establish uniform requirements for safety and the assessment of electrical, mechanical, thermal and climatic properties of fuse-holders and the compatibility between fuse-holders and fuse-links.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

~~IEC 60050 (all parts), *International Electrotechnical Vocabulary*~~

IEC 60050-441, *International Electrotechnical Vocabulary (IEV) – Part 441: Switchgear, controlgear and fuses*

IEC 60050-581, *International Electrotechnical Vocabulary (IEV) – Part 581: Electromechanical components for electronic equipment*

IEC 60068-1:2013, *Environmental testing – Part 1: General and guidance*

~~IEC 60068-2-1:2007, *Environmental testing - Part 2-1: Tests - Test A: Cold*~~

~~IEC 60068-2-2:2007, *Environmental testing - Part 2-2: Tests - Test B: Dry heat*~~

IEC 60068-2-6:2007, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-20:~~2008~~2021, *Environmental testing – Part 2-20: Tests –~~Test T~~ Tests Ta and Tb: Test methods for solderability and resistance to soldering heat of devices with leads*

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

IEC 60068-2-27:2008, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60068-2-45~~:1980~~, *Basic environmental testing procedures – Part 2-45: Tests – Test XA and guidance: Immersion in cleaning solvents*
~~IEC 60068-2-45:1980/AMD1:1993~~

IEC 60068-2-47~~:2005~~, *Environmental testing – Part 2-47: Test – Mounting of specimens for vibration, impact and similar dynamic tests*

IEC 60068-2-75~~:1997~~, *Environmental testing – Part 2-75: Tests – Test Eh: Hammer tests*

~~IEC 60068-2-78:2012, *Environmental testing - Part 2-78: Tests - Test Cab: Damp heat, steady state*~~

~~IEC 60068-3-4:2001, *Environmental testing - Part 3-4: Supporting documentation and guidance - Damp heat tests*~~

~~IEC 60112:2003, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*~~
~~IEC 60112:2003/AMD1:2009~~

IEC 60127-1[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 60127-2~~:2003~~, *Miniature fuses - Part 2: Cartridge fuse-links*
~~IEC 60127-2:2003/AMD1:2003~~
~~IEC 60127-2:2003/AMD2:2010~~

IEC 60127-3:~~1988~~2015, *Miniature fuses - Part 3: Sub-miniature fuse-links*
~~IEC 60127-3:1988/AMD1:1991~~
~~IEC 60127-3:1988/AMD2:2002~~

IEC 60216-1~~:2013~~, *Electrical insulating materials – Thermal endurance properties – Part 1: Ageing procedures and evaluation of test results*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*
~~IEC 60529:1989/AMD1:1999~~
~~IEC 60529:1989/AMD2:2013~~

IEC 60664-1:~~2007~~2020, *Insulation coordination for equipment within low-voltage supply systems – Part 1: Principles, requirements and tests*

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

[1] A consolidated version of this publication exists, comprising IEC 60127-1:2006, IEC 60127-1:2006/AMD 1:2011 and IEC 60127-1:2006/AMD 2:2015.

IEC 60695-2-12:~~2010~~2021, *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~~2021, *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 60695-11-5:~~2004~~2016, *Fire hazard testing - Part 11-5: Test flames - Needle-flame test method - Apparatus, confirmatory test arrangement and guidance*

IEC 60999-1~~:1999~~, *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 1: General requirements and particular requirements for clamping units for conductors from 0,2 mm^2 up to 35 mm^2 (included)*

~~IEC 61140:2001, *Protection against electric shock - Common aspects for installation and equipment*~~
~~IEC 61140:2001/AMD1:2004~~

IEC 61210~~:2010~~, *Connecting devices – Flat quick-connect terminations for electrical copper conductors – Safety requirements*

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

3 Terms and definitions

~~For the definitions of general terms used in this standard, reference should be made to IEC 60050-441, IEC 60050-581 and IEC 60664-1.~~

~~For definitions of terms relating to fuse-links, reference is made to IEC 60127-1:2006.~~

~~For the purposes of this document, the following terms and definitions apply.~~

For the purposes of this document, the terms and definitions given in IEC 60050-441, IEC 60050-581, IEC 60127-1 and the following apply.

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

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

3.1
fuse-holder
combination of a fuse-base with its fuse-carrier

Note 1 to entry: In some fuse-holder constructions where the fuse-base and the fuse-carrier are not separate parts the fuse-holder may consist of only the fuse-base and no fuse-carrier.

3.1.1
fuse-base
fuse-mount
fixed part of a fuse provided with contacts and terminals for connection to the system

[SOURCE: IEC 60127-1:2006, 3.10]

3.1.2
fuse-carrier
movable part of a fuse designed to carry a fuse-link

[SOURCE: IEC 60127-1:2006, 3.12]

3.1.3
unexposed fuse-holder
fuse-holder with enclosed contacts

3.1.4
exposed fuse-holder
fuse-holder with exposed contacts

EXAMPLE Clips.

3.2
rating
characteristic values that together define the working conditions upon which the tests are based and for which the fuse-holder is designed

EXAMPLE Examples of rated values usually stated for ~~fuses~~ fuse-holders are:

– voltage (U_N);

– current (I_N);

~~– breaking capacity.~~

– power acceptance.

~~[SOURCE: IEC 60127-1:2006, 3.16]~~

3.3
rated power acceptance
value of power acceptance of a fuse-holder assigned by the manufacturer

Note 1 to entry: This value is the maximum power dissipation produced by the inserted dummy fuse-link during testing, at the rated current tolerated by the fuse-holder without exceeding the specified temperatures.

Note 2 to entry: The rated power acceptance is referred to an ambient temperature of 23 °C.

3.4
rated current
value of current of a fuse-holder assigned by the manufacturer and to which the rated power acceptance is referred

3.5
rated voltage
value of voltage of a fuse-holder assigned by the manufacturer and to which operation and performance characteristics are referred

3.6
insulation coordination
mutual correlation of insulation characteristics of electrical equipment taking into account the expected micro-environment and other influencing stresses

[SOURCE: IEC 60664-1:~~2007~~2020, 3.1.3, modified – Note 1 to entry has been removed.]

3.7
impulse withstand voltage
highest peak value of impulse voltage of ~~prescribed~~ specified form and polarity which does not cause breakdown of insulation under specified conditions

[SOURCE: IEC 60664-1:~~2007~~2020, 3.1.15]

3.8
overvoltage category
numeral defining a transient overvoltage condition

Note 1 to entry: Specified categories, see Clause C.1.

[SOURCE: IEC 60664-1:~~2007~~2020, ~~3.10, modified by addition of "specified categories"~~ 3.1.20, modified – Note 1 to entry "Overvoltage categories I, II, III and IV are used, see 4.3.2" has been entirely reworded.]

3.9
pollution
~~any addition of foreign matter, solid, liquid, or gaseous that can result in a reduction of electric strength or surface resistivity of the insulation~~

<of an electrical system> any condition of foreign matter, solid, liquid, or gaseous (ionized gases), that can affect dielectric strength or surface resistivity

[SOURCE: IEC 60664-1:~~2007~~2020, 3.1.24]

3.10
pollution degree
numeral characterizing the expected pollution of the micro-environment

~~specified degrees, see C.2~~

Note 1 to entry: see Clause C.2.

[SOURCE: IEC 60664-1:~~2007~~2020, ~~3.13, modified by addition of "specified categories"~~ 3.1.25, modified – Note 1 to entry has been added]

3.11
micro-environment
~~immediate environment of the insulation which particularly influences the dimensioning of the creepage distances~~

<of an electrical system> ambient conditions which immediately influences the dimensioning of the clearance and creepage distances

[SOURCE: IEC 60664-1:~~2007~~2020, 3.1.23]

3.12
clearance
shortest distance in air between two conductive parts

[SOURCE: IEC 60664-1:~~2007~~2020, 3.1.4]

3.13
creepage distance
shortest distance along the surface of a solid insulating material between two conductive parts

[SOURCE: IEC 60050-151:2001, 151-15-50]

3.14
solid insulation
solid insulating material or a combination of solid insulating material, ~~interposed~~ placed between two conductive parts or between a conductive part and a body part

[SOURCE: IEC 60664-1:~~2007~~2020, 3.1.6]

3.15
comparative tracking index
CTI
numerical value of the maximum voltage in volts which a material can withstand without tracking and without a persistent flame occurring under specified test conditions

Note 1 to entry: The test for comparative tracking index in accordance with IEC 60112 is designed to compare the performance of various insulating materials under test conditions, namely drops of an aqueous contaminant falling on a horizontal surface leading to electrolytic conduction material groups and their CTI values, see Clause C.3.

[SOURCE: IEC 60050-212:2010, 212-11-59, modified – The Note to entry has been added.]

3.16
live part
conductor or conductive part intended to be energized in normal operation, including a neutral conductor, but by convention, not a PEN conductor or PEM conductor or PEL conductor

Note 1 to entry: This concept does not necessarily imply a risk of electric shock.

[SOURCE: IEC 60050-826:~~2004~~2022, 826-12-08, modified – The domain "<in electrical installations and equipment> has been deleted, the definition has been reworded and the note to entry has been added.]

3.17
fuse-holder electric shock protection categories
designation characterizing the level of the protection against electric shock of a fuse-holder

3.18
maximum allowable ambient ~~air~~ temperature
highest air temperature, in the immediate vicinity, that a fuse-holder can endure at a power acceptance assigned by the manufacturer of the fuse-holder without exceeding the maximum allowable temperatures on the accessible and inaccessible surfaces of the fuse-holder

3.19
relative temperature index
based on IEC 60216-1, temperature index of a test material obtained from the time which corresponds to the known temperature index of a reference material when both materials are subjected to the same ageing and diagnostic procedures in comparative test

3.20
insulation
part of an electrotechnical product which separates the conducting parts at different electric~~al~~ potentials during operation or insulates such parts from the surroundings

Note 1 to entry: For detailed information, see IEC 61140 and IEC 60664-1.

[SOURCE: IEC 60050-212:2010, ~~212-01-05~~ 212-11-07, modified – The term "electric insulation" has been replaced by "insulation".]

3.20.1
functional insulation
insulation between conductive parts which is necessary only for the proper functioning of the equipment

[SOURCE: IEC 60664-1:~~2007~~2020, 3.1.29]

3.20.2
basic insulation
insulation of hazardous-live-parts which provides basic protection

Note 1 to entry: The concept does not apply to insulation used exclusively for functional purposes.

[SOURCE: IEC 60050-826:~~2004~~2022, 826-12-14, modified – In the definition, the term "insulation" has been replaced by "insulation of hazardous-live-parts".]

3.20.3
supplementary insulation
independent insulation applied in addition to basic insulation for fault protection

[SOURCE: IEC 60050-826:~~2004~~2022, 826-12-15]

3.20.4
double insulation
insulation comprising both basic insulation and supplementary insulation

[SOURCE: IEC 60050-826:~~2004~~2022, 826-12-16]

3.20.5
reinforced insulation
insulation of hazardous-live-parts which provides a degree of protection against electric shock equivalent to double insulation

Note 1 to entry: Reinforced insulation ~~may~~ can comprise several layers which cannot be tested singly as basic insulation or supplementary insulation.

[SOURCE: IEC 60050-826:~~2004~~2022, 826-12-17, modified – In the definition, the term "insulation" has been replaced by "insulation of hazardous-live-parts".]

3.21
inaccessible part
~~(~~inaccessible surface~~)~~
part or surface inside the equipment which cannot be touched by means of the standard test finger according to IEC 60529

3.22
accessible part
accessible surface
part or surface which can be touched by means of the standard test finger according to IEC 60529, when the fuse-holder is installed and operated as in normal use, e.g. on the front panel of equipment

3.23
gauge
test fuse-link without a melting element

4 General requirements

Fuse-holders shall be so designed and constructed that in normal use, installed according to the manufacturer's instructions, their performance is reliable and without danger to the user or surroundings.

In general, compliance is checked by carrying out all of the relevant tests specified.

Additional tests and requirements may be added in accordance with the manufacturer's declaration, as shown in Annex D.

Examples of fuse-holder types with different features are given in Table 1.

Table 1 – Features of unexposed or exposed fuse-holders

No.	description
1	*Types of mounting*: – Panel and base mounting – Printed circuit board mounting
2	*Methods of fastening*: – Methods of fastening on panel: • Fixing nut fastening (threaded nut) • Snap-in fastening: a) Fuse-base with an integral spring system b) Fuse-base with a separate spring-nut (a nut fabricated, e.g. from thin spring steel having an impression designed to accommodate the mating part)
	– Methods of fastening on printed circuit (PC) board: • Solder fastening • Plug-in fastening
3	*Methods of insertion of the fuse-carrier into the fuse base:* – Screw insertion – Bayonet insertion – Plug-in insertion
4	*Types of terminals:* – Screw terminals – Solder terminals – Quick connect terminals – Other solderless terminals: • crimp terminals • wire wrap terminals
5	*Protection against electric shock* – Fuse-holder without integral protection against electric shock – Fuse-holder with integral protection against electric shock – Fuse-holder with enhanced integral protection against electric shock
NOTE This list is not intended to be comprehensive and fuse-holders which are not listed are not necessarily excluded from the scope.	

5 Preferred ~~standard~~ ratings and classifications for fuse-holders

Table 2 gives the values for ~~standard~~ preferred ratings and classifications.

Table 2 – Values for ~~standard~~ preferred ratings and classifications

~~Preferred~~ Ratings and classifications for fuse-holders	For fuse-links according to	
	IEC 60127-2	IEC 60127-3
Rated voltage	250 V and 500 V	125 V and 250 V
Rated current	6,3 A / 10 A / 12,5 A / 16 A / 20 A / 25 A	~~5 A~~ 6,3 A / 10 A
Rated power acceptance at an ambient temperature T_{A1} of 23 °C	1,6 W / 2,5 W / 3,2 W / 4 W /5 W / 6 W / 8 W	1,6 W / ~~2,5~~ 2,0 W
~~Protection against electric shock referring to fuse-holder~~ Fuse-holder electric shock protection categories	Category PC1 Category PC2 Category PC3	
Protection against electric shock referring to equipment, according to IEC 61140	Class I or II	
Insulation coordination according to IEC 60664-1: a) Overvoltage category b) Pollution degree c) Comparative tracking index CTI	 II or III 2 or 3 CTI ≥ 150	

In reference to ratings (voltage, current, power acceptance), if other values are required, these values should be selected from the R10 series according to ISO 3. For classifications (Insulation coordination according to IEC 60664-1 in Table 2), other values may be specified.

Complete information on ratings and classifications is given by the manufacturer according to Annex E.

6 Marking

~~Fuse-holders shall be marked with the name or trade mark of the manufacturer together with the catalogue or type reference.~~

~~The manufacturer may provide additional markings for the rated voltage in volts, the power acceptance in watts together with the rated current in amperes (. ./. .), e.g. 250 V (4 W/6,3 A).~~

~~The additional marking shall not be placed on the front of the fuse-holder.~~

~~NOTE This is to prevent installation of a replacement fuse-link with the wrong rating.~~

~~The marking shall be indelible and easily legible.~~

~~Compliance is checked by inspection and by the test according to 6.2 of IEC 60127-1:2006.~~

6.1 Fuse-holders shall be marked with:

– name or trade mark of the manufacturer

– catalogue or type reference.

The manufacturer shall provide the below markings on the smallest packaging label and may additionally mark them on the fuse-holder.

– rated voltage in volts,
– power acceptance in watts
– rated current in amperes

For panel-mount fuse-holders, these markings shall not be placed on the front of the fuse-holder. This is to prevent installation of a replacement fuse-link with the wrong rating.

Examples of Marking: 250 V 4 W/6,3 A or 250 V 4 W 6,3A.

The marking shall be indelible and easily legible.

6.2 Compliance is checked by inspection and by rubbing the marking by hand for 15 s with a piece of cloth soaked in water and again for 15 s with a piece of cloth soaked in petroleum spirit.

For petroleum spirit the use of an aliphatic solvent hexane, with an aromatics content of maximum 0,1 % volume, a kauri-butanol value of 29, initial boiling point approximately 65 °C, dry-point approximately 69 °C and specific gravity of approximately 0,68.

NOTE In the case of colour coding, the test for indelibility need not be applied.

~~**7 Clause deleted**~~

7 General notes on tests

7.1 Nature of tests

Tests according to this standard are type tests.

~~It is recommended that, where acceptance tests are required, they are chosen from the type tests in this standard.~~

The test sequences and number of samples to test is stated in Annex B.

7.2 Standard atmospheric conditions for measurement and tests

Unless otherwise specified, all tests shall be carried out under the atmospheric conditions according to 7.1 of IEC 60127-1:2006.

7.3 Preconditioning of test samples

Unless otherwise specified, the test samples shall be maintained at standard atmospheric conditions for not less than 4 h before measurements are performed.

7.4 Nature of supply

For alternating current, the test voltage shall be of substantially sinusoidal form with a frequency between 45 Hz and 62 Hz.

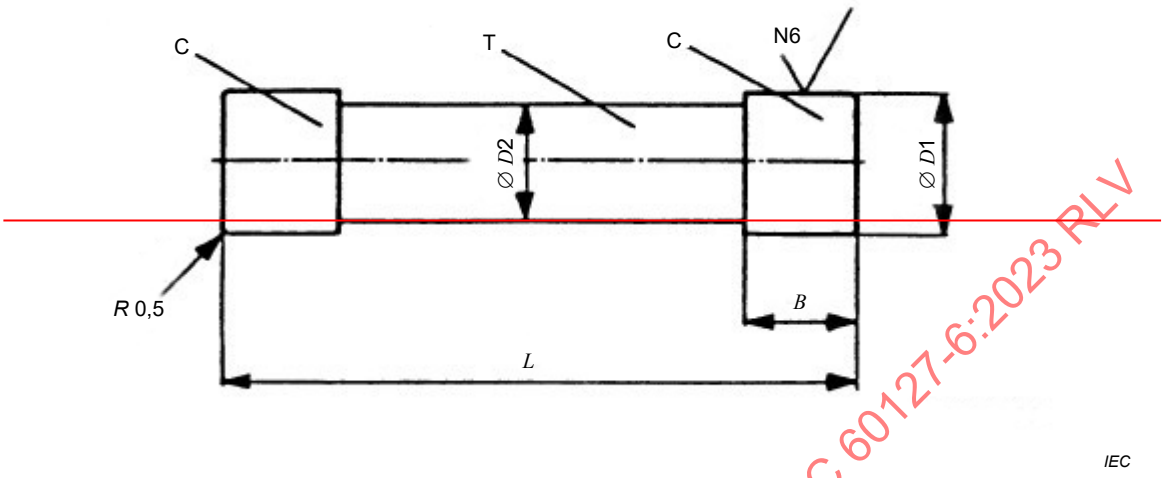
7.5 Gauges ~~and dummy fuse-links~~ for tests

7.5.1 Gauges ~~and dummy fuse-links~~ according to IEC 60127-2

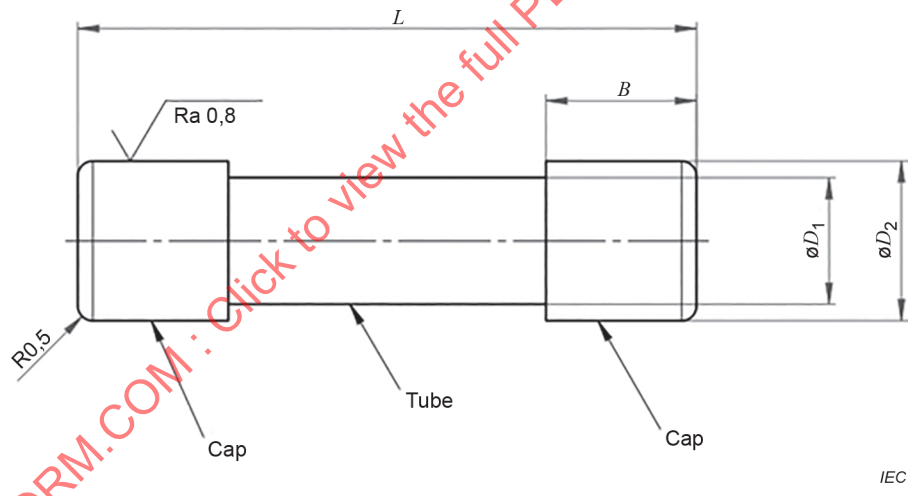
For tests that require gauges (Figure 1), the appropriate gauges mentioned in Table 3 shall be used. The gauges or parts thereof made of brass shall be provided with 8 µm of nickel plating plus 4,5 µm of gold plating.

There shall be no holes in the ends of the gauges.

The gauges shall have a homogeneous composition, except for gauge numbers 3 and 6.



Dimensions in millimetres



NOTE The symbol for roughness, N6, is in accordance with ISO 1302[2].

Figure 1 – Outline of gauges and dummy fuse-links according to IEC 60127-2

Table 3 gives the dimensions and materials for gauges according to IEC 60127-2.

2 This document has been revised by ISO 21920-1:2021.

Table 3 – Dimensions and materials for gauges according to IEC 60127-2

Type of cartridge			*L*	*D*1	*D*2	*B*	Weight Approximately	Materials of part	
Fuse-link	Gauge No.	Size						Cap	Tube
mm			mm	mm	mm	mm	g		
5 × 20	1	max.	$20{,}54\ ^{0}_{-0{,}04}$	$5{,}3\ ^{+0{,}01}_{0}$	4,2 ± 0,1	$5\ ^{+0{,}1}_{0}$	–	Steel [a]	
	2	min.	$19{,}46\ ^{+0{,}04}_{0}$	$5{,}0\ ^{0}_{-0{,}01}$	4,2 ± 0,1	$5\ ^{+0{,}1}_{0}$	2,5	Brass[b]	
	3	–	$20{,}54\ ^{0}_{-0{,}04}$	$5{,}3\ ^{+0{,}01}_{0}$	4,2	$6{,}2\ ^{+0{,}1}_{0}$	–	Brass end caps [b]	Glass or ceramic tube
6,3 × 32	4	max.	$32{,}64\ ^{0}_{-0{,}04}$	$6{,}45\ ^{+0{,}01}_{0}$	5,5 ± 0,1	$6\ ^{+0{,}1}_{0}$	–	Steel [a]	
	5	min.	$30{,}96\ ^{+0{,}04}_{0}$	$6{,}25\ ^{0}_{-0{,}01}$	5,5 ± 0,1	$6\ ^{+0{,}1}_{0}$	6	Brass[b]	
	6	–	$32{,}64\ ^{0}_{-0{,}04}$	$6{,}45\ ^{+0{,}01}_{0}$	5,5	$8{,}3\ ^{+0{,}1}_{0}$	–	Brass end caps [b]	Glass or ceramic tube

~~NOTE All test gauges are without a melting element.~~

[a] Hardened.

[b] Copper content from 58 % to 70 %.

~~For tests that require dummy fuse-links (Figure 1), the appropriate dummy fuse-link mentioned in Table 4 shall be used.~~

~~Table 4 – Dimensions and materials for dummy fuse-links according to IEC 60127-2~~

~~Dummy fuse-link for cartridge fuse-links~~	~~*L* mm~~	~~*D*1 mm~~	~~*D*2 mm~~	~~*B* mm~~	~~Mass (approximately) g~~	~~Materials of part~~	
						~~C~~	~~T~~
~~5 mm × 20 mm~~	~~$19{,}46\ ^{+0{,}08}_{0}$~~	~~6,0 ± 0,2~~	~~4,2 ± 0,1~~	~~5,0 ± 0,1~~	~~2~~	~~Brass end caps[a]~~	~~Ceramic tube~~
~~6,3 mm × 32 mm~~	~~$30{,}96\ ^{+0{,}08}_{0}$~~	~~6,25 ± 0,2~~	~~5,5 ± 0,1~~	~~6,0 ± 0,1~~	~~3~~	~~Brass end caps[a]~~	~~Ceramic tube~~

~~[a] Brass with copper content from 58 % to 70 %, surface with 2 µm (minimum) nickel plating (galvanic).~~

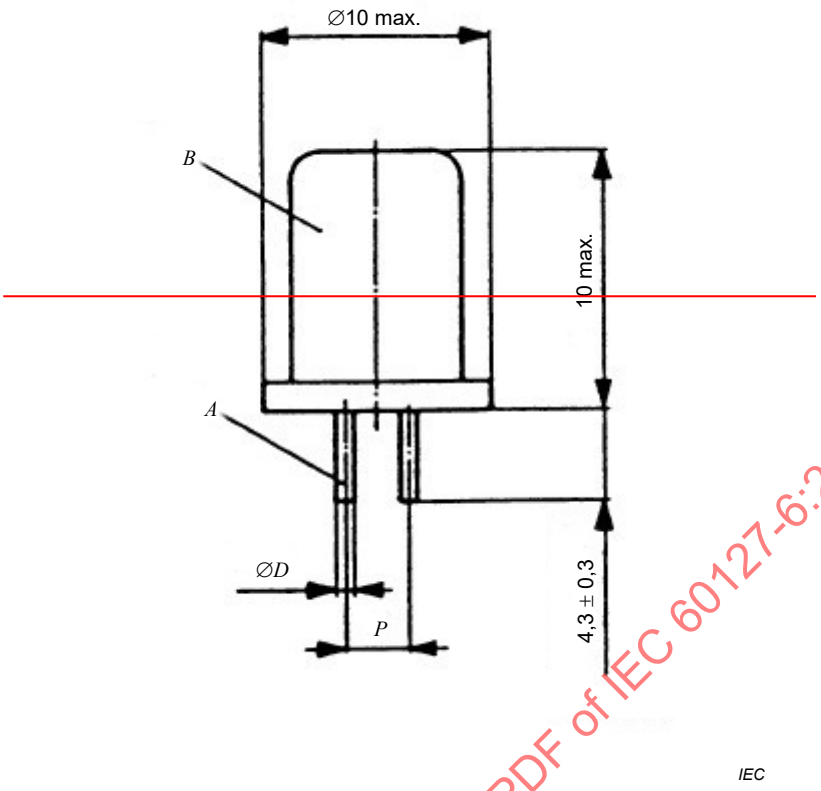
~~There shall be no holes in the ends of the dummy fuse-links.~~

7.5.2 Gauges ~~and dummy fuse-links~~ according to IEC 60127-3

For tests that require gauges (Figure 2 and Figure 3), the appropriate gauges mentioned in Table 4 shall be used.

The gauges or parts thereof made of brass shall be provided with 8 µm of nickel plating plus 4,5 µm of gold plating.

The gauges shall have a homogeneous composition, except for gauge numbers 3 and 6.



Dimensions in millimetres

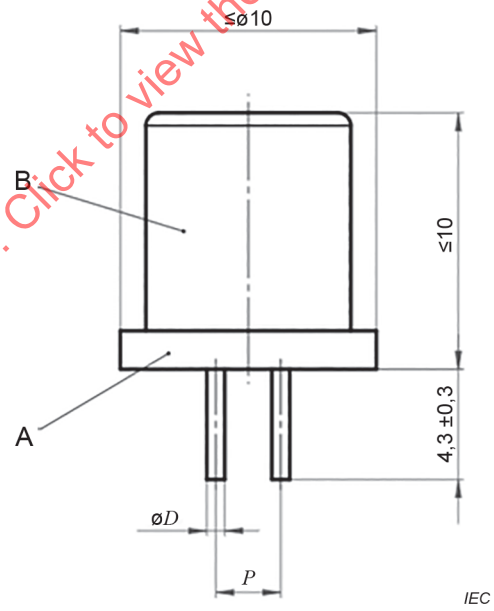
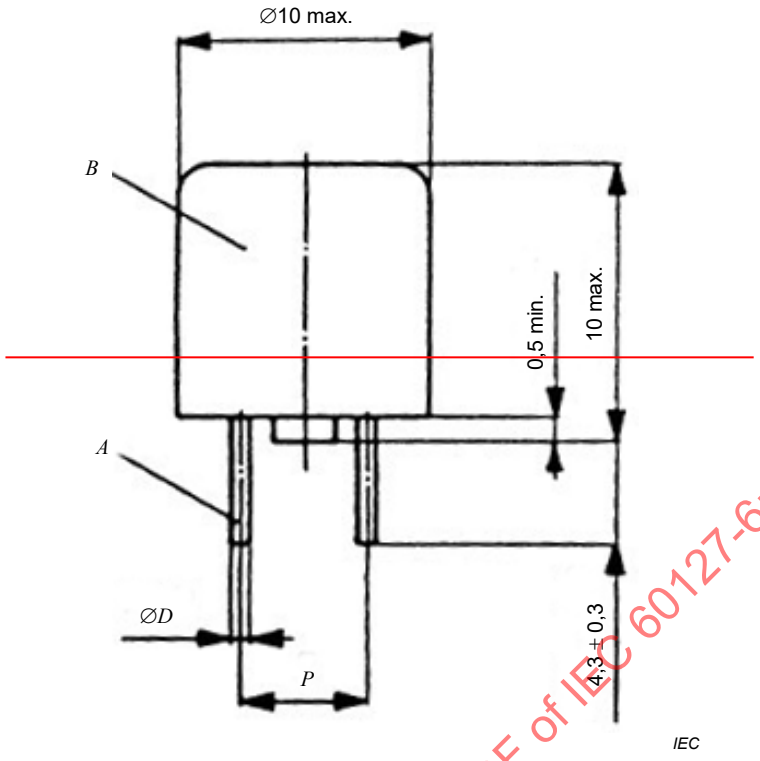


Figure 2 – Outline of gauges and dummy fuse-links according to IEC 60127-3:2015, standard sheet 1



Dimensions in millimetres

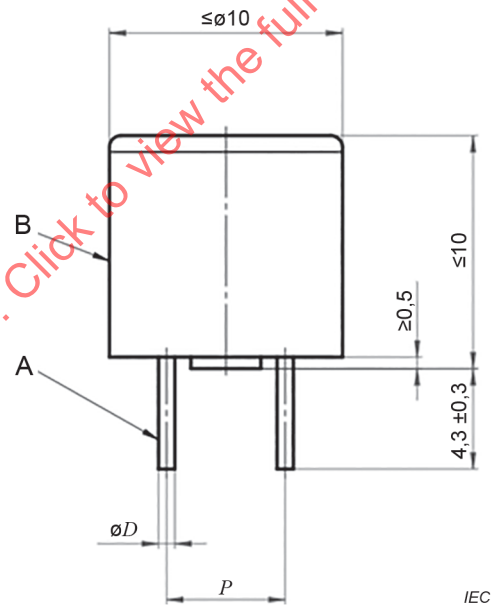


Figure 3 – Outline of gauges and dummy fuse-links according to IEC 60127-3:2015, standard sheets 3 and 4

Table 4 – Dimensions and materials for gauges according to IEC 60127-3

Type of			*D*	*P*	Materials of part	
Sub-miniature fuse-link	Gauge No.	Size	mm	mm	A	B
Standard sheet 1	1	max.	$0{,}70\ ^{0}_{-0{,}02}$	$2{,}54\ ^{+0{,}17}_{-0{,}09}$	Steel [a]	
	2	min.	$0{,}55\ ^{0}_{-0{,}02}$		Brass[b]	
	3	–	$0{,}70\ ^{0}_{-0{,}02}$		Brass [b]	Insulating material
Standard sheets 3 and 4	4	max.	$0{,}63\ ^{0}_{-0{,}02}$	5,08±0,1	Steel [a]	
	5	min.	$0{,}56\ ^{0}_{-0{,}02}$		Brass[b]	
	6	–	$0{,}7060\ ^{0}_{-0{,}02}$		Brass end caps[b]	Insulating material
NOTE All test gauges are without a melting element.						
[a] Hardened.						
[b] Copper content from 58 % to 70 %.						

For tests that require dummy fuse-links (Figure 2 and Figure 3), the appropriate dummy fuse-link mentioned in Table 6 shall be used.

Table 6 – Dimensions and materials for dummy fuse-links according to IEC 60127-3

Dummy fuse-link for sub-miniature fuse-links	*D* mm	*P* mm	Materials of part	
			A	B
Standard sheet 1	$0{,}55\ ^{0}_{-0{,}02}$	$2{,}54\ ^{+0{,}17}_{-0{,}09}$	Brass[a]	Brass[a]
Standard sheets 3 and 4	$0{,}56\ ^{0}_{-0{,}02}$	5,08 ± 0,1	Brass[a]	Brass[a]
[a] Copper content from 58 % to 70 %.				

8.6 Type tests

The compliance of the fuse-holder with this standard shall be verified by means of type tests.

The type tests required, the test sequences and the number of samples to be submitted are stated in Annex B.

8 Protection against electric shock

8.1 Category PC1: Fuse-holders without integral protection against electric shock

Fuse-holders of category PC1 are only suitable for applications where corresponding additional means are provided to protect against electric shock.

8.2 Category PC2: Fuse-holders with integral protection against electric shock

8.2.1 The fuse-holder shall be so designed that:

– live parts are not accessible when the fuse-holder is properly assembled and correctly installed on the front panel of equipment with fuse-carrier and gauge numbers 3 or 6 according to Table 3 or Table 4 inserted into the fuse-base;

– live parts do not become accessible, either during insertion or removal of the fuse-carrier by hand or with the aid of a tool or after the fuse-carrier has been removed.

8.2.2 Compliance is checked by using the standard test finger specified in IEC 60529. This test finger is applied without appreciable force in every possible position. Where the fuse-holder has a fuse-carrier, gauge numbers 3 or 6 according to Table 3 or Table 4 shall be placed in the fuse-carrier during testing. It is recommended that an electrical indicator with a voltage of approximately 40 V is used for the indication of contact with the relevant part.

8.3 Category PC3: Fuse-holders with enhanced integral protection against electric shock

The requirements for this category are the same as those for 8.2 (Category PC2) with the exception that the testing is carried out with a rigid test wire of 1 mm diameter according to IEC 60529:1989, Table VI, instead of the standard test finger.

9 Clearances and creepage distances

9.1 General

Clearances and creepage distances shall be checked for a fuse-holder properly assembled and installed as in normal use, and fitted with gauge numbers 3 or 6 according to Table 3 or Table 4.

Compliance is checked by measurement.

9.2 Minimum requirements for fuse-holders in respect to the grade of insulation

9.2.1 Table 5 shows the types of insulation between different live parts and accessible parts.

Table 5 – Types of insulation between different live parts and accessible parts

Type of insulation Insulation between:	Functional	Basic	Supplementary	Reinforced	Double
a) Live parts of different potential	X				
b) Live parts and a metal mounting-plate or any other metal parts which may be in contact with the mounting-plate e.g. base-fixing devices.					
Thickness of the mounting-plate according to 10.1.1					
– fuse-holders according to 9.2.2		X	(X)[a]		
– fuse-holders according to 9.2.3				X	X
c) Live parts and all parts which may be touched with the test finger (accessible parts)					
– fuse-holders according to 9.2.2		X	(X)[a]		
– fuse-holders according to 9.2.3				X	X
[a] Supplementary insulation is only applied in addition to basic insulation, whereas basic insulation can be applied without supplementary insulation.					

9.2.2 Fuse-holders intended for class I equipment shall have at least basic insulation between live parts and accessible metal parts. These metal parts shall be provided with means

enabling a reliable connection to the protective earthing circuit of the equipment in which it is intended to be used.

9.2.3 Fuse-holders intended for class II equipment shall have double or reinforced insulation between live parts and accessible parts.

9.3 Clearances

Clearances shall be dimensioned in such a way that the fuse-holder withstands the overvoltages expected to occur during normal use. The clearances shall be verified by measurement of dimensions and the impulse withstand voltage test according to 10.1.5, where this test is required.

Clearances equal to those specified in Table 7 or Table 8 shall be deemed to comply with this requirement. In this case the impulse withstand voltage test according to 10.1.5 is not required.

Clearances may be smaller than the values specified in Table 7 and Table 8 but not smaller than the values determined for the homogeneous field conditions according to Table F.2 of IEC 60664-1:~~2007~~2020. In this case, the clearances shall be deemed to comply with this requirement as long as no non-compliance occurs in the impulse withstand voltage test according to 10.1.5.

Clearances smaller than the values determined for the homogeneous field conditions according to Table F.2 of IEC 60664-1:~~2007~~2020 shall be deemed not to comply with this requirement.

Table 6 – Required impulse withstand voltage for clearances

Rated voltage V		**Required impulse withstand voltage** $\hat{U}$ **1,2/50** [1] kV	
Overvoltage category		**Functional, basic or supplementary insulation**	**Reinforced or double insulation**
~~α~~ **II**	~~β~~ **III**		
~~32~~	-	~~0,5~~	~~0,8~~
~~63~~	-	~~0,8~~	~~1,5~~
~~125~~	-	~~1,5~~	~~2,5~~
~~250~~	~~125~~	~~2,5~~	~~4,0~~
-	~~250~~	~~4,0~~	~~6,0~~
≤ 50	-	0,5	0,8
> 50 to ≤ 100	-	0,8	1,5
> 100 to ≤ 150	-	1,5	2,5
> 150 to ≤ 300	≤ 150	2,5	4,0
> 300 to ≤ 600	> 150 to ≤ 300	4,0	6,0
–	> 300 to ≤ 600	6,0	8,0
–	> 600 to ≤ 1 000	8,0	1,2

[1] According to IEC 60060-1. $\hat{U}$ 1,2/50 defines the impulse wave shape: 1,2 µs rise time and 50 µs half-value decay time.

There is increasing use of equipment operating at voltages below 125 V. In order to conform with IEC 60664-1, fuse holders specifically designed for these lower voltages ~~should~~ shall meet the prescriptions in this table.

~~NOTE~~ Attention is drawn to the fact that appliance specifications might contain requirements additional to or deviating from those specified in Table 5, Table 6, Table 7 and Table 8.

Table 7 and Table 8 show minimum clearances in air with regard to the rated voltage, the overvoltage category and the specified degree of pollution.

NOTE Minimum clearances in air in millimetres up to 2 000 m above sea-level for inhomogeneous field conditions corresponding to IEC 60664-1:~~2007~~2020, Table F.2.

~~Table 9 – Overvoltage category II~~

~~Rated voltage~~ ~~V~~		~~Clearances in air~~ ~~mm~~	
~~Functional, basic or supplementary insulation~~	~~Reinforced or double insulation~~	~~Pollution degree~~	
		~~2~~	~~3~~
~~32~~	~~32~~	~~0,2~~	~~0,8~~
~~63~~	~~–~~	~~0,2~~	~~0,8~~
~~125~~	~~63~~	~~0,5~~	~~0,8~~
~~250~~	~~125~~	~~1,5~~	~~1,5~~
~~–~~	~~250~~	~~3,0~~	~~3,0~~

~~Table 10 – Overvoltage category III~~

~~Rated voltage~~ ~~V~~		~~Clearances in air~~ ~~mm~~	
~~Functional, basic or supplementary insulation~~	~~Reinforced or double insulation~~	~~Pollution degree~~	
		~~2~~	~~3~~
~~125~~	~~–~~	~~1,5~~	~~1,5~~
~~250~~	~~125~~	~~3,0~~	~~3,0~~
~~–~~	~~250~~	~~5,5~~	~~5,5~~

Table 7 – Minimum clearances in air under overvoltage category II II

Rated voltage V		Clearances in air mm	
Functional, basic or supplementary insulation	Reinforced or double insulation	Pollution degree	
		2	3
≤ 50	–	0,2	0,8
> 50 to ≤ 100	≤ 50	0,2	0,8
> 100 to ≤ 150	> 50 to ≤ 100	0,5	0,8
> 150 to ≤ 300	> 100 to ≤ 150	1,5	1,5
> 300 to ≤ 600	> 150 to ≤ 300	3,0	3,0
–	> 300 to ≤ 600	5,5	5,5
–	> 600 to ≤ 1 000	8,0	8,0

Table 8 – Minimum clearances in air under overvoltage category II

Rated voltage V		Clearances in air mm	
Functional, basic or supplementary insulation	Reinforced or double insulation	Pollution degree	
		2	3
≤ 150	–	1,5	1,5
> 150 to ≤ 300	≤ 150	3,0	3,0
> 300 to ≤ 600	> 150 to ≤ 300	5,5	5,5
–	> 300 to ≤ 600	8,0	8,0
–	> 600 to ≤ 1 000	11	11

9.4 Creepage distances

9.4.1 Creepage distances for basic or supplementary insulation, based on the rated voltage shall be selected from Table 9. The following influencing factors shall be taken into account:

– rated voltage;
– pollution degree;
– shape of insulating surface;
– comparative tracking index (CTI).

9.4.2 Measurement of creepage distances and clearances, shape of insulating surface: requirements according to 6.2 of IEC 60664-1:~~2007~~2020.

9.4.3 Creepage distances for reinforced or double insulation: shall be twice the value as specified in Table 9.

9.4.4 A creepage distance cannot be less than the associated clearance so that the shortest creepage distance possible is equal to the required clearance.

Table 9 – Minimum creepage distances in millimetres for a microenvironment-dependent on rated voltage, pollution degree, insulating material, corresponding to IEC 60664-1:~~2007~~2020, Table F.~~4~~5

Rated voltage V	Creepage distances mm							
	Pollution degree 2				Pollution degree 3			
	Material group[1)]				Material group[1)]			
	I	II	IIIa	IIIb	I	II	IIIa	IIIb
≤ 32	0,53	0,53	0,53		1,30	1,30	1,30	
> 32 to ≤ 63	0,63	0,90	1,25		1,60	1,80	2,00	
> 63 to ≤ 125	0,75	1,05	1,50		1,90	2,10	2,40	
>125 to ≤ 250	1,25	1,80	2,50		3,20	3,60	4,00	
> 250 to ≤ 320	1,60	2,20	3,20		4,00	4,50	5,00	
> 320 to ≤ 400	2,0	2,8	4,0		5,0	5,6	6,3	
> 400 to ≤ 500	2,5	3,6	5,0		6,3	7,1	8,0	
Up to 1 000	5,0	7,1	10,0		12,5	14,0	16,0	

[1)] See Annex C.

There is increasing use of equipment operating at voltages below 125 V. In order to conform with IEC 60664-1, fuse holders specifically designed for these lower voltages ~~should~~ shall meet the prescriptions in this table.

10 Electrical requirements

10.1 Insulation resistance, dielectric strength and impulse withstand voltage

10.1.1 Mounting

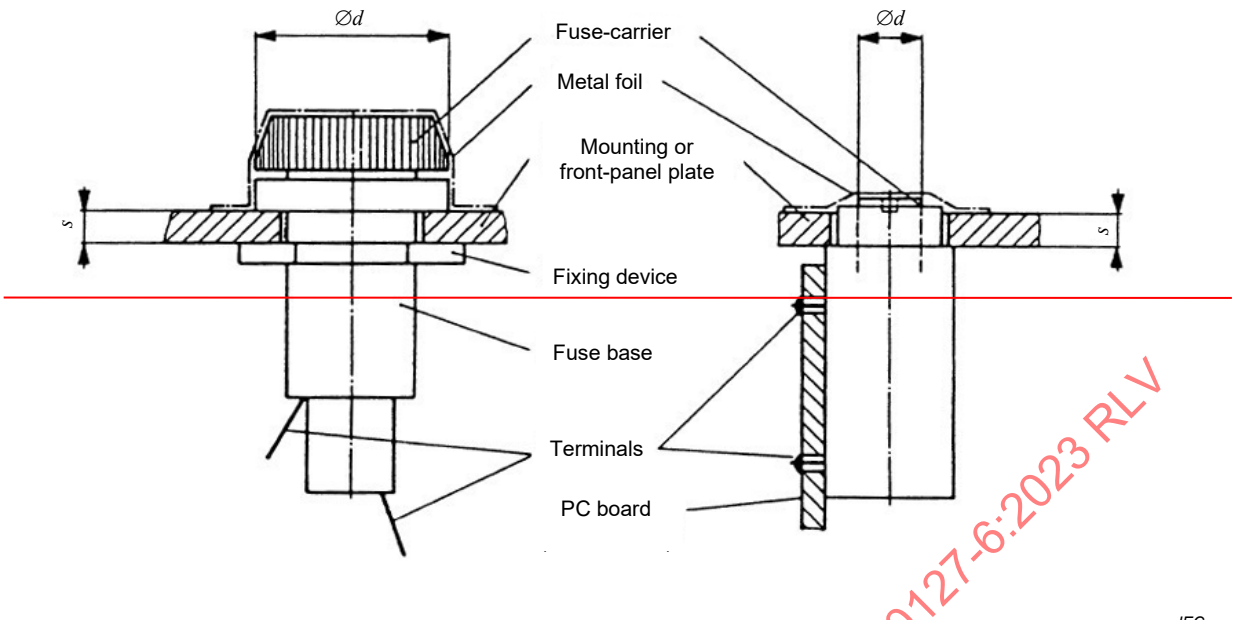
Fuse-holders shall be mounted as follows:

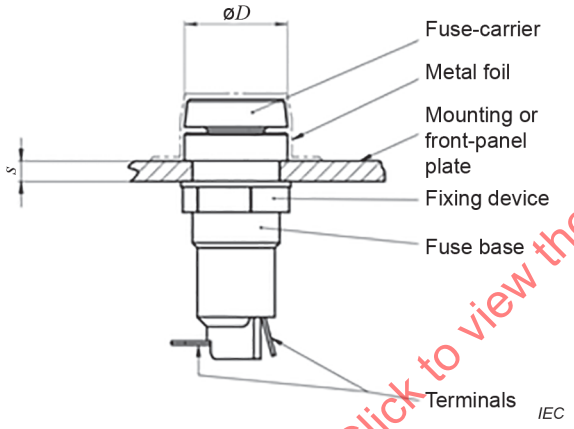
a) Fuse-holders designed for panel or base mounting, shall be mounted on a metal plate, with a thickness s, see Figure 4, as specified by the manufacturer. A test gauge according to Table 10 and with or without the fuse-carrier shall be inserted into the fuse-base.

   For fuse-holders having screw-in fuse-carriers, these carriers shall be fitted in the normal way for each operation with a torque equal to two-thirds of the value specified in Table 11.

b) Fuse-holders designed for PC board mounting shall be mounted on a test PC board according to Annex A and, if adapted to such use, with a front-panel metal plate of a thickness s, see Figure 5. A test gauge according to Table 10 and with or without the fuse-carrier shall be inserted into the fuse-base.

Fuse-holders for PC board mounting by soldering (through-hole types) should have a pin-spacing of $n \times e$ where n is an integer from 1 to 6 and e = 2,54 mm.





NOTE Thickness s to be specified by the manufacturer.

Figure 4 – Panel mounting

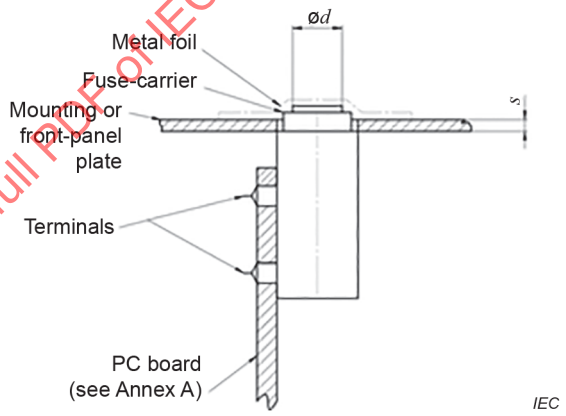


Figure 5 – PC board mounting

10.1.2 Humidity preconditioning

~~Mounted fuse-bases according to 11.1.1 and separate, not inserted fuse-carriers are submitted to the humidity preconditioning.~~

In accordance with 11.1.1, the separated mounted fuse-bases and fuse-carriers are submitted to the humidity preconditioning.

The humidity preconditioning is carried out in a humidity chamber containing air with a relative humidity maintained between 91 % and 95 %.

The air in the chamber where test samples are located shall be maintained at a temperature t = (40 ± 2) °C, uniformly distributed throughout the chamber.

The air in the chamber shall be stirred and the chamber shall be designed so that mist of condensed water will not precipitate on the test samples. Temperature variations shall not allow

any part of the test samples to reach a dew-point condition. Some methods of achieving the specified relative humidity are described in ~~IEC 60068-3-4~~ IEC TR 60260[3].

The test samples are kept in the chamber for 48 h.

Immediately after the humidity preconditioning, with the samples still in the humidity chamber or in the room in which the samples were brought to the prescribed temperature, the measurement of the insulation resistance and dielectric strength are made, after reassembly of those parts which were separated before the humidity preconditioning. Parts of insulating material shall be wrapped in metal foil as shown in Figure 4 and Figure 5.

10.1.3 Measurement of insulation resistance

The insulation resistance shall be measured between the points as specified in Table 10.

DC voltage according to Table 10 shall be applied. The measurement is made 1 min after application of the test-voltage.

The insulation resistance shall be not less than the values shown in Table 10.

~~There is increasing use of equipment operating at voltages below 125 V. In order to conform with IEC 60664-1, the fuse-holders specifically designed for these lower voltages should meet the requirements of the insulation resistance in Table 12.~~

10.1.4 Dielectric strength test

Immediately after the measurement of the insulation resistance, with the samples still in the humidity chamber or in the room in which the samples were brought to the prescribed temperature, an AC voltage according to Table 10 is applied for 1 min between the points specified in Table 10.

Initially, not more than half the prescribed voltage is applied, then it is raised rapidly to the full value.

~~There is increasing use of equipment operating at voltages below 125 V. In order to conform with IEC 60664-1, the dielectric strength test for fuse-holders specifically designed for these lower voltages should be as specified in Table 12.~~

No flashover or breakdown shall occur during the test.

10.1.5 Impulse withstand voltage test

After the test in 10.1.4 the impulse withstand voltage shall be tested between the points as specified in Table 10.

The required impulse withstand voltage according to Table 6 shall be applied.

Form and numbers of impulses:

The 1,2/50 µs impulse voltage shall be applied three times for each polarity at intervals of 1 s minimum.

Unless otherwise specified, the output impedance of the impulse generator should not be higher than 500 Ω.

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[3] This document has been withdrawn in 2000.

NOTE A description of the test equipment can be found in IEC 60060-1 and IEC 60060-3.

During this voltage test, no breakdown or flashover shall occur.

Corona effects and similar phenomena are disregarded.

~~There is increasing use of equipment operating at voltages below 125 V. In order to conform with IEC 60664-1, the impulse withstand voltage test for fuse-holders specifically designed for these lower voltages should be as specified in Table 12.~~

10.2 Contact resistance

10.2.1 General measuring requirements

Measurements may be carried out with direct current or alternating current. For AC measurements the frequency shall not exceed 1 kHz. In the case of dispute, the DC measurements shall govern.

The accuracy of the measuring apparatus shall be within ±3 %.

For fuse-holders having screw-in fuse-carriers these carriers shall be fitted in the normal way for each operation with a torque equal to two-thirds of the value specified in Table 11.

The contact resistance shall be measured between the terminals after the fuse-holder has been equipped with a gauge No. 2 or No. 5 according to Table 3 or Table 4.

Contact resistance of fuse-holders intended for PC board mounting shall be measured on a fuse-holder mounted (soldered) on a test PC board according to Annex A. The voltage drop shall be measured between points P and O of Figure A.1.

The contact resistance shall normally be calculated from the voltage drop measured between the terminals.

The measurement is carried out under the following conditions:

a) test voltage: the electromotive force of the source shall not exceed 60 V d.c. or a.c. (peak), but shall be at least 10 V;

b) test current: 0,1 A;

c) measurement shall be made within 1 min after the application of the test current;

d) care shall be taken during the measurement to avoid exerting abnormal pressure on the contacts under test and to avoid movement of the test cable.

10.2.2 Measuring cycle

10.2.2.1 Measuring cycle with direct current

One measuring cycle consists of:

a) insertion of the gauge in the fuse-holder;

b) measurement with current flowing in one direction;

c) measurement with current flowing in opposite direction;

d) removal of the gauge from the fuse-holder.

10.2.2.2 Measuring cycle with alternating current

One measuring cycle consists of:

a) insertion of the gauge in the fuse-holder;

b) measurement;

c) removal of the gauge from the fuse-holder.

10.2.2.3 Measurement and requirements

The complete measurement shall consist of five measuring cycles, which shall be carried out in immediate succession.

For fuse-holders for fuse-links in accordance with IEC 60127-2 the average values shall not exceed 5 mΩ. The value of any individual measurement shall not exceed 10 mΩ.

For fuse-holders for fuse-links in accordance with IEC 60127-3 the average values shall not exceed 10 mΩ. The value of any individual measurement shall not exceed 15 mΩ.

Table 10 – Values for insulation resistance, dielectric strength and impulse withstand voltage

Insulation resistance, dielectric strength and impulse withstand voltage	Number of test gauges according	Rated voltage	Insulation resistance			Dielectric strength		Impulse withstand voltage	
			DC test voltage		Insulation resistance	AC test voltage		Impulse test voltage	
		V	V		MΩ	V		V	
measured between:	to table 3 or 4		functional, basic or supplementary insulation	Reinforced or double insulation		functional, basic or supplementary insulation	Reinforced or double insulation	functional, basic or supplementary insulation	Reinforced or double insulation
1 Unexposed fuse-holder 1.1 The terminals	3 / 6	32 63 125 250 300 350 500 1 000	Twice rated voltage but at least 100 V		≥10 for functional, basic or supplementary insulation ≥20 for reinforced or double insulation	500	1 000	Required impulse withstand voltage values according to Table 6	
1.2 The terminals and the metal mounting or front-panel plate 1.3 The terminals and any other metal parts which may be in contact with the mounting plate, e. g. base fixing devices 1.4 The terminals and a metal foil covering the whole of the accessible surface (see figures 4 and 5)	1 / 4					Twice rated voltage +1 000 V	Twice the value for functional, basic or supplementary insulation		
2 Exposed fuse-holders 2.1 The terminals	3 / 6					500	1 000		
2.2 The terminals and the mounting plate	1 / 4					Twice rated voltage +1 000 V	Twice the value for functional, basic or supplementary insulation		

There is increasing use of equipment operating at voltages below 125 V. In order to conform with IEC 60664-1, fuse-holders specifically designed for these lower voltages shall meet the prescriptions in Table 9.

11 Mechanical requirements

11.1 General

Fuse-holders shall have adequate mechanical strength to withstand the stresses imposed during installation and use.

Compliance is checked by the appropriate tests of 11.2 to 11.8.

11.2 Mounting

For the tests of 11.3 to 11.5 the fuse-holders are mounted as follows.

a) Fuse-holders designed for front-panel mounting shall be mounted with their fixing elements, if any, in the centre of a metal plate 130 mm × 130 mm having a maximum thickness s as specified by the manufacturer.

The specimen as a whole is then fixed to a rigid plane support having a free space with a diameter of 100 mm for the base of a panel-mounted fuse-holder. To ensure that the specimen is rigidly supported, a block of metal or concrete having a mass of 15 kg shall be used (Figure 6).

Any fixing nut or fixing screw is screwed on with two-thirds of the torque specified in Table 12 or Table 13 as applicable.

Dimensions in millimetres

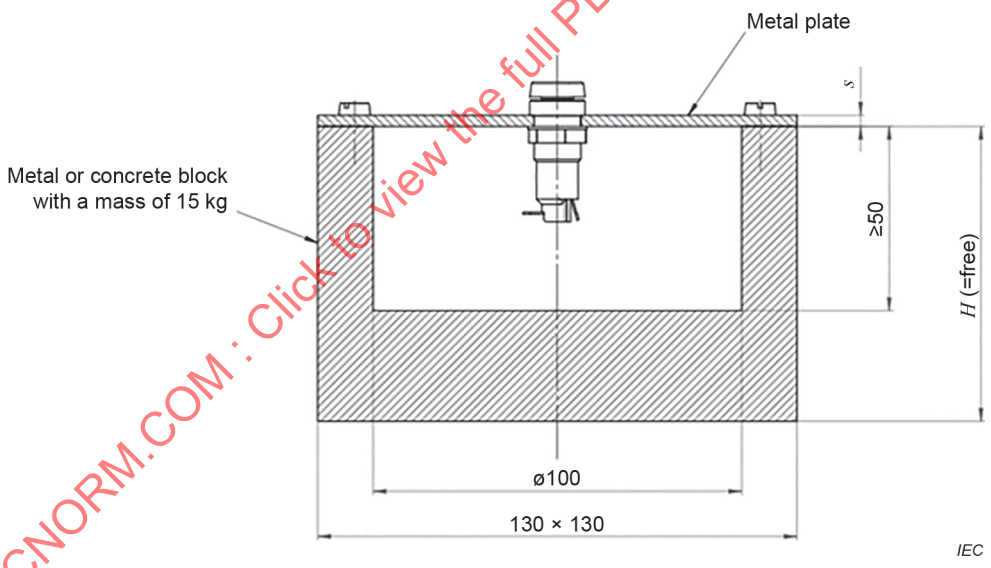


Figure 6 – Test device for mechanical test

b) Fuse-holders for PC board mounting shall be soldered to the test PC board according to Annex A and, by means of screws, this test PC board shall be fixed to the metal or concrete block of Figure 6 using a suitably adapted metal plate.

11.3 Compatibility between fuse-holder and fuse-link

The maximum gauge No. 1 or No. 4 according to Table 3 or Table 4 shall be inserted in and withdrawn from the fuse-holder and fuse-carrier, if any, 10 times for cartridge fuse-holder and 5 times for sub-miniature fuseholder.

For fuse-holders having screw-in fuse-carriers, these carriers shall be fitted in the normal way for each operation with a torque equal to two-thirds of the value specified in Table 11.

For fuse-holders having bayonet fuse-carriers there are no special torque requirements.

There shall be no visible damage or loosening of parts. In the most unfavourable position, the minimum gauge No. 2 or No. 5 according to Table 3 or Table 4 shall not fall from the fuse-carrier.

The minimum gauge No. 2 or No. 5 according to Table 3 or Table 4 shall then be inserted in the holder and the contact resistance shall be measured according to 10.2 with the same requirements.

11.4 Mechanical strength of the connection between fuse-base and fuse-carrier

11.4.1 Screw and bayonet connections

For the following tests, the fuse-carrier is fitted with the maximum gauge No. 1 or No. 4 according to Table 3 and inserted in the fuse-base mounted according to 11.2.

a) Torque test on fuse-carriers

   The fuse-carrier shall be subjected five times to the appropriate torque specified in Table 11.

b) Tensile test on fuse-carriers

   The screw-in fuse-carrier is screwed in with a torque of two-thirds of the value as specified in Table 11.

The screw-in or bayonet fuse-carrier shall then be subjected for 1 min to an axial pull as specified in Table 11.

Table 11 – Values for torque and axial pull

Diameter of fuse-carrier (*Φ d* in Figure 4 and Figure 5)	Torque Nm	Axial pull N
Up to and including 16 mm	0,4	25
Over 16 mm, up to and including 25 mm	0,6	50
Over 25 mm, up to and including 35 mm	0.8	75

During and after the tests, the fuse-carrier ~~must~~ shall be securely held in the fuse-base and shall not show any change impairing its further use.

For fuse-holders where fuse-carriers are flush with the fuse-base, the axial pull test is not required.

11.4.2 Plug-in connection

Insertion and withdrawal forces:

The fuse-carrier together with the maximum gauge No. 1 or No. 4 according to Table 3 shall be inserted in and withdrawn from the fuse-base. The forces have to be measured with suitable measuring devices. This test has to be repeated 10 times. The value of any individual measurement, insertion and withdrawal forces, shall be within limits assigned by the manufacturer.

After the test the contact resistance shall be measured according to 10.2 with the same requirements.

11.5 Impact test

This test shall only be applied to panel-mounted fuse-holders. The fuse-carrier with the maximum gauge No. 1 or No. 4 according to Table 3 shall be inserted in the fuse-holder.

The front of the fuse-holder is then subjected to three blows with a spring-operated impact-hammer according to IEC 60068-2-75, applied to points equally distributed over the front of the fuse-holder.

The adjusted value of the kinetic energy just before impact shall be (0,35 ± 0,03) J.

After the test, the sample shall show no serious damage. In particular, live parts shall not have become exposed so as to impair compliance with Clause 9 and there shall not have been such distortion as to impair compliance with Clause 10.

Compliance is checked by visual inspection and measurement of dimensions. If there is any doubt, compliance is additionally checked by the impulse withstand voltage test according to 10.1.5.

11.6 Mechanical strength of the fuse-holder fastening on panels

11.6.1 Fixing nut fastening

The fuse-base shall be mounted with supplied fixing elements, including gasket, on a steel plate according to the manufacturer's instructions.

The fixing nut of a one-hole mounted fuse-base shall be screwed on and off five times with a torque as specified in Table 12.

Table 12 – Torque values

Thread diameter mm	Torque Nm
Up to and including 12	0,6
Greater than 12, up to and including 18	1,2
Greater than 18, up to and including 30	2,4
Greater than 30, up to and including 40	3,6
Greater than 40, up to and including 50	4,8

After the test the fuse-base shall not show any change impairing its further use.

11.6.2 Fixing screw fastening

Fixing screws, bolts or nuts of a multi-hole mounted fuse-base shall be screwed on and off five times with a torque as specified in Table 13.

Table 13 – Torque values

Thread diameter mm	Torque Nm
2	0,25
2,5	0,4
3	0,5
3,5	0,8
4	1,2
5	2,0
6	2,5
≥8	3,5

After the test the fuse-base shall not show any change impairing its further use.

11.6.3 Snap-in fastening

11.6.3.1 General

The following types belong to this group of fuse-holders:

– fuse-base with integral spring-system;

– fuse-base with a separate spring-nut (a nut fabricated e.g. from thin spring steel having an impression designed to accommodate the mating part).

11.6.3.2 Tests and requirements

11.6.3.2.1 Test procedures

The mechanical strength of the fuse-holder fastening on panels (see Figure 7) shall be verified by the following tests.

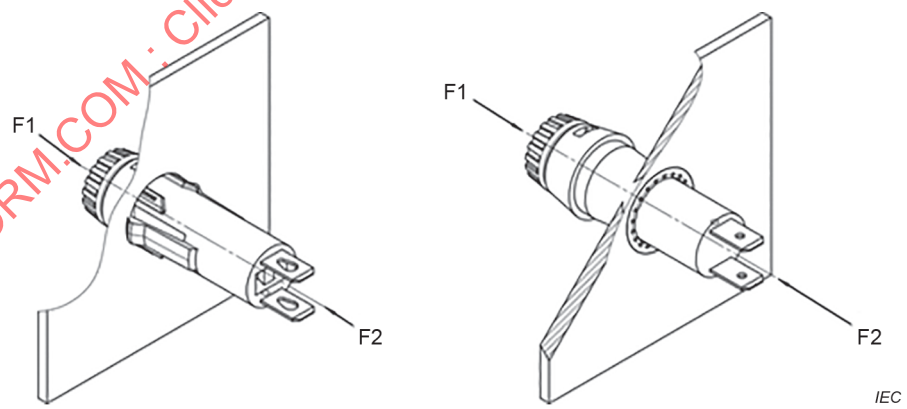


Figure 7 – Examples of snap-in fastening fuse-holder ~~fastening~~ on panels

The tests shall be performed with an engaged snap-in fastening and the fuse-holder shall lie flat on the surface of the mounting plate.

The specimens shall be divided into two mounting groups according to Table 14.

Table 14 – Mounting groups

	Group 1	Group 2
Mounting plate	Maximum panel thickness and mounting hole with smallest dimension	Minimum panel thickness and mounting hole with largest dimension
Testing force	Insertion force F1	Withdrawal force F2

Preparation of the specimen:

The thickness of the mounting plate and the diameter of the mounting hole shall be according to the specifications of the manufacturer.

The mounting plate may be positioned in any convenient orientation during the test procedures.

11.6.3.2.2 Insertion force F1

The insertion force F1 shall be ~~≤ 20~~ ⩽ 120 N or as specified by the manufacturer, and centered in the middle of the socket base of the fuse-holder (see Figure 7).

The insertion force F1 shall be so applied that the force on the whole surface is continuously increased in a monotonous manner without jogging.

The pressure device shall cover the flange completely.

11.6.3.2.3 Withdrawal force F2

The withdrawal force F2 (see Figure 7) shall be applied axially to the rear of the fuse-holder. The force shall be increased monotonously from 0 N to 50 N.

The snap-in fastening of the fuse-holder shall not be permanently distorted and the fuse-holder shall not be ejected by the maximum force.

11.6.3.2.4 Acceptance criteria in the above tests

– Cracks, chipping and breakage of the fuse-holder base due to the mechanical stress of F1 and F2 are not acceptable.
– Ridges and wear of the insulating body are acceptable.

11.7 Terminals of fuse-bases

11.7.1 Terminals with screw-type clamping or screwless-type clamping

Tests and requirements for terminals with screw-type and screwless-type clamping units for electrical copper conductors~~, according to~~ shall comply with IEC 60999-1.

11.7.2 Terminals for soldering

11.7.2.1 Tag terminals

11.7.2.1.1 General

Designed for being soldered with a soldering iron.

11.7.2.1.2 Size

Terminals of fuse-bases shall allow the connection of rigid conductors, solid or stranded and flexible conductors of the size shown in Table 15.

Table 15 – Cross-sections of conductors

Fuse-holder with a maximum rated current of:	Minimum hole diameter mm	Maximum cross-section of the conductor mm^2
Up to and including 6,3 A	1,2	1
More than 6,3 A, and up to and including 10 A	1,4	1,5
More than 10 A, and up to and including 16 A	1,8	2,5
More than 16 A, and up to and including 25 A	2,3	4,0

For soldering terminals there shall be a means such as a hole through which the conductor, or all strands of a multi-strand conductor, will pass so that the conductor may be held independently of the solder.

11.7.2.1.3 Tests

a) Robustness of termination

The terminals shall be subjected to the following tensile and bending tests.

– Tensile test according to Test Ua_1 of IEC 60068-2-21~~:2006~~.

An axial force of 20 N shall be applied.

Requirements: there shall be no damage which would impair normal operation.

– Bending test according to Test Ub of IEC 60068-2-21~~:2006~~.

Where applicable, method 1 shall be used, otherwise method 2.

Requirements: there shall be no damage which would impair normal operation.

b) Solderability, wetting, soldering iron method

The test shall be performed in accordance with Test Ta of IEC 60068-2-20:~~2008~~2021 after the accelerated ageing 4.1.4.3 detailed in 4.1.4 of IEC 60068-2-20:~~2008~~2021.

– Method 2.

– “B” size soldering iron.

Requirements: The solder shall have wetted the test area and there shall be no droplets.

c) Resistance to soldering heat, soldering iron method

The test shall be performed in accordance with Test Tb of IEC 60068-2-20:~~2008~~2021.

– Method 2.

– “B” size soldering iron.

Requirements: there shall be no damage that would impair normal operation.

11.7.2.2 Wire and pin terminals

11.7.2.2.1 General

Designed for use with printed boards or other applications using similar soldering techniques.

11.7.2.2.2 Size

Dimensions: no special requirements

11.7.2.2.3 Tests

a) Robustness of termination: see 11.7.2.1.3 a).

b) Solderability, wetting, solder bath method.

The test shall be performed in accordance with Test Ta of IEC 60068-2-20 after the accelerated ageing 4.1.4.3 detailed in 4.1.4 of IEC 60068-2-20:~~2008~~2021

– Method 1.

– A thermal screen shall be used: e.g. a PC board.

Requirements: the dipped surface shall be covered with a solder coating with no more than small amounts of scattered imperfections such as pin-holes or unwetted areas. These imperfections shall not be concentrated in one area.

c) Resistance to soldering heat, solder bath method.

The test shall be performed in accordance with Test Tb of IEC 60068-2-20:~~2008~~2021.

– Method 1.

– A thermal screen shall be used: e.g. a PC board.

– Immersion temperature: 260 °C ± 3 °C

– Immersion time: (5 ± 1) s.

Requirements: there shall be no damage that would impair normal operation.

11.7.2.3 Quick-connect male tab terminals

11.7.2.3.1 General

A quick-connect termination consists of a male tab with hole or dimple detent and the mating female connectors. The fuse-base is provided with the male tab.

11.7.2.3.2 Size

Dimensions, classified types of male tabs: according to IEC 61210.

11.7.2.3.3 Tests

Robustness of terminations

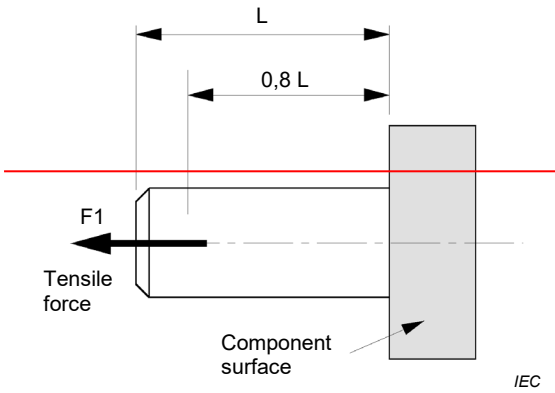
The terminals shall be subjected to the following tensile and compressive strength tests:

– tensile test according to test Ua_1 of IEC 60068-2-21~~:2006~~. A tensile force F1 according to Table 16 shall be applied to the fixed male tab as shown in Figure 8;

– compressive test analogous to the tensile test. A compressive force F2 according to Table 16 shall be applied to the fixed male tab as shown in Figure 9.

Separate specimens shall be used for tensile and compressive testing. Care shall be taken to ensure correct alignment and direction of forces.

Requirements: there shall be no damage which would impair normal operation.



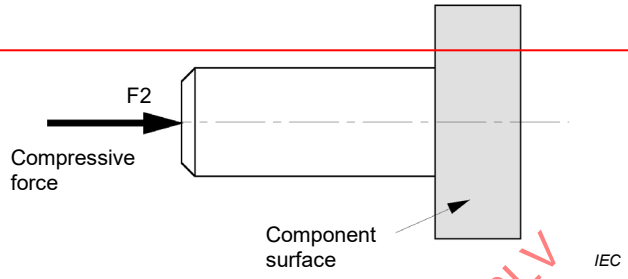
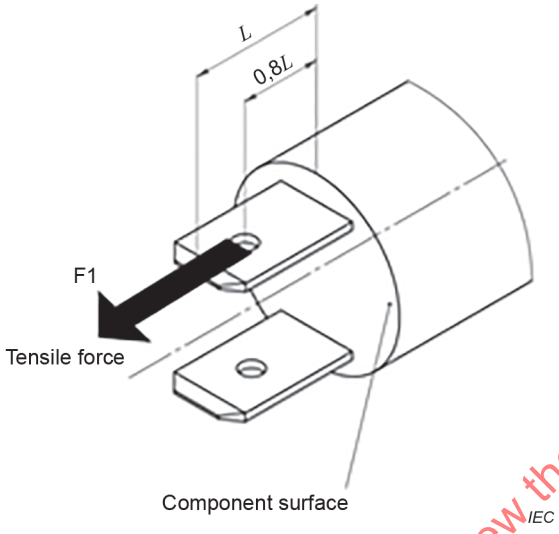


Figure 8 – Tensile force test



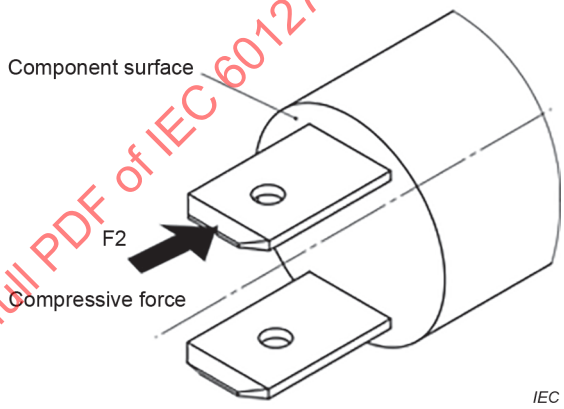


Figure 9 – Compressive force test

Table 16 – Tensile and compressive forces

Tab size mm	Tensile force F1 and compressive force F2 N
2,8	53
4,8	67
5,2	67
6,3	80
9,5	100

11.7.2.4 Quick-connect male tab terminals combined with solder tag terminals

Combined versions are tested according to 11.7.2.1 and 11.7.2.3 as applicable.

11.8 Resistance to vibration

11.8.1 General

The resistance to vibration of fuse-holders shall be adequate.

Compliance is checked by submitting the fuse-holder to the test in accordance with IEC 60068-2-6:2007, Test Fc, with the following general measuring requirements.

11.8.2 Mounting

The fuse-holder shall be mechanically connected to the test apparatus according to IEC 60068-2-47 by its normal mounting method.

The fixing nut of one-hole mounted fuse-bases shall be screwed on with a torque as specified in 11.6.1.

The fixing screws, bolts or nuts of multi-hole mounted fuse-bases shall be screwed on with a torque as specified in 11.6.2.

The snap-in fastening fuse-bases shall be mounted as specified in 11.6.3.

The minimum gauge No. 2 or No. 5 according to Table 3 or Table 4 shall be inserted in the fuse-holder.

For fuse-holders having screw-in fuse-carriers, these carriers shall be fitted in the normal way with a torque equal to two-thirds of the maximum allowable value specified in Table 11.

11.8.3 Measurement and requirements

11.8.3.1 Severity ~~(minimum level)~~

– Frequency range: 10 Hz to 55 Hz.

– Displacement amplitude 0,35 mm ~~or acceleration amplitude 5 g (see 5.2 of IEC 60068 -2- :2007, Table IV)~~ (Figure 1 and Figure 2 of IEC 60068 2 6:2007, 5.2 apply).

– Number of sweep cycles: five in each axis.

11.8.3.2 Axis of vibration

The fuse-holder shall be vibrated in three mutually perpendicular axes in turn which should be chosen in such a way that one axis is the main fuse-link axis.

11.8.3.3 Functional checks

During vibration, it shall be checked whether or not the electrical continuity between the contacts is interrupted. Interruption of 1 ms or less shall be ignored.

11.8.3.4 Final measurements

After the test, the contact resistance shall be in accordance with 10.2, and the fuse-holder shall show no serious damage in the sense of this standard.

12 Thermal requirements

12.1 Rated power acceptance test

12.1.1 General

A fuse-holder shall be so designed to carry continuously the rated current at the rated power acceptance and at an ambient air temperature T_{A1} of 23 °C without exceeding the allowable temperatures on the fuse-holder specified in 12.1.4.

Compliance is checked by the tests of 12.1.2 to 12.1.7.

12.1.2 Mounting

Fuse-holders designed for panel or base mounting shall be mounted in the centre of an insulating plate, e.g. laminated phenolic cellulose paper with the dimensions (100 × 100 × 3) mm.

Fuse-holders designed for PC board mounting shall be mounted on a test PC board according to Annex A.

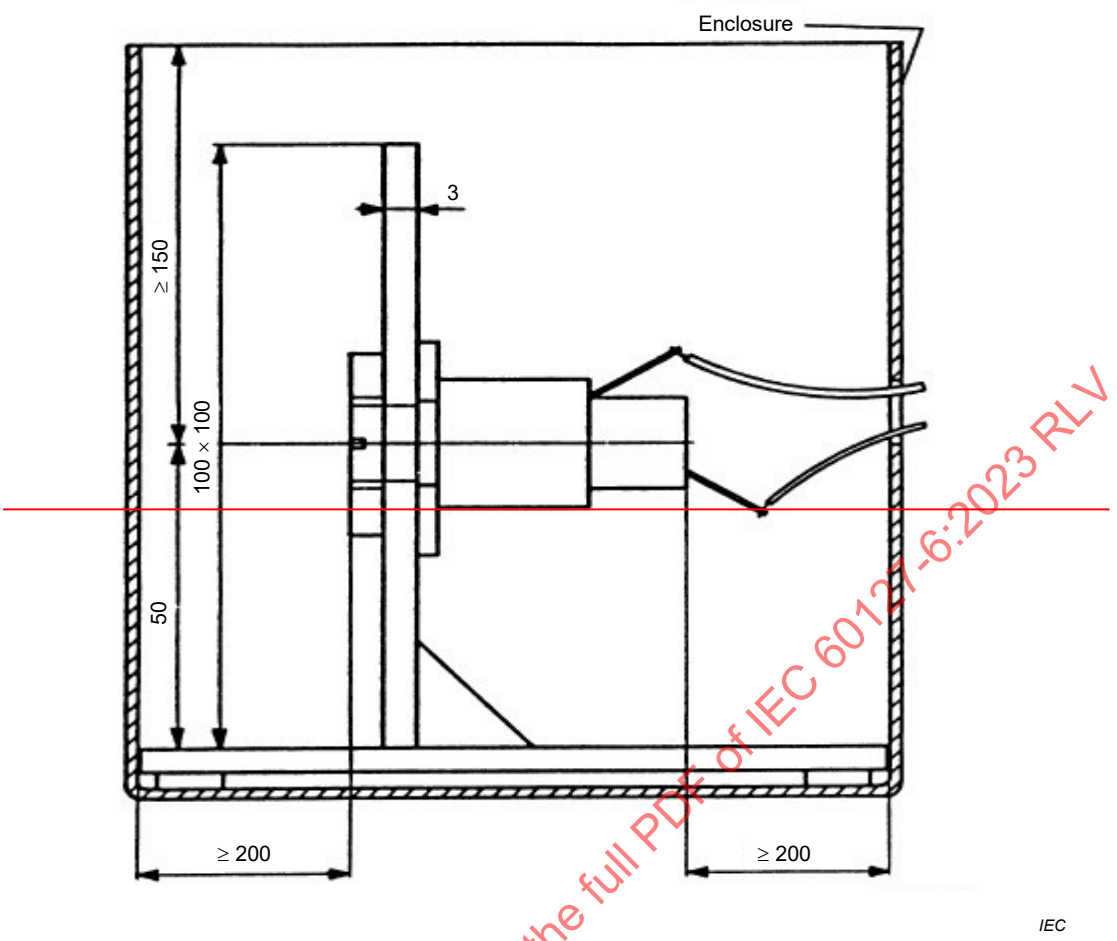
For fuse-holders having screw-in fuse-carriers, these carriers shall be fitted in the normal way with a torque equal to two-thirds of the maximum allowable value specified in Table 11.

The temperature measurements shall be carried out in air as undisturbed as possible. Therefore the fuse-holder, mounted on the corresponding plate, shall be placed in an enclosure which protects the immediate environment from external movements of air. The enclosure should be made of negligible reflective materials.

The enclosure sides shall not be closer than 200 mm from the edges of the fuse-holder. The enclosure shall not have a cover. For an example see Figure 10.

The fuse-holder samples shall be arranged in three different positions, one in the horizontal plane (Figure 10) and two in the vertical plane (upright and downwards).

The arrangement in the other planes has to be made in a similar way.



Dimensions in millimetres

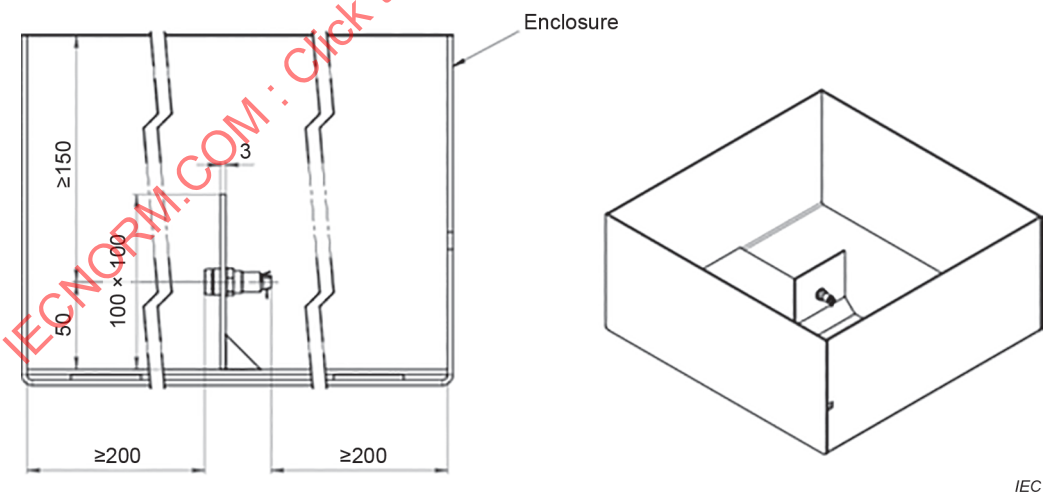


Figure 10 – Example of test device

The insulated conductors fitted to the fuse-holder or test PC board terminals shall have the following dimensions:

a) Length: 1 m.

b) Cross-sectional area of a single-core copper conductor:

– 0,5 mm^2 for fuse-holders rated up to and including 1 A;

- 1 mm^2 for fuse-holders rated more than 1 A but less than or equal to 6,3 A;
- 1,5 mm^2 for fuse-holders rated more than 6,3 A but less than or equal to 10 A;
- 2,5 mm^2 for fuse-holders rated more than 10 A but less than or equal to 16 A.
- 4 mm^2 for fuse-holders rated more than 16 A but less than or equal to 25 A.

12.1.3 Dummy fuse-links

12.1.3.1 Dummy fuse-links for cartridge fuse-links

A dummy fuse-link is a test fuse-link with defined resistance according to Table 18.

The material of the resistance wire used in the dummy fuse-link shall be of CuNi44 or any similar material having a temperature coefficient of resistance of less than ±~~8,0~~ 10,0 × 10^{-5} K^{-1} within the temperature range of 20 °C to 200 °C.

The dimensions of the dummy fuse-links are specified in ~~Table 4~~ Table 17.

~~These dimensions are equivalent to the dimensions of the minimum gauges No. 2 or No. 5, except for the permissible tolerances.~~

~~Material of the end cap: brass, nickel plated; minimum thickness of nickel plating: 2 µm.~~

Table 17 – Dimensions and materials for dummy fuse-link according to IEC 60127-2

Type of cartridge		*L*	*D*1	*D*2	*B*	Materials of part	
Fuse-link	Size					Cap	Tube
mm		mm	mm	mm	mm		
5 × 20	min.	$19{,}46\ ^{+0{,}5}_{0}$	$5{,}0\ ^{+0{,}2}_{0}$	4,2 ± 0,1	$5\ ^{+0{,}2}_{0}$	Brass[a]	Ceramic
6,3 × 32	min.	$30{,}96\ ^{+0{,}8}_{0}$	$6{,}25\ ^{+0{,}2}_{0}$	5,5 ± 0,1	$6\ ^{+0{,}2}_{0}$	Brass[a]	Ceramic
[a] Brass with copper content from 58 % to 70 %, surface with 2 µm (minimum) nickel plating (galvanic).							

In case of doubt concerning the behaviour of the used dummy fuse-links, these should be tested at rated current in the fuse-base shown in Figure 1 of IEC 60127-2:~~2010~~2014, and they should show no special effects such as thermoelectrical voltage.

There shall be no holes in the ends of the dummy fuse-links.

Table 18 – Dummy fuse-links according to IEC 60127-2

Dummy No.		Nominal power dissipation of the dummy fuse-link [a]	Current [a]	Resistance [b] ± 10 %
Dummy fuse-link for fuse-links				
5 mm × 20 mm	6,3 mm × 32 mm	P W	I A	R mΩ
A1/1625	A2/1625	1,6	2,5	256
A1/1663	A2/1663		6,3	40
A1/2525	A2/2525	2,5	2,5	400
A1/2563	A2/2563		6,3	63
A1/2510	A2/2510		10	25
A1/3263	A2/3263	3,2	6,3	81
A1/3210	A2/3210		10	32
A1/4063	A2/4063	4,0	6,3	101
A1/4010	A2/4010		10	40
A1/4012	A2/4012		12,5	25,6
A1/4016	A2/4016		16	15,6
A1/4020	A2/4020		20	10
A1/5012	A2/5012	5,0	12,5	32
A1/5016	A2/5016		16	19,5
A1/5020	A2/5020		20	12,5
A1/6012	A2/6012	6,0	12,5	38,4
A1/6016	A2/6016		16	23,4
A1/6020	A2/6020		20	15
A1/8020	A2/8020	8,0	20	20
A1/8025	A2/8025		25	12,8

[a] If other values are required, these values should be selected from the series R10 of ISO 3.

[b] The resistance of the dummy fuse-link is calculated as follows: $R = P/I^2$.

~~In reference to ratings (current, power dissipation), if other values are required, these values should be selected from the R10 series according to ISO 3.~~

12.1.3.2 Dummy fuse-links for sub-miniature fuse-links

Requirements:

a) Defined resistance according to Table 20. The material should be of low temperature coefficient of resistance.

b) Dimensions of the ~~minimum gauge in Table 6~~ dummy fuse-links according Table 19.

c) Materials of parts A and B according to ~~Table 5~~ Table 19:

- part A: brass or copper, nickel- or tin-plated;
- part B: insulating material.

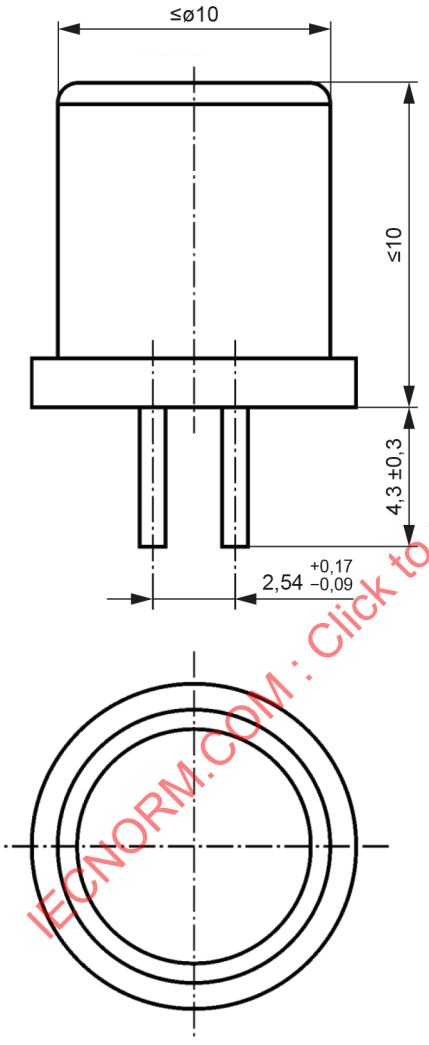
The type of material shall be assigned by the manufacturer.

Table 19 – Dimensions and materials for dummy fuse-links according to IEC 60127-3

Dummy fuse-link for sub-miniature fuse-links	*D* mm	*P* mm	Materials of part A	Materials of part B
Standard sheet 1	$0{,}55\ ^{0}_{-0{,}02}$	$2{,}54\ ^{+0{,}17}_{-0{,}09}$	Brass [a]	Insulating Material
Standard sheets 3 and 4	$0{,}56\ ^{0}_{-0{,}02}$	5,08 ± 0,1	Brass [a]	Insulating Material

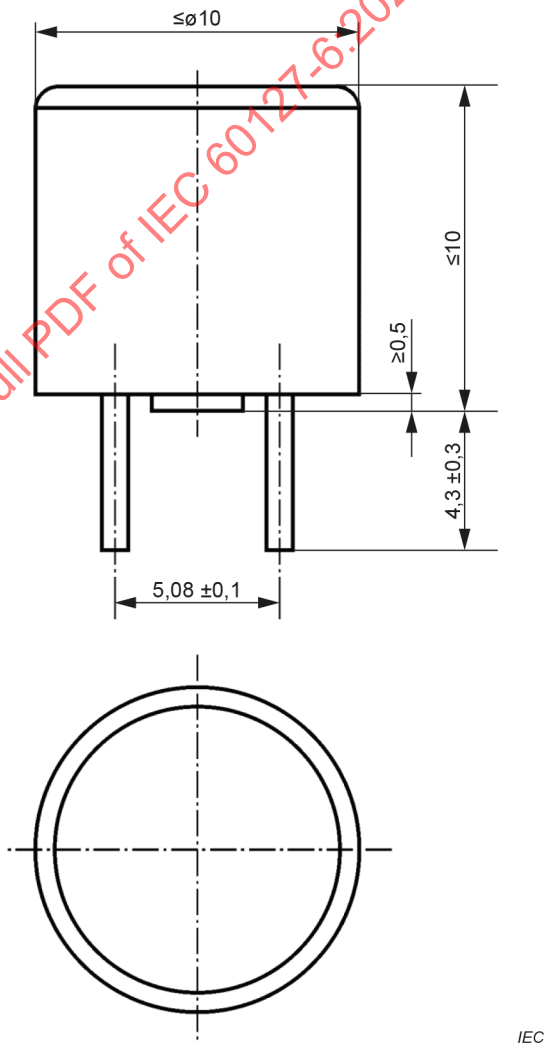
[a] Brass with copper content from 58 % to 70 %, surface with 2 µm (minimum) nickel plating (galvanic).

Dimensions in millimetres



Source: Standard sheet 1 of IEC 60127-3:2015

Figure 11 – IEC 60127-3:2015, Standard sheet 1



Source: Standard sheets 3 and 4 of IEC 60127-3:2015

Figure 12 – IEC 60127-3:2015, Standard sheets 3 and 4

Table 20 – Dummy fuse-links according to IEC 60127-3

Dummy No.		Nominal power dissipation of the dummy fuse-link [a]	Current [a]	Resistance [b] ± 10 %
Dummy fuse-link for sub-miniature fuse-links according to				
Standard sheet 1	Standard sheets 3 and 4	*P* W	*I* A	*R* mΩ
B1/1650		1,6	5,0	64
	B2/1620	1,6	2,0	400
	B2/1650		5,0	64
	B2/~~2550~~2050	~~2,5~~ 2,0	5,0	~~100~~ 80
	B2/2010	2,0	10,0	20

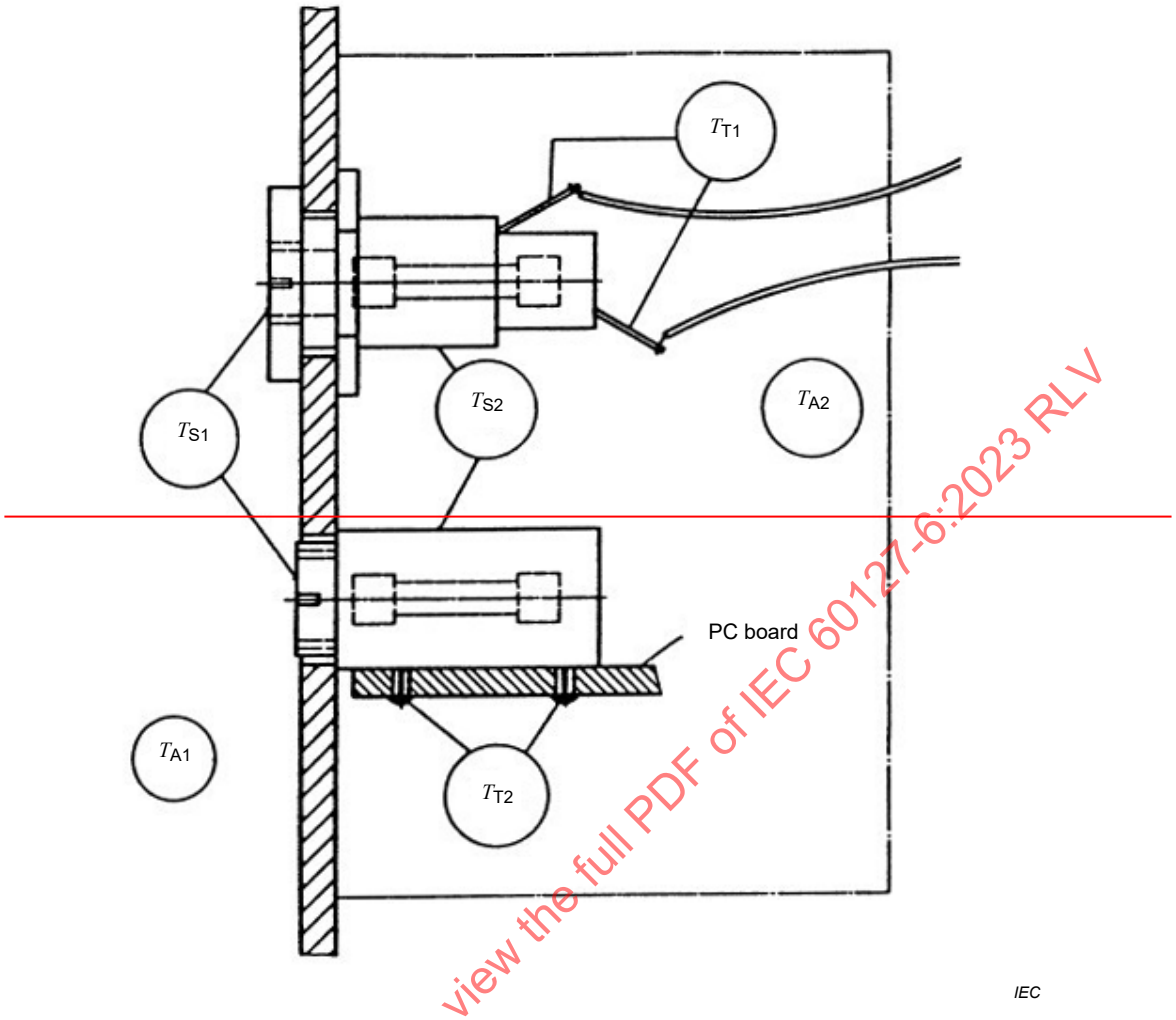
[a] If other values are required, these values should be selected from the series R10 of ISO 3.

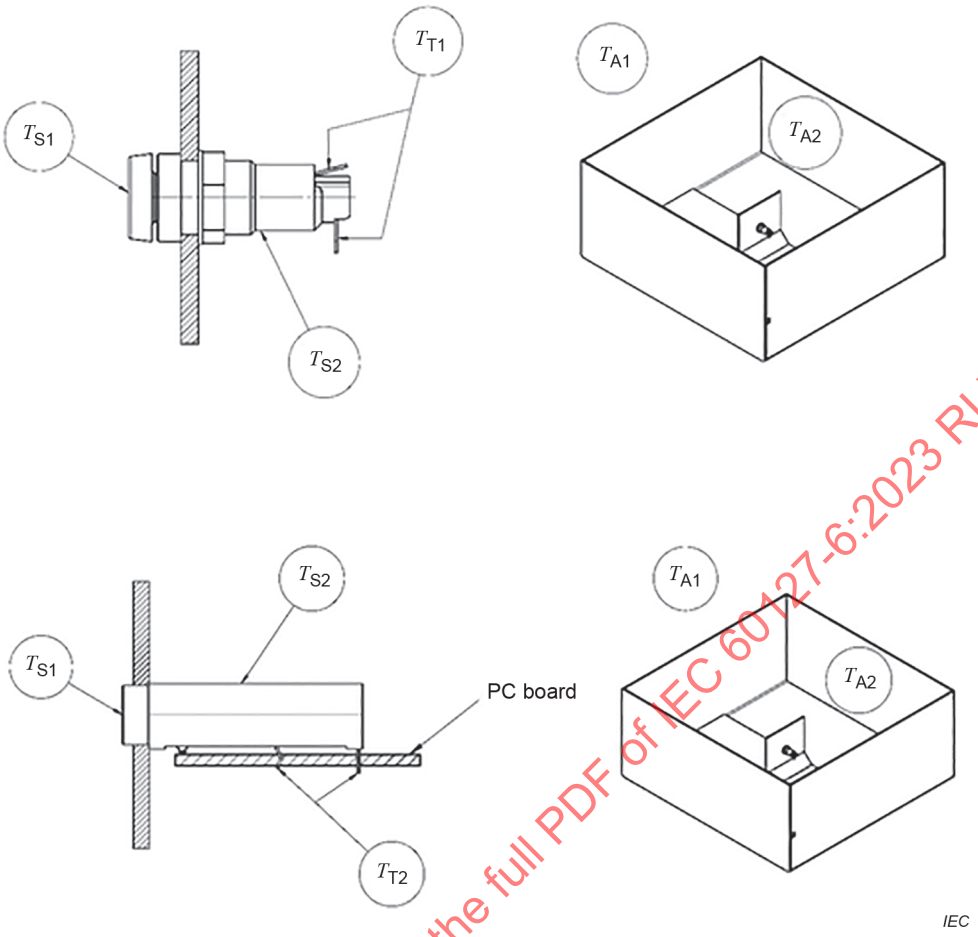
[b] The resistance of the dummy fuse-link is calculated as follows: $R = P/I^2$.

~~In reference to ratings (current, power dissipation), if other values are required, these values should be selected from the R10 series according to ISO 3.~~

12.1.4 Measurement of maximum allowable temperatures on fuse-holders

The locations where the relevant temperatures shall be measured are illustrated in Figure 13.





Key:

T_{A1} = ambient air temperature, ~~surrounding the equipment~~ outside the enclosure

T_{A2}= ~~ambient air temperature, in the equipment~~ surrounding air temperature, in the enclosure

T_{S1} = temperature of accessible part on fuse-holder surface

T_{S2} = temperature of inaccessible part on fuse-holder surface

T_{T1} = temperature on the tag-terminal of panel fuse-holder

T_{T2} = temperature on the pin-terminal of PC-board fuse-holder

Figure 13 – Illustration of temperatures experienced in practice

A thermocouple or any other temperature measuring device that does not appreciably affect the result shall be used. Even the mounting method of the thermocouple shall be chosen in such a way, that the measuring results shall not be affected. and there shall be no damage to the fuse-holder surface.

Remarks on the individual measuring points:

T_{A1} denotes the ambient temperature surrounding the ~~equipment~~ enclosure. It is measured at a distance of approximately 100 mm from the enclosure of the test device.

The rated power acceptance is referred to an ambient temperature T_{A1} of 23 °C.

The power acceptance at higher ambient temperatures T_{A1} shall be assigned by the manufacturer.

Preferred ratings at ambient temperatures T_{A1} are given in Table 2. See also Annex E.

T_{A2} denotes the ambient temperature inside the ~~equipment~~ enclosure. It is measured at a distance of approximately 50 mm from the fuse-holder under test.

T_{S1} denotes the temperature of accessible parts on the fuse-holder surface which can be touched by means of the standard test finger according to IEC 60529, when the fuse-holder is installed and operated as in normal use, e.g. on the front panel of ~~equipment~~ the enclosure (see 3.17).

T_{S2} denotes the temperature of inaccessible parts on the fuse-holder surface. It is measured on the insulating parts of the fuse-holder which are located inside the ~~equipment~~ enclosure. The measuring point on the surface of the fuse-holder shall be accessible by means of a test wire of 1 mm diameter according to IEC 60529.

T_{S1} and T_{S2} shall be measured on the hottest point of the fuse-holder surface area.

The temperature measuring points ~~shall~~ should be chosen by performing a plot test (placing of thermocouples in various areas) or by the use of a thermal imaging camera to determine the approximate location of the hottest point.

T_{T1} denotes the temperature on the tag-terminals of panel fuse-holders. It is measured on the centre point of the tag-terminal surface.

T_{T2} denotes the temperature on the pin-terminals of PC-board fuse-holders. It is measured underneath the PC board on the centre point of the fillet formed by the meniscus of the solder.

Table 21 – Maximum allowable temperatures

Fuse-holder surface area		Maximum allowable temperatures	
		[b]	°C
1	Accessible parts[a]	T_{S1}	85
2	Inaccessible parts[a]		
2.1	Insulating parts	T_{S2}	[c]
2.2	Terminals:		
2.2.1	of fuse-holder for panel or base mounting: (area around the fitted conductor)	T_{T1}	[d]
2.2.2	of fuse-holder for PC board mounting: (soldered points on PC board)	T_{T2}	[d]

[a] When the fuse-holder is properly assembled, installed and operated as in normal use, e.g. on the front panel of ~~equipment~~ end-product.

[b] See Figure 13.

[c] The maximum allowable temperature of the fuse-holder's insulating materials corresponds to the relative temperature index (RTI) or temperature index (TI) according to IEC 60216-1, which is based on test conditions of 20 000 h – electrical, without impact – if the insulating material is inaccessible after normal installation of the fuse-holder in the ~~equipment~~ end-product. If there are no relevant IEC values available, as an alternative, comparable RTI values may be chosen from an equivalent standard.

The RTI value shall be assigned by the manufacturer.

[d] The maximum allowable temperature shall be assigned by the manufacturer, but not above 175 °C.

12.1.5 Correlation between ambient air temperature T_{A1} and the power acceptance of a fuse-holder

The rated power acceptance of a fuse-holder is determined at an ambient temperature T_{A1} of 23 °C (see 3.3).

The power acceptance at higher ambient temperatures T_{A1} shall be assigned by the manufacturer. See also Annex E.

12.1.6 Temperature measuring point for ambient air temperature T_{A1}

The measuring point for measuring the ambient air temperatures T_{A1} shall be located outside the enclosure in Figure 10.

12.1.7 Test method

The fuse-holder shall be mounted according to 12.1.2.

The dummy fuse-link corresponding to the fuse-holder to be tested shall be chosen from Table 19 or Table 20 and inserted in the holder.

~~NOTE 1~~ For example, for a fuse-holder designed for fuse-links 5 mm × 20 mm and a rated power acceptance of 4 W at a rated current of 6,3 A, the dummy fuse-link No. A1/4063 with a resistance of 101 mΩ ± 10 % should be used.

The rated power acceptance test shall be carried out at an ambient temperature of not less than 23 °C and the result is corrected to a reference temperature of T_{A1} = 23 °C.

A test current equal to the rated current, a.c. or d.c., shall be passed through the fuse-holder. It is permissible for the test voltage to be less than the rated voltage of the fuse-holder.

Based on the dummy fuse-link resistance, the test current of the fuse-holder is adjusted within a tolerance of $^{+5}_{0}$ % of the rated current to give the nominal power dissipation P of the inserted dummy fuse-link.

NOTE ~~2~~ For the above example the tolerances of the 101 mΩ dummy fuse-link are:

R_{min} = 90,9 mΩ, adjusted current: 6,63 A;

R_{max} = 111 mΩ, adjusted current: 6,00 A.

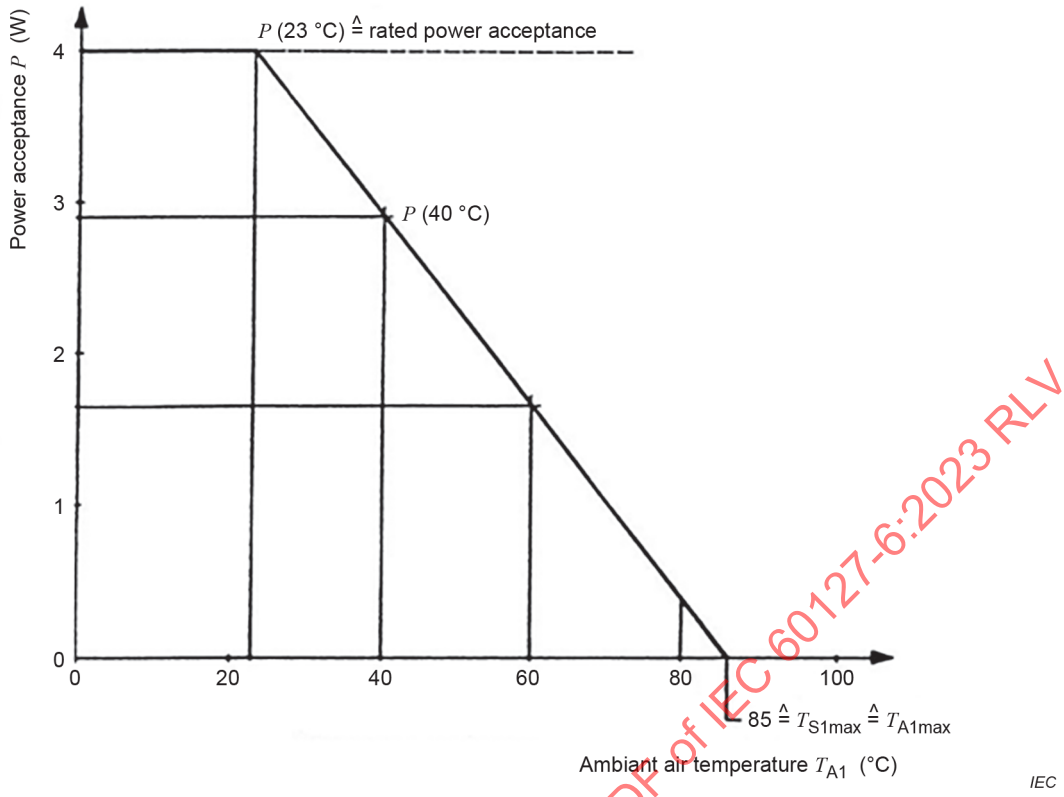
The test shall be continued until temperature stability has been reached.

Temperature stability shall be considered to have been reached when three (3) successive readings, at least 10 min apart, indicate no further temperature rise.

After temperature stability has been reached, the endurance test, according to Clause 13, shall be carried out with the same fuse-holder.

To obtain power acceptance values at higher ambient temperatures T_{A1}, tests shall be carried out at these higher temperatures following the test described above. The results can then be represented by means of a derating curve similar to the example shown in Figure 14.

Because of the maximum allowable temperature T_{S1max} = 85 °C for accessible parts, the derating curve should intersect the x-axis at the point T_{A1} = 85 °C.



NOTE Attention is drawn to the fact that this figure is an example of a derating curve. The relevant derating curve for any individual fuse-holder is assigned by the manufacturer.

Figure 14 – Example of a derating curve

12.2 Resistance to abnormal heat and fire

12.2.1 Needle-flame test

Insulation materials of fuse-holders which might be exposed to thermal stress due to electric effects and the deterioration of which might impair the safety of the ~~equipment~~ end-product shall not be unduly affected by heat and by fire generated within the fuse-holder.

Compliance is checked by subjecting the fuse-holder to the needle-flame test according to IEC 60695-11-5:~~2004~~2016, with the following modifications:

– Clause 7: ~~Severities~~ Flame application times

  The duration of application of the test flame is (10 ± 1) s.

– Clause 9: Test procedure

  The fuse-holder shall be positioned as in normal use and, at the beginning of the test, the flame is applied so that the tip of the flame is in contact with the surface of the fuse-holder. During the test, the burner shall not be moved.

– Clause 11: Evaluation of test results

  Add the following:

  There shall be no ignition of the tissue paper or scorching of the white pine board, a slight discoloration, if any, of the white pine board being neglected.

12.2.2 Glow-wire ignition test

This is not applicable for fuse-holders which represent small parts according to IEC 60695-2-11.

For fuse-holders 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

For GWFI and GWIT, reference should be made to IEC 60695-2-12 and IEC 60695-2-13 respectively. For the glow wire test, it is necessary to use material plates with the dimensions according to 4.2 of IEC 60695-2-12:~~2010~~2021 or IEC 60695-2-13:2021.

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

13 Endurance

13.1 General

Fuse-holders shall be sufficiently resistant to heat and to mechanical stresses which may occur in normal use.

Compliance is checked by the following test.

13.2 Endurance test

The fuse-holder shall be subjected to the rated power acceptance test according to 12.1. The test together with measurements of temperature and voltage drop shall go on continuously for a period of 500 h.

13.3 Requirements

After the test the fuse-holder shall be in a satisfactory condition. It shall not have suffered any deformation that would impair its correct operation. The requirements according to the following subclauses shall be fulfilled:

10.1.3 Insulating resistance.

10.1.4 Dielectric strength.

11.3 Compatibility between fuse-holder and fuse-link. For this test, the requirements in the second paragraph of 10.2.2.3 shall be replaced by the following: “The average of the values of the contact resistance shall not exceed 10 mΩ. The value of any individual measurement shall not exceed 15 mΩ.”

The maximum allowable temperatures according to Table 21 shall not be exceeded.

14 Additional requirements

14.1 Resistance to rusting

Ferrous parts shall be adequately protected against rusting. Compliance is checked by the following test.

All grease is removed from the parts to be tested by immersion in trichloroethane or an equivalent degreasing agent, for 10 min. The parts are then immersed for 10 min in a 10 % solution of ammonium chloride in water at a temperature of (20 ± 5) °C.

Without drying, but after shaking off any drops, the parts are placed for 10 min in a box containing air saturated with moisture at a temperature of (20 ± 5) °C.

After the parts have been dried for 10 min in a heating cabinet at a temperature of (100 ± 5) °C, their surface shall show no signs of rust.

Traces of rust on sharp edges and any yellowish film removable by rubbing are ignored.

For small springs and for inaccessible parts exposed to abrasion, a layer of grease may provide sufficient protection against rusting. Such parts are subjected to the test only if there is doubt about the effectiveness of the grease film, and the test is then made without previous removal of the grease.

14.2 Resistance to cleaning solvents

This test shall be applied to fuse-holders designed for PC board mounting.

The cleaning solvent to be used shall be propan-2-ol (isopropyl alcohol) or any similar solvent, except for solvent containing freon.

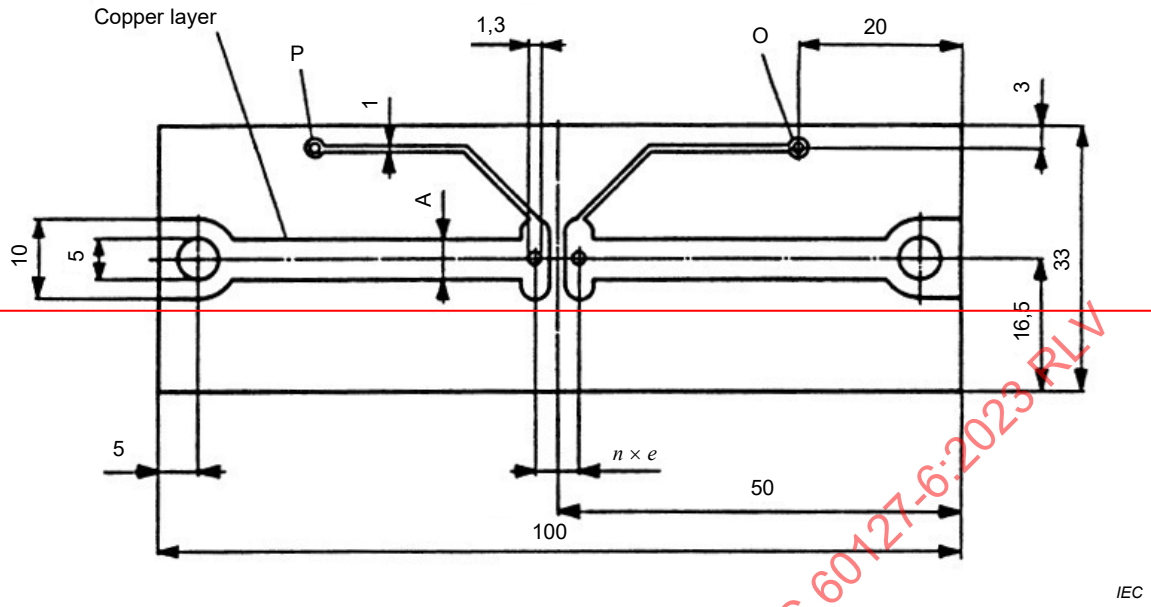
Compliance is checked by the test according to IEC 60068-2-45, with the following conditions:

– solvent temperature: (23 ± 5) °C;
– duration of immersion: (5 ± 0,5) min;
– conditioning: Method 2 (without rubbing);
– recovery time: not less than 1 h;
– final measurement:
  - visual inspection and
  - dielectric strength test according to Table 9.

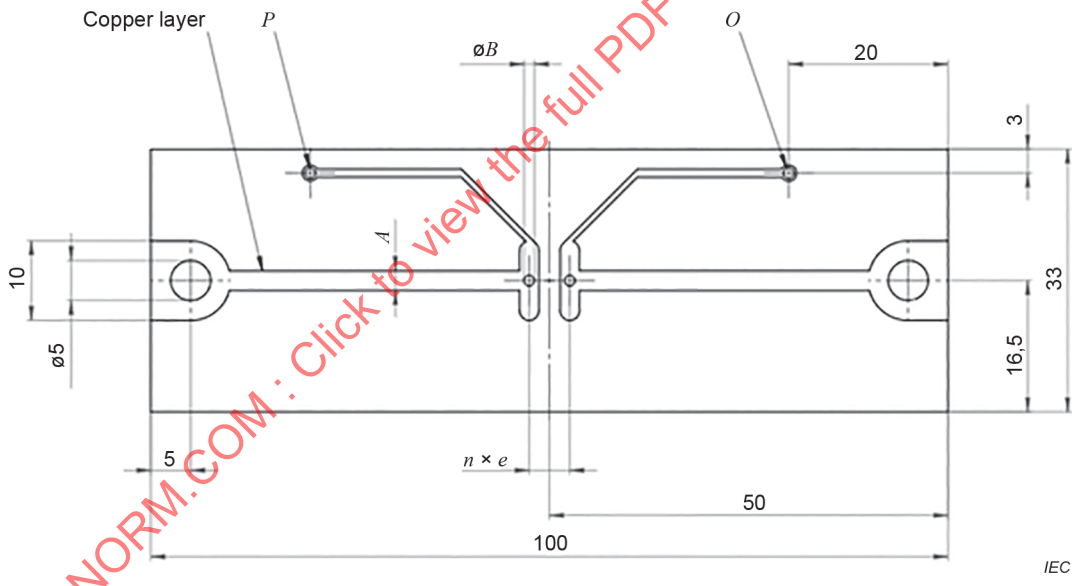
Annex A
(normative)

Test PC board for fuse-holders of rated currents up to ~~10~~ 25 A

Figure A.1 shows an example of a test board. The number and alignment of the holes for the solder terminal of the fuse-holder may be chosen to suit the relevant fuse-holder. The dimensions of the copper layer (nominal width A, nominal thickness) and the overall dimensions (approximately 100 mm × 33 mm) shall be met. ~~Table A.1 gives nominal width and nominal thickness of copper layer for test board.~~



Dimensions in millimetres



ΦB – minimum 1,3 mm or in accordance to manufacturer declaration

P/O – Connection for voltage drop measurement:

e – 2,54 mm

n – 1 to 6

Figure A.1 – Example of a test board

Base material:

– glass-fibre reinforced epoxy, temperature strength ≥150 °C;
– nominal thickness shall be 1,6 mm;
– copper layer:

Table A.1 – Copper layer for test board

Rated current of fuse-holder	Copper layer	
	Nominal width *A*	Nominal thickness
	mm	mm
<6,3 A	2,5	0,035
6,3 A to ≤10 A	5,0	0,070
~~≤16 A~~	~~Under consideration~~	~~Under consideration~~
>10 A to ≤16 A	10,0	0,105
>16 A to ≤25 A	15,0	0,140

Other layouts of the pc-board are acceptable, as long as the length, width and thickness of the copper layer inside the requested values.

Annex B
(normative)

Type tests, test sequences and number of samples

~~Table B.1 gives type tests, test sequences and number of samples. Care shall be taken that 12 spares are available.~~

~~Table B.1 – Type tests, test sequences and number of samples~~

~~Test~~ ~~group~~	~~no.~~	~~Number of samples~~	~~Parameters~~	~~Sub-clause~~
		~~1 to 15 (15 samples)~~	~~Marking~~	~~6~~
	~~1.1~~		~~Protection against electric shock~~	~~9~~
	~~1.2~~		~~Clearance, creepage distances~~	~~10~~
~~1~~	~~1.3~~	~~1 to 3 (3 samples)~~	~~Insulation resistance, dielectric strength, impulse withstand voltage~~	~~11.1~~
	~~1.4~~		~~Mechanical strength of the fuse-holder fastening on panels~~	~~12.5~~
	~~2.1~~		~~Contact resistance~~	~~11.2~~
	~~2.2~~		~~Compatibility between fuse-holder and fuse-link~~	~~12.2~~
~~2~~	~~2.3~~	~~4 to 6 (3 samples)~~	~~Mechanical strength of the connection between fuse-base and fuse-carrier~~	~~12.3~~
	~~2.4~~		~~Impact test~~	~~12.4~~
	~~2.5~~		~~Terminals of fuse-bases~~	~~12.6~~
~~3~~	~~3.1~~	~~7 to 9 (3 samples)~~	~~Rated power acceptance test including endurance test~~	~~13.1~~ ~~14~~
~~4~~	~~4.1~~	~~10 to 12 (3 samples)~~	~~Resistance to abnormal heat and fire~~	~~13.2~~
	~~5.1~~		~~Resistance to vibration~~	~~12.7~~
~~5~~	~~5.2~~	~~13 to 15 (3 samples)~~	~~Resistance to rusting~~	~~15.1~~
	~~5.3~~		~~Resistance to cleaning solvents~~	~~15.2~~

~~All 15 samples in Table B.1 shall comply with the requirements of Clause 6.~~

~~All 3 samples in Group 1 in Table B.1 shall comply with the requirements of Clause and sub-clause 9, 10, 11.1 and 12.5.~~

~~If one instance of non-compliance occurs in Group 2, 3, 4 and 5 in Table B.1, then the test shall be repeated on this parameter using the original sample size. Providing that no further instances of non-compliance occur, the fuse-holder shall be deemed to comply with this standard.~~

~~If a total of two or more instances of non-compliance occur, not necessarily for the same parameter of this group, then the fuse-holder is deemed not to comply with this standard.~~

Table B.1 gives type tests, test sequences and number of samples. Twelve (12) spare samples shall be available.

Table B.1 – Type tests, test sequences and number of samples

Test group	Test no.	Number of samples	Parameters	Clause or Sub-clause	Acceptance criteria
		1 to 15 (15 samples)	Marking	6	All samples shall comply with the standard
1	1.1	1 to 3 (3 samples)	Protection against electric shock	8	All samples shall comply with the standard
	1.2		Clearance, creepage distances	9	
	1.3		Insulation resistance, dielectric strength, impulse withstand voltage	10.1	
	1.4		Mechanical strength of the fuse-holder fastening on panels	11.6	
2	2.1	4 to 6 (3 samples)	Contact resistance	10.2	[a]
	2.2		Compatibility between fuse-holder and fuse-link	11.3	
	2.3		Mechanical strength of the connection between fuse-base and fuse-carrier	11.4	
	2.4		Impact test	11.5	
	2.5		Terminals of fuse-bases	11.7	
3	3.1	7 to 9 (3 samples)	Rated power acceptance test including endurance test	12.1 13	[a]
	3.2		Measurement of insulation resistance	10.1.3	
	3.3		Dielectric strength test	10.1.4	
	3.4		Compatibility between fuse-holder and fuse-link with requirements according to 13.3	11.3	
4	4.1	10 to 12 (3 samples)	Resistance to abnormal heat and fire	12.2	[a]
5	5.1	13 to 15 (3 samples)	Resistance to vibration	11.8	[a]
	5.2		Resistance to rusting	14.1	
	5.3		Resistance to cleaning solvents	14.2	

[a] If one instance of non-compliance occurs, then the test shall be repeated on this parameter using the original sample size. Providing that no further instances of non-compliance occur, the fuse-holder shall be deemed to comply with this standard.

If a total of two or more instances of non-compliance occur, not necessarily for the same parameter of this group, then the fuse-holder is deemed not to comply with this standard.

Annex C
(informative)

Insulation coordination4

C.1 Overvoltage categories

The concept of overvoltage categories is used for equipment energized directly from the low-voltage mains.

NOTE 1 This concept of overvoltage categories is used in IEC 60364-4-44.

– Equipment of overvoltage category IV is for use at the origin of the installation.

NOTE 2 Examples of such equipment are electricity meters and primary overcurrent protection equipment.

– Equipment of *overvoltage* category III is equipment in fixed installations, and for cases where the reliability and the availability of the equipment is subject to special requirements.

NOTE 3 Examples of such equipment are switches in the fixed installation and equipment for industrial use with permanent connection to the fixed installation.

– Equipment of overvoltage category II is energy-consuming equipment to be supplied from the fixed installation.

NOTE 4 Examples of such equipment are appliances, portable tools, and other household and similar loads.

If such equipment is subjected to special requirements with regard to reliability and availability, overvoltage category III applies.

– Equipment of *overvoltage category I* is equipment for connection to circuits in which measures are taken to limit transient overvoltages to an appropriately low level.

NOTE 5 Examples are protected electronic circuits.

C.2 Degrees of pollution in the micro-environment

Pollution degree 1

No pollution or only dry, non-conductive pollution occurs. The pollution has no influence.

Pollution degree 2

Only non-conductive pollution occurs except that occasionally a temporary conductivity caused by condensation is to be expected.

Pollution degree 3

Conductive pollution occurs or dry non-conductive pollution occurs which becomes conductive due to condensation which is to be expected.

Pollution degree 4

The pollution generates persistent conductivity caused by conductive dust, or by rain or snow.

4 See IEC 60664-1.

C.3 Comparative tracking index CTI

Material groups and their CTI value as follows:

Material group I 600 ≤ CTI

Material group II 400 ≤ CTI < 600

Material group IIIa 175 ≤ CTI < 400

Material group IIIb 100 ≤ CTI < 175

The CTI values above refer to values obtained, in accordance with IEC 60112, on samples specifically made for the purpose and tested with solution A.

The proof-tracking index (PTI) is also used to identify the tracking characteristics of materials. A material may be included in one of the four groups given above on the basis that its PTI, established by the methods of IEC 60112 using solution A, is equal to or greater than the lower value specified for the group.

Annex D
(informative)

Additional tests and requirements

D.1 General

The tests mentioned in this Annex D are optional. However, if they are carried out, the following requirements shall be met.

It shall also be indicated in which lot for a type test this test shall be included.

D.2 Resistance to shock

D.2.1 General

The resistance to shock of fuse-holders shall be adequate. Compliance is checked by submitting the fuse-holder to the test in accordance with IEC 60068-2-27, test Ea, with the following general measuring requirements.

D.2.2 Mounting

According to 11.8.2.

D.2.3 Measurement and requirements

D.2.3.1 Severity (minimum level)

– Acceleration amplitude: 50 g

– Pulse duration: 11 ms

(see 4.1 of IEC 60068-2-27:2008, Table 1)

D.2.3.2 Axes of shocks

According to 11.8.3.2.

D.2.3.3 Final measurements

According to 11.8.3.4.

D.3 Verification of the degree of protection of enclosures

If the fuse-holder is qualified equipment with a degree of protection provided by enclosure according to IEC 60529, as declared by the manufacturer, the verification of the degree of protection shall be carried out according to IEC 60529.

IEC 60529 gives test conditions for each degree of protection. The conditions appropriate to the stated degree of protection should be applied, immediately followed by the dielectric strength test on the fuse holder as specified in 10.1.4.

Preferred degree of protection: Minimum IP 40.

D.4 Climatic category

D.4.1 General

The climatic category assigned to the fuse-holder by the manufacturer shall be in accordance with IEC 60068-1, as shown in Table D.1.

Table D.1 – Examples of climatic categories

Category	Temperature limits °C		Damp heat, steady state: number of days	Designation [a] of the test according to IEC 60068-2
55/125/56	-55	+125	56	A (Cold, IEC 60068-2-1) B (Dry heat, IEC 60068-2-2) C (Damp heat, steady state, IEC 60068-2-78)
40/85/56	-40	+85	56	
25/70/21	-25	+70	21	
10/55/04	-10	+55	4	

[a] The following upper case letters of tests are designated by the introduction of IEC 60068-1:~~1998~~2013.

D.4.2 Test conditions and requirements

The verification of the stated climatic category shall be carried out under the conditions in the relevant IEC 60068-1 and IEC 60068-2.

The fuse-holder shall be mounted as specified in 10.1.1.

Immediately after these tests the parts of insulating material, normally accessible when in use, shall be wrapped with metal foil as shown in Figure 4 and Figure 5. After this treatment the requirements shall be in accordance with:

10.1.3 Insulation resistance

10.1.4 Dielectric strength

11.3 Compatibility between fuse-holder and fuse-link. For this test the requirements in the second paragraph of 10.2.2.3 shall be replaced by the following: “The average of the values of the contact resistance shall not exceed 10 mΩ. The value of any individual measurement shall not exceed 15 mΩ.”

Annex E
(~~informative~~ normative)

Information for the correct application of the fuse-holder

Manufacturers shall hold available the following minimum information which is necessary for the correct application of the fuse-holder.

Table E.1 – Information for the correct application of the fuse-holder

	~~Ratings, characteristics~~	~~According to clauses and subclauses~~
~~1 Rated voltage~~		~~3.5 / 5.1~~
~~2 Rated current~~		~~3.4 / 5.2~~
~~3 Rated power acceptance at ambient temperature T_{A1} of 23 °C~~		~~3.3 / 5.3 / 13.1~~
~~4 Maximum allowable ambient temperature:~~		~~3.19 /13.1.3 / 13.1.4~~
~~4.1 for accessible parts (T_{A1})~~		
~~4.2 for inaccessible parts (T_{A2})~~		
~~5 Protection against electric shock Category PC1 or PC2 or PC3~~		~~5.4 / 9~~
~~6 Protection class I or II of electrical equipment for which the fuse-holder is suitable, regarding protection against electric shock according to IEC 61140~~		~~5.5 / 9~~
~~7 Overvoltage category and degree of pollution~~		~~3.8 / 3.10 / 5.6~~
~~8 Comparative tracking index CTI of insulation materials~~		~~3.15 / 5.6~~

		Ratings, characteristics	According to clauses and subclauses
1	Rated voltage		3.5 /Table 2
2	Rated current		3.4 / Table 2
3	Rated power acceptance at ambient temperature T_{A1} of 23 °C		3.3 / Table 2 / 12.1
4	Maximum allowable ambient temperature:		3.18 /12.1.3 / 12.1.4
4.1	for accessible parts (T_{A1})		
4.2	for inaccessible parts (T_{A2})		
5	Protection against electric shock Category PC1 or PC2 or PC3		Table 2 / 8
6	Protection class I or II of electrical equipment for which the fuse-holder is suitable, regarding protection against electric shock according to IEC 61140		Table 2 / 8
7	Overvoltage category and degree of pollution		3.8 / 3.10 / Table 2
8	Comparative tracking index CTI of insulation materials		3.15 / Table 2

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5 This document has been revised by ISO 21920-1:2021.

6 This document has been withdrawn in 2000.

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

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IEC 60127-6

Edition 3.0 2023-10

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Miniature fuses –
Part 6: Fuse-holders for miniature fuse-links

Coupe-circuit miniatures –
Partie 6: Ensembles-porteurs pour cartouches de coupe-circuits miniatures

IEC 60127-6:2023-10(en-fr)

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

MINIATURE FUSES –

Part 6: Fuse-holders for miniature fuse-links

FOREWORD

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IEC 60127-6 has been prepared by subcommittee 32C: Miniature fuses, of IEC technical committee 32: Fuses. It is an International Standard.

This third edition cancels and replaces the second edition published in 2014. This edition constitutes a technical revision.

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

a) enhanced maximum rated current from 16 A to 25 A in Clause 1;
b) adding of IEC 60127-4 and IEC 60127-7 in Clause 1;
c) modification of marking position in Clause 6;
d) modification of rated voltage, rated current and rated power acceptance in Table 2;
e) modification of Table 5, Table 6, Table 7, Table 9, Table 16 and Table A.1.

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

Draft	Report on voting
32C/620/FDIS	32C/623/RVD

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

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

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

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

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

- reconfirmed,
- withdrawn, or
- revised.

INTRODUCTION

According to the wish expressed by the users of miniature fuses, all standards, recommendations and other documents relating to miniature fuses 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 and subclauses containing general requirements need not be repeated.

To this day, the IEC 60127 series, 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, *Miniature fuses – Part 8: Fuse resistors with particular overcurrent protection*

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

This part of IEC 60127 covers requirements, test equipment and test methods for fuse-holders. It is a self-standing document, which refers back to IEC 60127-1 with regard to certain definitions and the atmospheric conditions for test. It also makes reference to other parts of the IEC 60127 series with regard to dimensions and maximum power losses of fuse-links.

MINIATURE FUSES –

Part 6: Fuse-holders for miniature fuse-links

1 Scope

This part of IEC 60127 is applicable to fuse-holders for miniature cartridge fuse-links according to IEC 60127-2, sub-miniature fuse-links according to IEC 60127-3, universal modular fuse-links to IEC 60127-4 and miniature fuse-links for special applications to IEC 60127-7 for the protection of electric appliances, electronic equipment and component parts thereof, normally intended for use indoors.

NOTE Requirements for fuse-holders for miniature fuse-links complying with IEC 60127-4 and IEC 60127-7 are under consideration.

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

This document applies to fuse-holders with:

– a maximum rated current of 25 A and
– a maximum rated voltage of 1 500 V DC or 1 000 V AC; and
– for use up to 2 000 m above sea-level, unless otherwise specified.

The object of this document is to establish uniform requirements for safety and the assessment of electrical, mechanical, thermal and climatic properties of fuse-holders and the compatibility between fuse-holders and fuse-links.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050-441, *International Electrotechnical Vocabulary (IEV) – Part 441: Switchgear, controlgear and fuses*

IEC 60050-581, *International Electrotechnical Vocabulary (IEV) – Part 581: Electromechanical components for electronic equipment*

IEC 60068-1:2013, *Environmental testing – Part 1: General and guidance*

IEC 60068-2-6:2007, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-20:2021, *Environmental testing – Part 2-20: Tests – Tests Ta and Tb: Test methods for solderability and resistance to soldering heat of devices with leads*

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

IEC 60068-2-27:2008, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60068-2-45, *Basic environmental testing procedures – Part 2-45: Tests – Test XA and guidance: Immersion in cleaning solvents*

IEC 60068-2-47, *Environmental testing – Part 2-47: Test – Mounting of specimens for vibration, impact and similar dynamic tests*

IEC 60068-2-75, *Environmental testing – Part 2-75: Tests – Test Eh: Hammer tests*

IEC 60127-1[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 60127-2, *Miniature fuses – Part 2: Cartridge fuse-links*

IEC 60127-3:2015, *Miniature fuses – Part 3: Sub-miniature fuse-links*

IEC 60216-1, *Electrical insulating materials – Thermal endurance properties – Part 1: Ageing procedures and evaluation of test results*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*

IEC 60664-1:2020, *Insulation coordination for equipment within low-voltage supply systems – Part 1: Principles, requirements and tests*

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

IEC 60695-2-12:2021, *Fire hazard testing – Part 2-12: Glowing/hot-wire based test methods – Glow-wire flammability index (GWFI) test method for materials*

IEC 60695-2-13:2021, *Fire hazard testing – Part 2-13: Glowing/hot-wire based test methods – Glow-wire ignition temperature (GWIT) test method for materials*

IEC 60695-11-5:2016, *Fire hazard testing – Part 11-5: Test flames – Needle-flame test method – Apparatus, confirmatory test arrangement and guidance*

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

IEC 61210, *Connecting devices – Flat quick-connect terminations for electrical copper conductors – Safety requirements*

[1] A consolidated version of this publication exists, comprising IEC 60127-1:2006, IEC 60127-1:2006/AMD 1:2011 and IEC 60127-1:2006/AMD 2:2015.

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-441, IEC 60050-581, IEC 60127-1 and the following apply.

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

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

3.1
fuse-holder
combination of a fuse-base with its fuse-carrier

Note 1 to entry: In some fuse-holder constructions where the fuse-base and the fuse-carrier are not separate parts the fuse-holder may consist of only the fuse-base and no fuse-carrier.

3.1.1
fuse-base
fuse-mount
fixed part of a fuse provided with contacts and terminals for connection to the system

[SOURCE: IEC 60127-1:2006, 3.10]

3.1.2
fuse-carrier
movable part of a fuse designed to carry a fuse-link

[SOURCE: IEC 60127-1:2006, 3.12]

3.1.3
unexposed fuse-holder
fuse-holder with enclosed contacts

3.1.4
exposed fuse-holder
fuse-holder with exposed contacts

EXAMPLE Clips.

3.2
rating
characteristic values that together define the working conditions upon which the tests are based and for which the fuse-holder is designed

EXAMPLE Examples of rated values usually stated for fuse-holders are:

– voltage (U_N);
– current (I_N);
– power acceptance.

3.3
rated power acceptance
value of power acceptance of a fuse-holder assigned by the manufacturer

Note 1 to entry: This value is the maximum power dissipation produced by the inserted dummy fuse-link during testing, at the rated current tolerated by the fuse-holder without exceeding the specified temperatures.

Note 2 to entry: The rated power acceptance is referred to an ambient temperature of 23 °C.

3.4
rated current
value of current of a fuse-holder assigned by the manufacturer and to which the rated power acceptance is referred

3.5
rated voltage
value of voltage of a fuse-holder assigned by the manufacturer and to which operation and performance characteristics are referred

3.6
insulation coordination
mutual correlation of insulation characteristics of electrical equipment taking into account the expected micro-environment and other influencing stresses

[SOURCE: IEC 60664-1:2020, 3.1.3, modified – Note 1 to entry has been removed.]

3.7
impulse withstand voltage
highest peak value of impulse voltage of specified form and polarity which does not cause breakdown of insulation under specified conditions

[SOURCE: IEC 60664-1:2020, 3.1.15]

3.8
overvoltage category
numeral defining a transient overvoltage condition

Note 1 to entry: Specified categories, see Clause C.1.

[SOURCE: IEC 60664-1:2020, 3.1.20, modified – Note 1 to entry “Overvoltage categories I, II, III and IV are used, see 4.3.2” has been entirely reworded.”]

3.9
pollution
<of an electrical system> any condition of foreign matter, solid, liquid, or gaseous (ionized gases), that can affect dielectric strength or surface resistivity

[SOURCE: IEC 60664-1:2020, 3.1.24]

3.10
pollution degree
numeral characterizing the expected pollution of the micro-environment

Note 1 to entry: see Clause C.2.

[SOURCE: IEC 60664-1:2020, 3.1.25, modified – Note 1 to entry has been added].

3.11
micro-environment
<of an electrical system> ambient conditions which immediately influences the dimensioning of the clearance and creepage distances

[SOURCE: IEC 60664-1:2020, 3.1.23]

3.12
clearance
shortest distance in air between two conductive parts

[SOURCE: IEC 60664-1:2020, 3.1.4]

3.13
creepage distance
shortest distance along the surface of a solid insulating material between two conductive parts

[SOURCE: IEC 60050-151:2001, 151-15-50]

3.14
solid insulation
solid insulating material or a combination of solid insulating material, placed between two conductive parts or between a conductive part and a body part

[SOURCE: IEC 60664-1:2020, 3.1.6]

3.15
comparative tracking index
CTI
numerical value of the maximum voltage in volts which a material can withstand without tracking and without a persistent flame occurring under specified test conditions

Note 1 to entry: The test for comparative tracking index in accordance with IEC 60112 is designed to compare the performance of various insulating materials under test conditions, namely drops of an aqueous contaminant falling on a horizontal surface leading to electrolytic conduction material groups and their CTI values, see Clause C.3.

[SOURCE: IEC 60050-212:2010, 212-11-59, modified – The Note to entry has been added.]

3.16
live part
conductor or conductive part intended to be energized in normal operation, including a neutral conductor, but by convention, not a PEN conductor or PEM conductor or PEL conductor

Note 1 to entry: This concept does not necessarily imply a risk of electric shock.

[SOURCE: IEC 60050-826:2022, 826-12-08, modified – The domain "<in electrical installations and equipment> has been deleted, the definition has been reworded and the note to entry has been added.]

3.17
fuse-holder electric shock protection categories
designation characterizing the level of the protection against electric shock of a fuse-holder

3.18
maximum allowable ambient temperature
highest air temperature, in the immediate vicinity, that a fuse-holder can endure at a power acceptance assigned by the manufacturer of the fuse-holder without exceeding the maximum allowable temperatures on the accessible and inaccessible surfaces of the fuse-holder

3.19
relative temperature index
based on IEC 60216-1, temperature index of a test material obtained from the time which corresponds to the known temperature index of a reference material when both materials are subjected to the same ageing and diagnostic procedures in comparative test

3.20
insulation
part of an electrotechnical product which separates the conducting parts at different electric potentials during operation or insulates such parts from the surroundings

Note 1 to entry: For detailed information, see IEC 61140 and IEC 60664-1.

[SOURCE: IEC 60050-212:2010, 212-11-07, modified – The term “electric insulation” has been replaced by “insulation”.]

3.20.1
functional insulation
insulation between conductive parts which is necessary only for the proper functioning of the equipment

[SOURCE: IEC 60664-1:2020, 3.1.29]

3.20.2
basic insulation
insulation of hazardous-live-parts which provides basic protection

Note 1 to entry: The concept does not apply to insulation used exclusively for functional purposes.

[SOURCE: IEC 60050-826:2022, 826-12-14, modified – In the definition, the term “insulation” has been replaced by “insulation of hazardous-live-parts”.]

3.20.3
supplementary insulation
independent insulation applied in addition to basic insulation for fault protection

[SOURCE: IEC 60050-826:2022, 826-12-15]

3.20.4
double insulation
insulation comprising both basic insulation and supplementary insulation

[SOURCE: IEC 60050-826:2022, 826-12-16]

3.20.5
reinforced insulation
insulation of hazardous-live-parts which provides a degree of protection against electric shock equivalent to double insulation

Note 1 to entry: Reinforced insulation can comprise several layers which cannot be tested singly as basic insulation or supplementary insulation.

[SOURCE: IEC 60050-826:2022, 826-12-17, modified – In the definition, the term “insulation” has been replaced by “insulation of hazardous-live-parts”.]

3.21
inaccessible part
inaccessible surface
part or surface inside the equipment which cannot be touched by means of the standard test finger according to IEC 60529

3.22
accessible part
accessible surface
part or surface which can be touched by means of the standard test finger according to IEC 60529, when the fuse-holder is installed and operated as in normal use, e.g. on the front panel of equipment

3.23
gauge
test fuse-link without a melting element

4 General requirements

Fuse-holders shall be so designed and constructed that in normal use, installed according to the manufacturer's instructions, their performance is reliable and without danger to the user or surroundings.

In general, compliance is checked by carrying out all of the relevant tests specified.

Additional tests and requirements may be added in accordance with the manufacturer's declaration, as shown in Annex D.

Examples of fuse-holder types with different features are given in Table 1.

Table 1 – Features of unexposed or exposed fuse-holders

No.	description
1	*Types of mounting*: – Panel and base mounting – Printed circuit board mounting
2	*Methods of fastening*: – Methods of fastening on panel: • Fixing nut fastening (threaded nut) • Snap-in fastening: a) Fuse-base with an integral spring system b) Fuse-base with a separate spring-nut (a nut fabricated, e.g. from thin spring steel having an impression designed to accommodate the mating part)
	– Methods of fastening on printed circuit (PC) board: • Solder fastening • Plug-in fastening
3	*Methods of insertion of the fuse-carrier into the fuse base:* – Screw insertion – Bayonet insertion – Plug-in insertion
4	*Types of terminals:* – Screw terminals – Solder terminals – Quick connect terminals – Other solderless terminals: • crimp terminals • wire wrap terminals

No.	**description**
5	*Protection against electric shock* – Fuse-holder without integral protection against electric shock – Fuse-holder with integral protection against electric shock – Fuse-holder with enhanced integral protection against electric shock
NOTE This list is not intended to be comprehensive and fuse-holders which are not listed are not necessarily excluded from the scope.	

5 Preferred ratings and classifications for fuse-holders

Table 2 gives the values for preferred ratings and classifications.

Table 2 – Values for preferred ratings and classifications

Ratings and classifications for fuse-holders	**For fuse-links according to**	
	IEC 60127-2	**IEC 60127-3**
Rated voltage	250 V and 500 V	125 V and 250 V
Rated current	6,3 A / 10 A / 12,5 A / 16 A / 20 A / 25 A	6,3 A / 10 A
Rated power acceptance at an ambient temperature T_{A1} of 23 °C	1,6 W / 2,5 W / 3,2 W / 4 W / 5 W / 6 W / 8 W	1,6 W / 2,0 W
Fuse-holder electric shock protection categories	Category PC1 Category PC2 Category PC3	
Protection against electric shock referring to equipment, according to IEC 61140	Class I or II	
Insulation coordination according to IEC 60664-1: a) Overvoltage category b) Pollution degree c) Comparative tracking index CTI	 II or III 2 or 3 CTI ≥ 150	

In reference to ratings (voltage, current, power acceptance), if other values are required, these values should be selected from the R10 series according to ISO 3. For classifications (Insulation coordination according to IEC 60664-1 in Table 2), other values may be specified.

Complete information on ratings and classifications is given by the manufacturer according to Annex E.

6 Marking

6.1 Fuse-holders shall be marked with:

– name or trade mark of the manufacturer

– catalogue or type reference.

The manufacturer shall provide the below markings on the smallest packaging label and may additionally mark them on the fuse-holder.

– rated voltage in volts,

– power acceptance in watts

– rated current in amperes

For panel-mount fuse-holders, these markings shall not be placed on the front of the fuse-holder. This is to prevent installation of a replacement fuse-link with the wrong rating.

Examples of Marking: 250 V 4 W/6,3 A or 250 V 4 W 6,3A.

The marking shall be indelible and easily legible.

6.2 Compliance is checked by inspection and by rubbing the marking by hand for 15 s with a piece of cloth soaked in water and again for 15 s with a piece of cloth soaked in petroleum spirit.

For petroleum spirit the use of an aliphatic solvent hexane, with an aromatics content of maximum 0,1 % volume, a kauri-butanol value of 29, initial boiling point approximately 65 °C, dry-point approximately 69 °C and specific gravity of approximately 0,68.

NOTE In the case of colour coding, the test for indelibility need not be applied.

7 General notes on tests

7.1 Nature of tests

Tests according to this standard are type tests.

The test sequences and number of samples to test is stated in Annex B.

7.2 Standard atmospheric conditions for measurement and tests

Unless otherwise specified, all tests shall be carried out under the atmospheric conditions according to 7.1 of IEC 60127-1:2006.

7.3 Preconditioning of test samples

Unless otherwise specified, the test samples shall be maintained at standard atmospheric conditions for not less than 4 h before measurements are performed.

7.4 Nature of supply

For alternating current, the test voltage shall be of substantially sinusoidal form with a frequency between 45 Hz and 62 Hz.

7.5 Gauges for tests

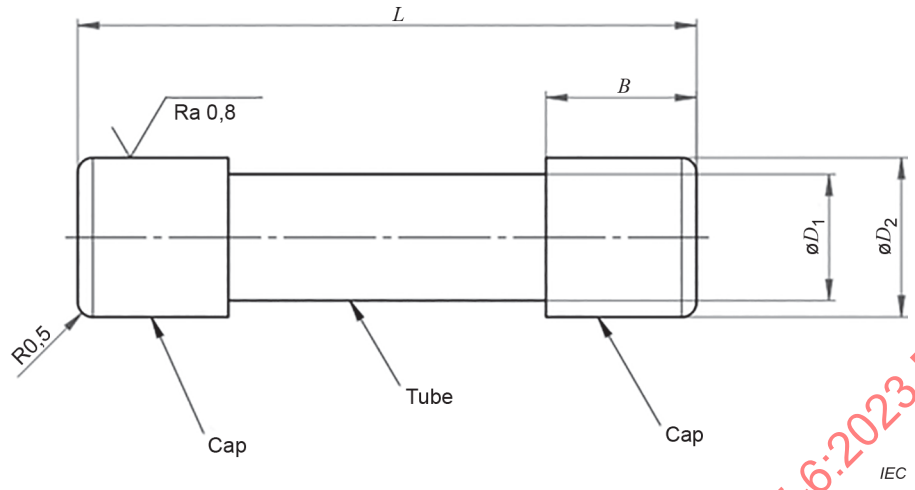
7.5.1 Gauges according to IEC 60127-2

For tests that require gauges (Figure 1), the appropriate gauges mentioned in Table 3 shall be used. The gauges or parts thereof made of brass shall be provided with 8 µm of nickel plating plus 4,5 µm of gold plating.

There shall be no holes in the ends of the gauges.

The gauges shall have a homogeneous composition, except for gauge numbers 3 and 6.

Dimensions in millimetres



NOTE The symbol for roughness, N6, is in accordance with ISO 1302[2].

Figure 1 – Outline of gauges and dummy fuse-links according to IEC 60127-2

Table 3 gives the dimensions and materials for gauges according to IEC 60127-2.

Table 3 – Dimensions and materials for gauges according to IEC 60127-2

Type of cartridge			*L*	*D1*	*D2*	*B*	Weight Approximately	Materials of part	
Fuse-link mm	Gauge No.	Size	mm	mm	mm	mm	g	Cap	Tube
5 × 20	1	max.	$20{,}54\ ^{0}_{-0{,}04}$	$5{,}3\ ^{+0{,}01}_{0}$	4,2 ± 0,1	$5\ ^{+0{,}1}_{0}$	–	Steel [a]	
	2	min.	$19{,}46\ ^{+0{,}04}_{0}$	$5{,}0\ ^{0}_{-0{,}01}$	4,2 ± 0,1	$5\ ^{+0{,}1}_{0}$	2,5	Brass[b]	
	3	–	$20{,}54\ ^{0}_{-0{,}04}$	$5{,}3\ ^{+0{,}01}_{0}$	4,2	$6{,}2\ ^{+0{,}1}_{0}$	–	Brass end caps [b]	Glass or ceramic tube
6,3 × 32	4	max.	$32{,}64\ ^{0}_{-0{,}04}$	$6{,}45\ ^{+0{,}01}_{0}$	5,5 ± 0,1	$6\ ^{+0{,}1}_{0}$	–	Steel [a]	
	5	min.	$30{,}96\ ^{+0{,}04}_{0}$	$6{,}25\ ^{0}_{-0{,}01}$	5,5 ± 0,1	$6\ ^{+0{,}1}_{0}$	6	Brass[b]	
	6	–	$32{,}64\ ^{0}_{-0{,}04}$	$6{,}45\ ^{+0{,}01}_{0}$	5,5	$8{,}3\ ^{+0{,}1}_{0}$	–	Brass end caps [b]	Glass or ceramic tube

[a] Hardened.

[b] Copper content from 58 % to 70 %.

2 This document has been revised by ISO 21920-1:2021.

7.5.2 Gauges according to IEC 60127-3

For tests that require gauges (Figure 2 and Figure 3), the appropriate gauges mentioned in Table 4 shall be used.

The gauges or parts thereof made of brass shall be provided with 8 µm of nickel plating plus 4,5 µm of gold plating.

The gauges shall have a homogeneous composition, except for gauge numbers 3 and 6.

Dimensions in millimetres

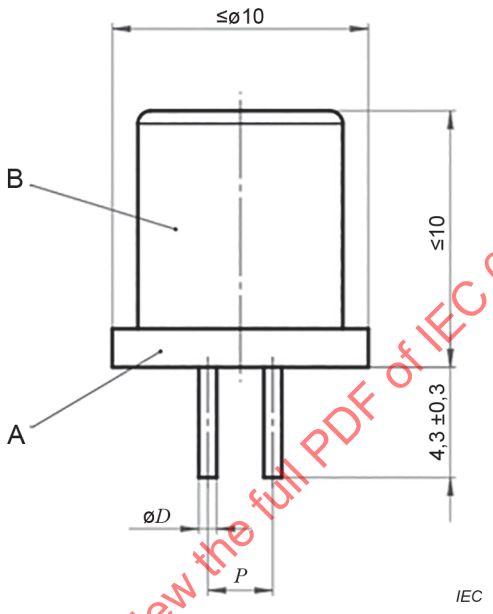


Figure 2 – Outline of gauges and dummy fuse-links according to IEC 60127-3:2015, standard sheet 1

Dimensions in millimetres

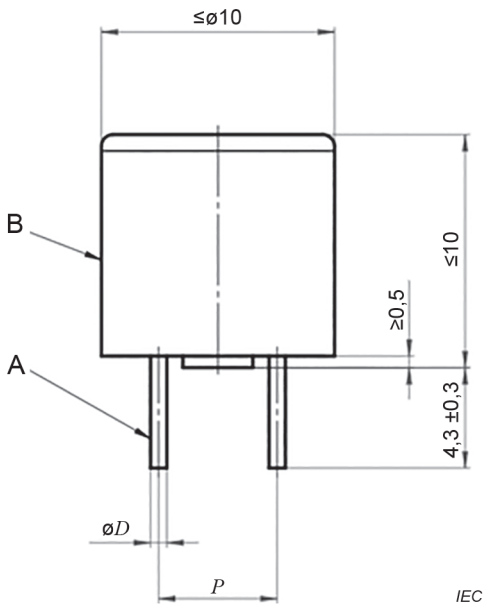


Figure 3 – Outline of gauges and dummy fuse-links according to IEC 60127-3:2015, standard sheets 3 and 4

Table 4 – Dimensions and materials for gauges according to IEC 60127-3

Type of			*D*	*P*	Materials of part	
Sub-miniature fuse-link	Gauge No.	Size	mm	mm	A	B
Standard sheet 1	1	max.	$0{,}70\ ^{0}_{-0{,}02}$	$2{,}54\ ^{+0{,}17}_{-0{,}09}$	Steel [a]	
	2	min.	$0{,}55\ ^{0}_{-0{,}02}$		Brass[b]	
	3	–	$0{,}70\ ^{0}_{-0{,}02}$		Brass [b]	Insulating material
Standard sheets 3 and 4	4	max.	$0{,}63\ ^{0}_{-0{,}02}$	5,08±0,1	Steel [a]	
	5	min.	$0{,}56\ ^{0}_{-0{,}02}$		Brass[b]	
	6	–	$0{,}60\ ^{0}_{-0{,}02}$		Brass	Insulating material

[a] Hardened.

[b] Copper content from 58 % to 70 %.

8 Protection against electric shock

8.1 Category PC1: Fuse-holders without integral protection against electric shock

Fuse-holders of category PC1 are only suitable for applications where corresponding additional means are provided to protect against electric shock.

8.2 Category PC2: Fuse-holders with integral protection against electric shock

8.2.1 The fuse-holder shall be so designed that:

– live parts are not accessible when the fuse-holder is properly assembled and correctly installed on the front panel of equipment with fuse-carrier and gauge numbers 3 or 6 according to Table 3 or Table 4 inserted into the fuse-base;

– live parts do not become accessible, either during insertion or removal of the fuse-carrier by hand or with the aid of a tool or after the fuse-carrier has been removed.

8.2.2 Compliance is checked by using the standard test finger specified in IEC 60529. This test finger is applied without appreciable force in every possible position. Where the fuse-holder has a fuse-carrier, gauge numbers 3 or 6 according to Table 3 or Table 4 shall be placed in the fuse-carrier during testing. It is recommended that an electrical indicator with a voltage of approximately 40 V is used for the indication of contact with the relevant part.

8.3 Category PC3: Fuse-holders with enhanced integral protection against electric shock

The requirements for this category are the same as those for 8.2 (Category PC2) with the exception that the testing is carried out with a rigid test wire of 1 mm diameter according to IEC 60529:1989, Table VI, instead of the standard test finger.

9 Clearances and creepage distances

9.1 General

Clearances and creepage distances shall be checked for a fuse-holder properly assembled and installed as in normal use, and fitted with gauge numbers 3 or 6 according to Table 3 or Table 4.

Compliance is checked by measurement.

9.2 Minimum requirements for fuse-holders in respect to the grade of insulation

9.2.1 Table 5 shows the types of insulation between different live parts and accessible parts.

Table 5 – Types of insulation between different live parts and accessible parts

Type of insulation Insulation between:	Functional	Basic	Supplementary	Reinforced	Double
a) Live parts of different potential	X				
b) Live parts and a metal mounting-plate or any other metal parts which may be in contact with the mounting-plate e.g. base-fixing devices.					
Thickness of the mounting-plate according to 10.1.1					
– fuse-holders according to 9.2.2		X	(X)[a]		
– fuse-holders according to 9.2.3				X	X
c) Live parts and all parts which may be touched with the test finger (accessible parts)					
– fuse-holders according to 9.2.2		X	(X)[a]		
– fuse-holders according to 9.2.3				X	X
[a] Supplementary insulation is only applied in addition to basic insulation, whereas basic insulation can be applied without supplementary insulation.					

9.2.2 Fuse-holders intended for class I equipment shall have at least basic insulation between live parts and accessible metal parts. These metal parts shall be provided with means enabling a reliable connection to the protective earthing circuit of the equipment in which it is intended to be used.

9.2.3 Fuse-holders intended for class II equipment shall have double or reinforced insulation between live parts and accessible parts.

9.3 Clearances

Clearances shall be dimensioned in such a way that the fuse-holder withstands the overvoltages expected to occur during normal use. The clearances shall be verified by measurement of dimensions and the impulse withstand voltage test according to 10.1.5, where this test is required.

Clearances equal to those specified in Table 7 or Table 8 shall be deemed to comply with this requirement. In this case the impulse withstand voltage test according to 10.1.5 is not required.

Clearances may be smaller than the values specified in Table 7 and Table 8 but not smaller than the values determined for the homogeneous field conditions according to Table F.2 of IEC 60664-1:2020. In this case, the clearances shall be deemed to comply with this requirement as long as no non-compliance occurs in the impulse withstand voltage test according to 10.1.5.

Clearances smaller than the values determined for the homogeneous field conditions according to Table F.2 of IEC 60664-1:2020 shall be deemed not to comply with this requirement.

Table 6 – Required impulse withstand voltage for clearances

Rated voltage V		Required impulse withstand voltage $\hat{U}$ 1,2/50 [1] kV	
Overvoltage category		Functional, basic or supplementary insulation	Reinforced or double insulation
II	III		
≤ 50	-	0,5	0,8
> 50 to ≤ 100	-	0,8	1,5
> 100 to ≤ 150	-	1,5	2,5
> 150 to ≤ 300	≤ 150	2,5	4,0
> 300 to ≤ 600	> 150 to ≤ 300	4,0	6,0
–	> 300 to ≤ 600	6,0	8,0
–	> 600 to ≤ 1 000	8,0	1,2

[1] According to IEC 60060-1. $\hat{U}$ 1,2/50 defines the impulse wave shape: 1,2 µs rise time and 50 µs half-value decay time.

There is increasing use of equipment operating at voltages below 125 V. In order to conform with IEC 60664-1, fuse holders specifically designed for these lower voltages shall meet the prescriptions in this table.

Attention is drawn to the fact that appliance specifications might contain requirements additional to or deviating from those specified in Table 5, Table 6, Table 7 and Table 8.

Table 7 and Table 8 show minimum clearances in air with regard to the rated voltage, the overvoltage category and the specified degree of pollution.

NOTE Minimum clearances in air in millimetres up to 2 000 m above sea-level for inhomogeneous field conditions corresponding to IEC 60664-1:2020, Table F.2.

Table 7 – Minimum clearances in air under overvoltage category II II

Rated voltage V		Clearances in air mm	
Functional, basic or supplementary insulation	Reinforced or double insulation	Pollution degree	
		2	3
≤ 50	–	0,2	0,8
> 50 to ≤ 100	≤ 50	0,2	0,8
> 100 to ≤ 150	> 50 to ≤ 100	0,5	0,8
> 150 to ≤ 300	> 100 to ≤ 150	1,5	1,5
> 300 to ≤ 600	> 150 to ≤ 300	3,0	3,0
–	> 300 to ≤ 600	5,5	5,5
–	> 600 to ≤ 1 000	8,0	8,0

Table 8 – Minimum clearances in air under overvoltage category II

Rated voltage V		Clearances in air mm	
Functional, basic or supplementary insulation	Reinforced or double insulation	Pollution degree	
		2	3
≤ 150	–	1,5	1,5
> 150 to ≤ 300	≤ 150	3,0	3,0
> 300 to ≤ 600	> 150 to ≤ 300	5,5	5,5
–	> 300 to ≤ 600	8,0	8,0
–	> 600 to ≤ 1 000	11	11

9.4 Creepage distances

9.4.1 Creepage distances for basic or supplementary insulation, based on the rated voltage shall be selected from Table 9. The following influencing factors shall be taken into account:

– rated voltage;
– pollution degree;
– shape of insulating surface;
– comparative tracking index (CTI).

9.4.2 Measurement of creepage distances and clearances, shape of insulating surface: requirements according to 6.2 of IEC 60664-1:2020.

9.4.3 Creepage distances for reinforced or double insulation: shall be twice the value as specified in Table 9.

9.4.4 A creepage distance cannot be less than the associated clearance so that the shortest creepage distance possible is equal to the required clearance.

Table 9 – Minimum creepage distances in millimetres for a microenvironment-dependent on rated voltage, pollution degree, insulating material, corresponding to IEC 60664-1:2020, Table F.5

Rated voltage V	Creepage distances mm							
	Pollution degree 2				Pollution degree 3			
	Material group[1)]				Material group[1)]			
	I	II	IIIa	IIIb	I	II	IIIa	IIIb
≤ 32	0,53	0,53	0,53		1,30	1,30	1,30	
> 32 to ≤ 63	0,63	0,90	1,25		1,60	1,80	2,00	
> 63 to ≤ 125	0,75	1,05	1,50		1,90	2,10	2,40	
>125 to ≤ 250	1,25	1,80	2,50		3,20	3,60	4,00	
> 250 to ≤ 320	1,60	2,20	3,20		4,00	4,50	5,00	
> 320 to ≤ 400	2,0	2,8	4,0		5,0	5,6	6,3	
> 400 to ≤ 500	2,5	3,6	5,0		6,3	7,1	8,0	
Up to 1 000	5,0	7,1	10,0		12,5	14,0	16,0	

[1)] See Annex C.

There is increasing use of equipment operating at voltages below 125 V. In order to conform with IEC 60664-1, fuse holders specifically designed for these lower voltages shall meet the prescriptions in this table.

10 Electrical requirements

10.1 Insulation resistance, dielectric strength and impulse withstand voltage

10.1.1 Mounting

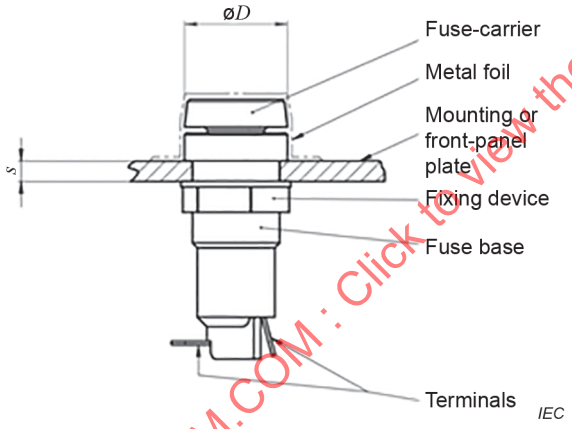
Fuse-holders shall be mounted as follows:

a) Fuse-holders designed for panel or base mounting, shall be mounted on a metal plate, with a thickness s, see Figure 4, as specified by the manufacturer. A test gauge according to Table 10 and with or without the fuse-carrier shall be inserted into the fuse-base.

   For fuse-holders having screw-in fuse-carriers, these carriers shall be fitted in the normal way for each operation with a torque equal to two-thirds of the value specified in Table 11.

b) Fuse-holders designed for PC board mounting shall be mounted on a test PC board according to Annex A and, if adapted to such use, with a front-panel metal plate of a thickness s, see Figure 5. A test gauge according to Table 10 and with or without the fuse-carrier shall be inserted into the fuse-base.

Fuse-holders for PC board mounting by soldering (through-hole types) should have a pin-spacing of $n \times e$ where n is an integer from 1 to 6 and e = 2,54 mm.



NOTE Thickness s to be specified by the manufacturer.

Figure 4 – Panel mounting

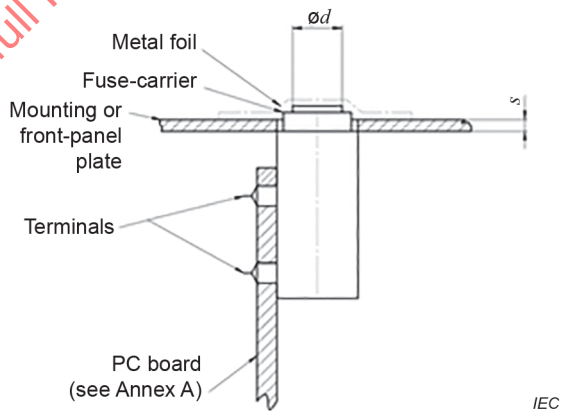


Figure 5 – PC board mounting

10.1.2 Humidity preconditioning

In accordance with 10.1.1, the separated mounted fuse-bases and fuse-carriers are submitted to the humidity preconditioning.

The humidity preconditioning is carried out in a humidity chamber containing air with a relative humidity maintained between 91 % and 95 %.

The air in the chamber where test samples are located shall be maintained at a temperature t = (40 ± 2) °C, uniformly distributed throughout the chamber.

The air in the chamber shall be stirred and the chamber shall be designed so that mist of condensed water will not precipitate on the test samples. Temperature variations shall not allow

any part of the test samples to reach a dew-point condition. Some methods of achieving the specified relative humidity are described in IEC TR 60260[3].

The test samples are kept in the chamber for 48 h.

Immediately after the humidity preconditioning, with the samples still in the humidity chamber or in the room in which the samples were brought to the prescribed temperature, the measurement of the insulation resistance and dielectric strength are made, after reassembly of those parts which were separated before the humidity preconditioning. Parts of insulating material shall be wrapped in metal foil as shown in Figure 4 and Figure 5.

10.1.3 Measurement of insulation resistance

The insulation resistance shall be measured between the points as specified in Table 10.

DC voltage according to Table 10 shall be applied. The measurement is made 1 min after application of the test-voltage.

The insulation resistance shall be not less than the values shown in Table 10.

10.1.4 Dielectric strength test

Immediately after the measurement of the insulation resistance, with the samples still in the humidity chamber or in the room in which the samples were brought to the prescribed temperature, an AC voltage according to Table 10 is applied for 1 min between the points specified in Table 10.

Initially, not more than half the prescribed voltage is applied, then it is raised rapidly to the full value.

No flashover or breakdown shall occur during the test.

10.1.5 Impulse withstand voltage test

After the test in 10.1.4 the impulse withstand voltage shall be tested between the points as specified in Table 10.

The required impulse withstand voltage according to Table 6 shall be applied.

Form and numbers of impulses:

The 1,2/50 µs impulse voltage shall be applied three times for each polarity at intervals of 1 s minimum.

Unless otherwise specified, the output impedance of the impulse generator should not be higher than 500 Ω.

NOTE A description of the test equipment can be found in IEC 60060-1 and IEC 60060-3.

During this voltage test, no breakdown or flashover shall occur.

Corona effects and similar phenomena are disregarded.

[3] This document has been withdrawn in 2000.

10.2 Contact resistance

10.2.1 General measuring requirements

Measurements may be carried out with direct current or alternating current. For AC measurements the frequency shall not exceed 1 kHz. In the case of dispute, the DC measurements shall govern.

The accuracy of the measuring apparatus shall be within ±3 %.

For fuse-holders having screw-in fuse-carriers these carriers shall be fitted in the normal way for each operation with a torque equal to two-thirds of the value specified in Table 11.

The contact resistance shall be measured between the terminals after the fuse-holder has been equipped with a gauge No. 2 or No. 5 according to Table 3 or Table 4.

Contact resistance of fuse-holders intended for PC board mounting shall be measured on a fuse-holder mounted (soldered) on a test PC board according to Annex A. The voltage drop shall be measured between points P and O of Figure A.1.

The contact resistance shall normally be calculated from the voltage drop measured between the terminals.

The measurement is carried out under the following conditions:

a) test voltage: the electromotive force of the source shall not exceed 60 V d.c. or a.c. (peak), but shall be at least 10 V;
b) test current: 0,1 A;
c) measurement shall be made within 1 min after the application of the test current;
d) care shall be taken during the measurement to avoid exerting abnormal pressure on the contacts under test and to avoid movement of the test cable.

10.2.2 Measuring cycle

10.2.2.1 Measuring cycle with direct current

One measuring cycle consists of:

a) insertion of the gauge in the fuse-holder;
b) measurement with current flowing in one direction;
c) measurement with current flowing in opposite direction;
d) removal of the gauge from the fuse-holder.

10.2.2.2 Measuring cycle with alternating current

One measuring cycle consists of:

a) insertion of the gauge in the fuse-holder;
b) measurement;
c) removal of the gauge from the fuse-holder.

10.2.2.3 Measurement and requirements

The complete measurement shall consist of five measuring cycles, which shall be carried out in immediate succession.

For fuse-holders for fuse-links in accordance with IEC 60127-2 the average values shall not exceed 5 mΩ. The value of any individual measurement shall not exceed 10 mΩ.

For fuse-holders for fuse-links in accordance with IEC 60127-3 the average values shall not exceed 10 mΩ. The value of any individual measurement shall not exceed 15 mΩ.

Table 10 – Values for insulation resistance, dielectric strength and impulse withstand voltage

Insulation resistance, dielectric strength and impulse withstand voltage	Number of test gauges according	Rated voltage	Insulation resistance			Dielectric strength		Impulse withstand voltage	
			DC test voltage		Insulation resistance	AC test voltage		Impulse test voltage	
		V	V		MΩ	V		V	
measured between:	to table 3 or 4		functional, basic or supplementary insulation	Reinforced or double insulation		functional, basic or supplementary insulation	Reinforced or double insulation	functional, basic or supplementary insulation	Reinforced or double insulation
1 Unexposed fuse-holder 1.1 The terminals	3 / 6	32 63 125 250 300 350 500 1 000	Twice rated voltage but at least 100 V		≥10 for functional, basic or supplementary insulation ≥20 for reinforced or double insulation	500	1 000	Required impulse withstand voltage values according to Table 6	
1.2 The terminals and the metal mounting or front-panel plate 1.3 The terminals and any other metal parts which may be in contact with the mounting plate, e. g. base fixing devices 1.4 The terminals and a metal foil covering the whole of the accessible surface (see figures 4 and 5)	1 / 4					Twice rated voltage +1 000 V	Twice the value for functional, basic or supplementary insulation		
2 Exposed fuse-holders 2.1 The terminals	3 / 6					500	1 000		
2.2 The terminals and the mounting plate	1 / 4					Twice rated voltage +1 000 V	Twice the value for functional, basic or supplementary insulation		

There is increasing use of equipment operating at voltages below 125 V. In order to conform with IEC 60664-1, fuse-holders specifically designed for these lower voltages shall meet the prescriptions in Table 9.

11 Mechanical requirements

11.1 General

Fuse-holders shall have adequate mechanical strength to withstand the stresses imposed during installation and use.

Compliance is checked by the appropriate tests of 11.2 to 11.8.

11.2 Mounting

For the tests of 11.3 to 11.5 the fuse-holders are mounted as follows.

a) Fuse-holders designed for front-panel mounting shall be mounted with their fixing elements, if any, in the centre of a metal plate 130 mm × 130 mm having a maximum thickness s as specified by the manufacturer.

The specimen as a whole is then fixed to a rigid plane support having a free space with a diameter of 100 mm for the base of a panel-mounted fuse-holder. To ensure that the specimen is rigidly supported, a block of metal or concrete having a mass of 15 kg shall be used (Figure 6).

Any fixing nut or fixing screw is screwed on with two-thirds of the torque specified in Table 12 or Table 13 as applicable.

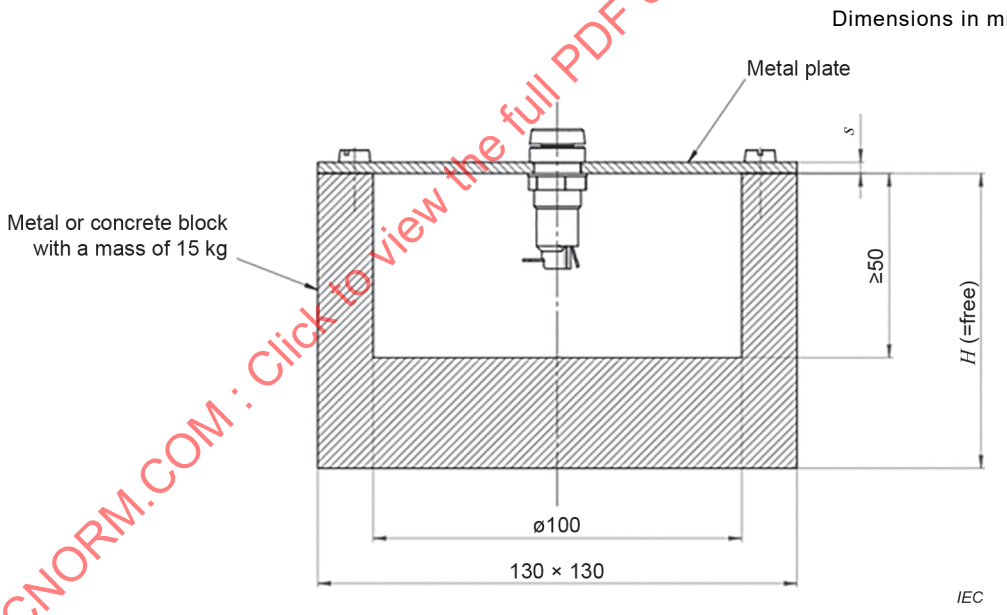


Figure 6 – Test device for mechanical test

b) Fuse-holders for PC board mounting shall be soldered to the test PC board according to Annex A and, by means of screws, this test PC board shall be fixed to the metal or concrete block of Figure 6 using a suitably adapted metal plate.

11.3 Compatibility between fuse-holder and fuse-link

The maximum gauge No. 1 or No. 4 according to Table 3 or Table 4 shall be inserted in and withdrawn from the fuse-holder and fuse-carrier, if any, 10 times for cartridge fuse-holder and 5 times for sub-miniature fuseholder.

For fuse-holders having screw-in fuse-carriers, these carriers shall be fitted in the normal way for each operation with a torque equal to two-thirds of the value specified in Table 11.

For fuse-holders having bayonet fuse-carriers there are no special torque requirements.

There shall be no visible damage or loosening of parts. In the most unfavourable position, the minimum gauge No. 2 or No. 5 according to Table 3 or Table 4 shall not fall from the fuse-carrier.

The minimum gauge No. 2 or No. 5 according to Table 3 or Table 4 shall then be inserted in the holder and the contact resistance shall be measured according to 10.2 with the same requirements.

11.4 Mechanical strength of the connection between fuse-base and fuse-carrier

11.4.1 Screw and bayonet connections

For the following tests, the fuse-carrier is fitted with the maximum gauge No. 1 or No. 4 according to Table 3 and inserted in the fuse-base mounted according to 11.2.

a) Torque test on fuse-carriers

   The fuse-carrier shall be subjected five times to the appropriate torque specified in Table 11.

b) Tensile test on fuse-carriers

   The screw-in fuse-carrier is screwed in with a torque of two-thirds of the value as specified in Table 11.

The screw-in or bayonet fuse-carrier shall then be subjected for 1 min to an axial pull as specified in Table 11.

Table 11 – Values for torque and axial pull

Diameter of fuse-carrier (*Φ d* in Figure 4 and Figure 5)	Torque Nm	Axial pull N
Up to and including 16 mm	0,4	25
Over 16 mm, up to and including 25 mm	0,6	50
Over 25 mm, up to and including 35 mm	0.8	75

During and after the tests, the fuse-carrier shall be securely held in the fuse-base and shall not show any change impairing its further use.

For fuse-holders where fuse-carriers are flush with the fuse-base, the axial pull test is not required.

11.4.2 Plug-in connection

Insertion and withdrawal forces:

The fuse-carrier together with the maximum gauge No. 1 or No. 4 according to Table 3 shall be inserted in and withdrawn from the fuse-base. The forces have to be measured with suitable measuring devices. This test has to be repeated 10 times. The value of any individual measurement, insertion and withdrawal forces, shall be within limits assigned by the manufacturer.

After the test the contact resistance shall be measured according to 10.2 with the same requirements.

11.5 Impact test

This test shall only be applied to panel-mounted fuse-holders. The fuse-carrier with the maximum gauge No. 1 or No. 4 according to Table 3 shall be inserted in the fuse-holder.

The front of the fuse-holder is then subjected to three blows with a spring-operated impact-hammer according to IEC 60068-2-75, applied to points equally distributed over the front of the fuse-holder.

The adjusted value of the kinetic energy just before impact shall be (0,35 ± 0,03) J.

After the test, the sample shall show no serious damage. In particular, live parts shall not have become exposed so as to impair compliance with Clause 9 and there shall not have been such distortion as to impair compliance with Clause 10.

Compliance is checked by visual inspection and measurement of dimensions. If there is any doubt, compliance is additionally checked by the impulse withstand voltage test according to 10.1.5.

11.6 Mechanical strength of the fuse-holder fastening on panels

11.6.1 Fixing nut fastening

The fuse-base shall be mounted with supplied fixing elements, including gasket, on a steel plate according to the manufacturer's instructions.

The fixing nut of a one-hole mounted fuse-base shall be screwed on and off five times with a torque as specified in Table 12.

Table 12 – Torque values

Thread diameter mm	Torque Nm
Up to and including 12	0,6
Greater than 12, up to and including 18	1,2
Greater than 18, up to and including 30	2,4
Greater than 30, up to and including 40	3,6
Greater than 40, up to and including 50	4,8

After the test the fuse-base shall not show any change impairing its further use.

11.6.2 Fixing screw fastening

Fixing screws, bolts or nuts of a multi-hole mounted fuse-base shall be screwed on and off five times with a torque as specified in Table 13.

Table 13 – Torque values

Thread diameter mm	Torque Nm
2	0,25
2,5	0,4
3	0,5
3,5	0,8
4	1,2
5	2,0
6	2,5
≥8	3,5

After the test the fuse-base shall not show any change impairing its further use.

11.6.3 Snap-in fastening

11.6.3.1 General

The following types belong to this group of fuse-holders:

– fuse-base with integral spring-system;

– fuse-base with a separate spring-nut (a nut fabricated e.g. from thin spring steel having an impression designed to accommodate the mating part).

11.6.3.2 Tests and requirements

11.6.3.2.1 Test procedures

The mechanical strength of the fuse-holder fastening on panels (see Figure 7) shall be verified by the following tests.

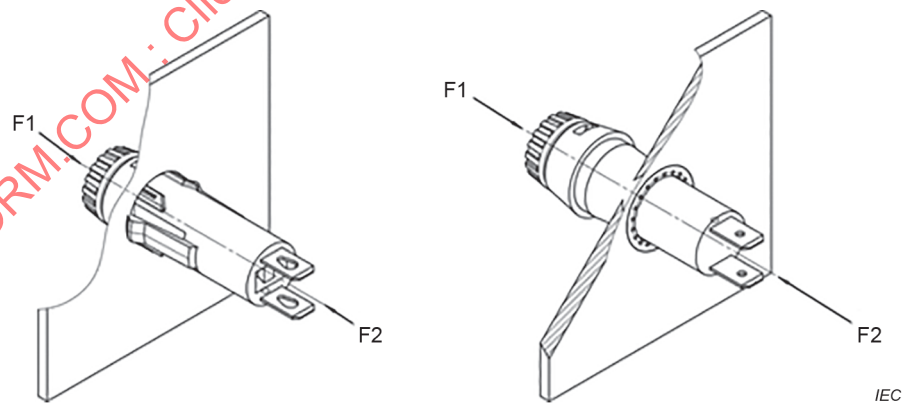


Figure 7 – Examples of snap-in fastening Fuse-holder on panels

The tests shall be performed with an engaged snap-in fastening and the fuse-holder shall lie flat on the surface of the mounting plate.

The specimens shall be divided into two mounting groups according to Table 14.

Table 14 – Mounting groups

	Group 1	Group 2
Mounting plate	Maximum panel thickness and mounting hole with smallest dimension	Minimum panel thickness and mounting hole with largest dimension
Testing force	Insertion force F1	Withdrawal force F2

Preparation of the specimen:

The thickness of the mounting plate and the diameter of the mounting hole shall be according to the specifications of the manufacturer.

The mounting plate may be positioned in any convenient orientation during the test procedures.

11.6.3.2.2 Insertion force F1

The insertion force F1 shall be ≤ 120 N or as specified by the manufacturer, and centered in the middle of the socket base of the fuse-holder (see Figure 7).

The insertion force F1 shall be so applied that the force on the whole surface is continuously increased in a monotonous manner without jogging.

The pressure device shall cover the flange completely.

11.6.3.2.3 Withdrawal force F2

The withdrawal force F2 (see Figure 7) shall be applied axially to the rear of the fuse-holder. The force shall be increased monotonously from 0 N to 50 N.

The snap-in fastening of the fuse-holder shall not be permanently distorted and the fuse-holder shall not be ejected by the maximum force.

11.6.3.2.4 Acceptance criteria in the above tests

– Cracks, chipping and breakage of the fuse-holder base due to the mechanical stress of F1 and F2 are not acceptable.
– Ridges and wear of the insulating body are acceptable.

11.7 Terminals of fuse-bases

11.7.1 Terminals with screw-type clamping or screwless-type clamping

Tests and requirements for terminals with screw-type and screwless-type clamping units for electrical copper conductors shall comply with IEC 60999-1.

11.7.2 Terminals for soldering

11.7.2.1 Tag terminals

11.7.2.1.1 General

Designed for being soldered with a soldering iron.

11.7.2.1.2 Size

Terminals of fuse-bases shall allow the connection of rigid conductors, solid or stranded and flexible conductors of the size shown in Table 15.

Table 15 – Cross-sections of conductors

Fuse-holder with a maximum rated current of:	Minimum hole diameter mm	Maximum cross-section of the conductor mm^2
Up to and including 6,3 A	1,2	1
More than 6,3 A, and up to and including 10 A	1,4	1,5
More than 10 A, and up to and including 16 A	1,8	2,5
More than 16 A, and up to and including 25 A	2,3	4,0

For soldering terminals there shall be a means such as a hole through which the conductor, or all strands of a multi-strand conductor, will pass so that the conductor may be held independently of the solder.

11.7.2.1.3 Tests

a) Robustness of termination

The terminals shall be subjected to the following tensile and bending tests.

– Tensile test according to Test Ua_1 of IEC 60068-2-21.

An axial force of 20 N shall be applied.

Requirements: there shall be no damage which would impair normal operation.

– Bending test according to Test Ub of IEC 60068-2-21.

Where applicable, method 1 shall be used, otherwise method 2.

Requirements: there shall be no damage which would impair normal operation.

b) Solderability, wetting, soldering iron method

The test shall be performed in accordance with Test Ta of IEC 60068-2-20:2021 after the accelerated ageing 4.1.4.3 detailed in 4.1.4 of IEC 60068-2-20:2021

– Method 2.

– “B” size soldering iron.

Requirements: The solder shall have wetted the test area and there shall be no droplets.

c) Resistance to soldering heat, soldering iron method

The test shall be performed in accordance with Test Tb of IEC 60068-2-20:2021.

– Method 2.

– “B” size soldering iron.

Requirements: there shall be no damage that would impair normal operation.

11.7.2.2 Wire and pin terminals

11.7.2.2.1 General

Designed for use with printed boards or other applications using similar soldering techniques.

11.7.2.2.2 Size

Dimensions: no special requirements

11.7.2.2.3 Tests

a) Robustness of termination: see 11.7.2.1.3 a).

b) Solderability, wetting, solder bath method.

The test shall be performed in accordance with Test Ta of IEC 60068-2-20 after the accelerated ageing 4.1.4.3 detailed in 4.1.4 of IEC 60068-2-20:2021

– Method 1.

– A thermal screen shall be used: e.g. a PC board.

Requirements: the dipped surface shall be covered with a solder coating with no more than small amounts of scattered imperfections such as pin-holes or unwetted areas. These imperfections shall not be concentrated in one area.

c) Resistance to soldering heat, solder bath method.

The test shall be performed in accordance with Test Tb of IEC 60068-2-20:2021.

– Method 1.

– A thermal screen shall be used: e.g. a PC board.

– Immersion temperature: 260 °C ± 3 °C

– Immersion time: (5 ± 1) s.

Requirements: there shall be no damage that would impair normal operation.

11.7.2.3 Quick-connect male tab terminals

11.7.2.3.1 General

A quick-connect termination consists of a male tab with hole or dimple detent and the mating female connectors. The fuse-base is provided with the male tab.

11.7.2.3.2 Size

Dimensions, classified types of male tabs: according to IEC 61210.

11.7.2.3.3 Tests

Robustness of terminations

The terminals shall be subjected to the following tensile and compressive strength tests:

– tensile test according to test Ua_1 of IEC 60068-2-21. A tensile force F1 according to Table 16 shall be applied to the fixed male tab as shown in Figure 8;

– compressive test analogous to the tensile test. A compressive force F2 according to Table 16 shall be applied to the fixed male tab as shown in Figure 9.

Separate specimens shall be used for tensile and compressive testing. Care shall be taken to ensure correct alignment and direction of forces.

Requirements: there shall be no damage which would impair normal operation.

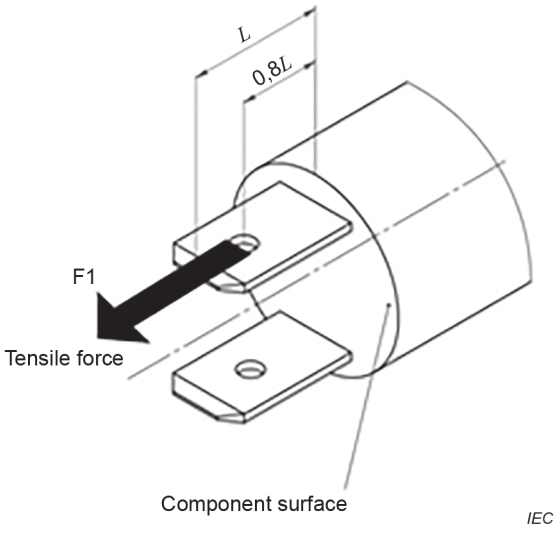


Figure 8 – Tensile force test

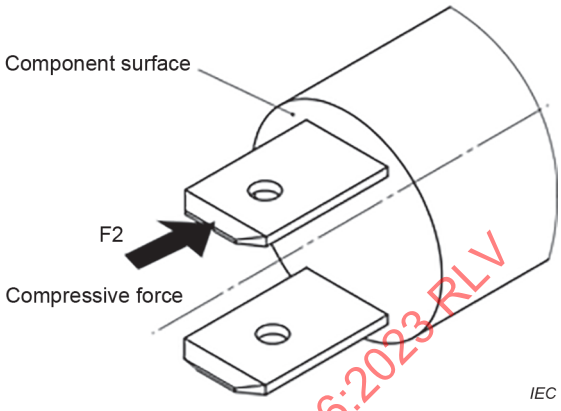


Figure 9 – Compressive force test

Table 16 – Tensile and compressive forces

Tab size mm	Tensile force F1 and compressive force F2 N
2,8	53
4,8	67
5,2	67
6,3	80
9,5	100

11.7.2.4 Quick-connect male tab terminals combined with solder tag terminals

Combined versions are tested according to 11.7.2.1 and 11.7.2.3 as applicable.

11.8 Resistance to vibration

11.8.1 General

The resistance to vibration of fuse-holders shall be adequate.

Compliance is checked by submitting the fuse-holder to the test in accordance with IEC 60068-2-6:2007, Test Fc, with the following general measuring requirements.

11.8.2 Mounting

The fuse-holder shall be mechanically connected to the test apparatus according to IEC 60068-2-47 by its normal mounting method.

The fixing nut of one-hole mounted fuse-bases shall be screwed on with a torque as specified in 11.6.1.

The fixing screws, bolts or nuts of multi-hole mounted fuse-bases shall be screwed on with a torque as specified in 11.6.2.

The snap-in fastening fuse-bases shall be mounted as specified in 11.6.3.

The minimum gauge No. 2 or No. 5 according to Table 3 or Table 4 shall be inserted in the fuse-holder.

For fuse-holders having screw-in fuse-carriers, these carriers shall be fitted in the normal way with a torque equal to two-thirds of the maximum allowable value specified in Table 11.

11.8.3 Measurement and requirements

11.8.3.1 Severity

– Frequency range: 10 Hz to 55 Hz.
– Displacement amplitude 0,35 mm (Figure 1 and Figure 2 of IEC 60068 2 6:2007, 5.2 apply).
– Number of sweep cycles: five in each axis.

11.8.3.2 Axis of vibration

The fuse-holder shall be vibrated in three mutually perpendicular axes in turn which should be chosen in such a way that one axis is the main fuse-link axis.

11.8.3.3 Functional checks

During vibration, it shall be checked whether or not the electrical continuity between the contacts is interrupted. Interruption of 1 ms or less shall be ignored.

11.8.3.4 Final measurements

After the test, the contact resistance shall be in accordance with 10.2, and the fuse-holder shall show no serious damage in the sense of this standard.

12 Thermal requirements

12.1 Rated power acceptance test

12.1.1 General

A fuse-holder shall be so designed to carry continuously the rated current at the rated power acceptance and at an ambient air temperature T_{A1} of 23 °C without exceeding the allowable temperatures on the fuse-holder specified in 12.1.4.

Compliance is checked by the tests of 12.1.2 to 12.1.7.

12.1.2 Mounting

Fuse-holders designed for panel or base mounting shall be mounted in the centre of an insulating plate, e.g. laminated phenolic cellulose paper with the dimensions (100 × 100 × 3) mm.

Fuse-holders designed for PC board mounting shall be mounted on a test PC board according to Annex A.

For fuse-holders having screw-in fuse-carriers, these carriers shall be fitted in the normal way with a torque equal to two-thirds of the maximum allowable value specified in Table 11.

The temperature measurements shall be carried out in air as undisturbed as possible. Therefore the fuse-holder, mounted on the corresponding plate, shall be placed in an enclosure which protects the immediate environment from external movements of air. The enclosure should be made of negligible reflective materials.

The enclosure sides shall not be closer than 200 mm from the edges of the fuse-holder. The enclosure shall not have a cover. For an example see Figure 10.

The fuse-holder samples shall be arranged in three different positions, one in the horizontal plane (Figure 10) and two in the vertical plane (upright and downwards).

The arrangement in the other planes has to be made in a similar way.

Dimensions in millimetres

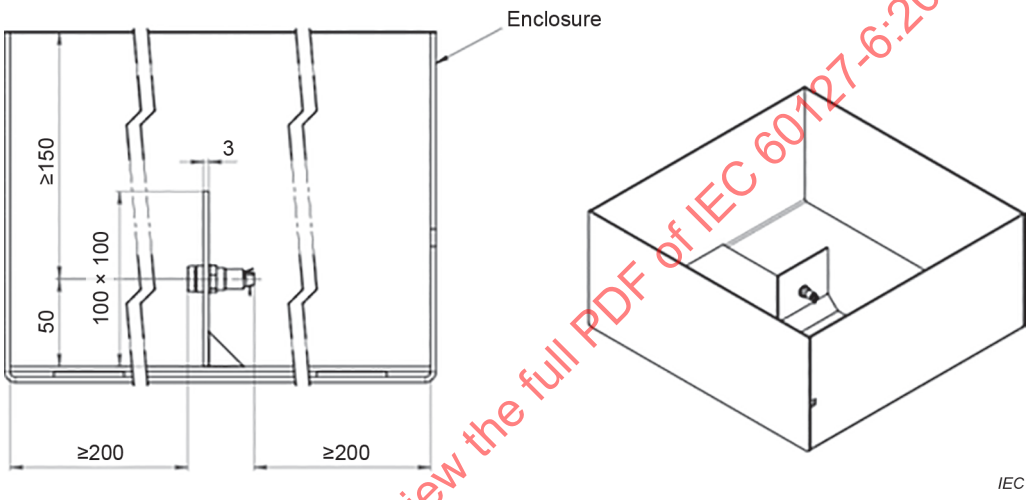


Figure 10 – Example of test device

The insulated conductors fitted to the fuse-holder or test PC board terminals shall have the following dimensions:

a) Length: 1 m.

b) Cross-sectional area of a single-core copper conductor:

- 0,5 mm^2 for fuse-holders rated up to and including 1 A;
- 1 mm^2 for fuse-holders rated more than 1 A but less than or equal to 6,3 A;
- 1,5 mm^2 for fuse-holders rated more than 6,3 A but less than or equal to 10 A;
- 2,5 mm^2 for fuse-holders rated more than 10 A but less than or equal to 16 A.
- 4 mm^2 for fuse-holders rated more than 16 A but less than or equal to 25 A.

12.1.3 Dummy fuse-links

12.1.3.1 Dummy fuse-links for cartridge fuse-links

A dummy fuse-link is a test fuse-link with defined resistance according to Table 18.

The material of the resistance wire used in the dummy fuse-link shall be of CuNi44 or any similar material having a temperature coefficient of resistance of less than ±10,0 × 10^{-5} K^{-1} within the temperature range of 20 °C to 200 °C.

The dimensions of the dummy fuse-links are specified in Table 17.

Table 17 – Dimensions and materials for dummy fuse-link according to IEC 60127-2

Type of cartridge		*L*	*D*1	*D*2	*B*	Materials of part	
Fuse-link	Size					Cap	Tube
mm		mm	mm	mm	mm		
5 × 20	min.	$19{,}46\ ^{+0,5}_{0}$	$5{,}0\ ^{+0,2}_{0}$	4,2 ± 0,1	$5\ ^{+0,2}_{0}$	Brass[a]	Ceramic
6,3 × 32	min.	$30{,}96\ ^{+0,8}_{0}$	$6{,}25\ ^{+0,2}_{0}$	5,5 ± 0,1	$6\ ^{+0,2}_{0}$	Brass[a]	Ceramic
[a] Brass with copper content from 58 % to 70 %, surface with 2 µm (minimum) nickel plating (galvanic).							

In case of doubt concerning the behaviour of the used dummy fuse-links, these should be tested at rated current in the fuse-base shown in Figure 1 of IEC 60127-2:2014, and they should show no special effects such as thermoelectrical voltage.

There shall be no holes in the ends of the dummy fuse-links.

Table 18 – Dummy fuse-links according to IEC 60127-2

Dummy No.		Nominal power dissipation of the dummy fuse-link [a]	Current [a]	Resistance [b] ± 10 %
Dummy fuse-link for fuse-links				
5 mm × 20 mm	6,3 mm × 32 mm	*P* W	*I* A	*R* mΩ
A1/1625	A2/1625	1,6	2,5	256
A1/1663	A2/1663		6,3	40
A1/2525	A2/2525	2,5	2,5	400
A1/2563	A2/2563		6,3	63
A1/2510	A2/2510		10	25
A1/3263	A2/3263	3,2	6,3	81
A1/3210	A2/3210		10	32
A1/4063	A2/4063	4,0	6,3	101
A1/4010	A2/4010		10	40
A1/4012	A2/4012		12,5	25,6
A1/4016	A2/4016		16	15,6
A1/4020	A2/4020		20	10
A1/5012	A2/5012	5,0	12,5	32
A1/5016	A2/5016		16	19,5
A1/5020	A2/5020		20	12,5
A1/6012	A2/6012	6,0	12,5	38,4
A1/6016	A2/6016		16	23,4
A1/6020	A2/6020		20	15
A1/8020	A2/8020	8,0	20	20
A1/8025	A2/8025		25	12,8
[a] If other values are required, these values should be selected from the series R10 of ISO 3.				
[b] The resistance of the dummy fuse-link is calculated as follows: $R = P/I^2$.				

12.1.3.2 Dummy fuse-links for sub-miniature fuse-links

Requirements:

a) Defined resistance according to Table 20. The material should be of low temperature coefficient of resistance.

b) Dimensions of the dummy fuse-links according Table 19.

c) Materials of parts A and B according to Table 19:
   - part A: brass or copper, nickel- or tin-plated;
   - part B: insulating material.

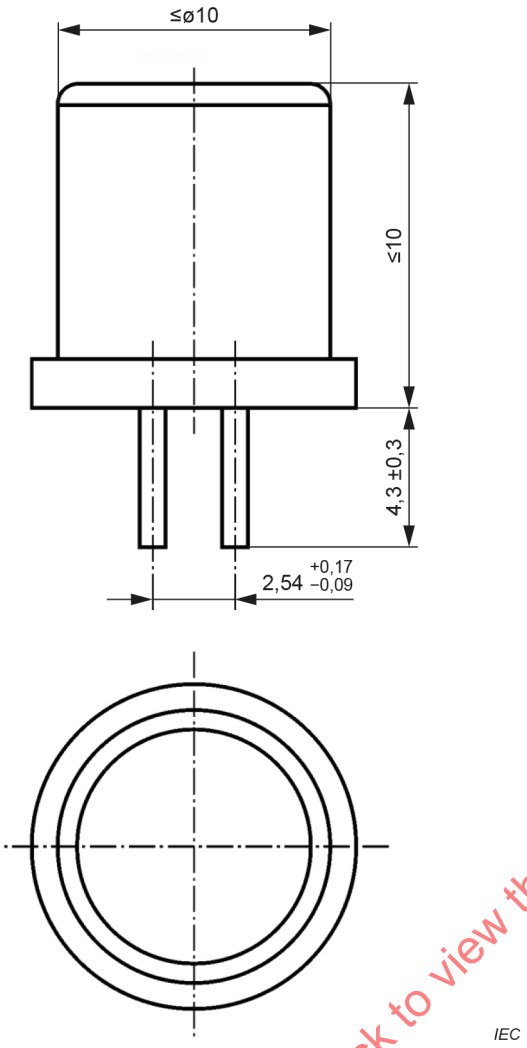
The type of material shall be assigned by the manufacturer.

Table 19 – Dimensions and materials for dummy fuse-links according to IEC 60127-3

Dummy fuse-link for sub-miniature fuse-links	*D* mm	*P* mm	Materials of part A	Materials of part B
Standard sheet 1	$0{,}55\ ^{0}_{-0{,}02}$	$2{,}54\ ^{+0{,}17}_{-0{,}09}$	Brass [a]	Insulating Material
Standard sheets 3 and 4	$0{,}56\ ^{0}_{-0{,}02}$	5,08 ± 0,1	Brass [a]	Insulating Material

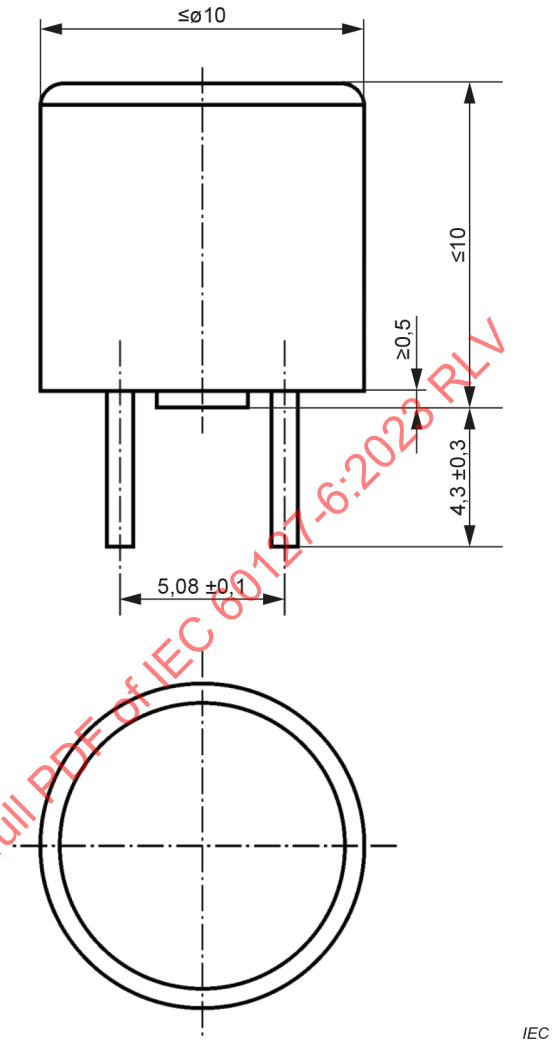
[a] Brass with copper content from 58 % to 70 %, surface with 2 µm (minimum) nickel plating (galvanic).

Dimensions in millimetres



Source: Standard sheet 1
of IEC 60127-3:2015

Figure 11 – IEC 60127-3:2015, Standard sheet 1



Source: Standard sheets 3 and 4
of IEC 60127-3:2015

Figure 12 – IEC 60127-3:2015, Standard sheets 3 and 4

Table 20 – Dummy fuse-links according to IEC 60127-3

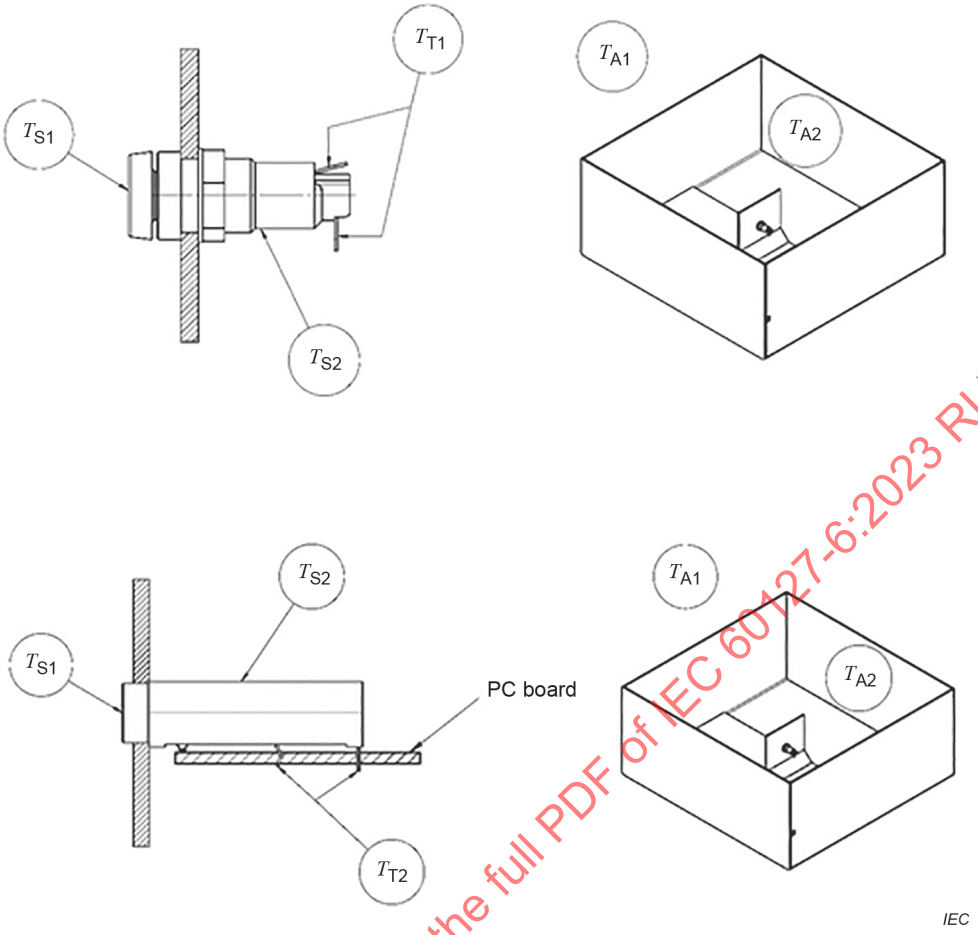
Dummy No.		Nominal power dissipation of the dummy fuse-link [a]	Current [a]	Resistance [b] ± 10 %
Dummy fuse-link for sub-miniature fuse-links according to				
Standard sheet 1	Standard sheets 3 and 4	P W	I A	R mΩ
B1/1650		1,6	5,0	64
	B2/1620	1,6	2,0	400
	B2/1650		5,0	64
	B2/2050	2,0	5,0	80
	B2/2010	2,0	10,0	20

[a] If other values are required, these values should be selected from the series R10 of ISO 3.

[b] The resistance of the dummy fuse-link is calculated as follows: $R = P/I^2$.

12.1.4 Measurement of maximum allowable temperatures on fuse-holders

The locations where the relevant temperatures shall be measured are illustrated in Figure 13.



Key:

T_{A1} = ambient air temperature, outside the enclosure

T_{A2} = surrounding air temperature, in the enclosure

T_{S1} = temperature of accessible part on fuse-holder surface

T_{S2} = temperature of inaccessible part on fuse-holder surface

T_{T1} = temperature on the tag-terminal of panel fuse-holder

T_{T2} = temperature on the pin-terminal of PC-board fuse-holder

Figure 13 – Illustration of temperatures experienced in practice

A thermocouple or any other temperature measuring device that does not appreciably affect the result shall be used. Even the mounting method of the thermocouple shall be chosen in such a way, that the measuring results shall not be affected. and there shall be no damage to the fuse-holder surface.

Remarks on the individual measuring points:

T_{A1} denotes the ambient temperature surrounding the enclosure. It is measured at a distance of approximately 100 mm from the enclosure of the test device.

The rated power acceptance is referred to an ambient temperature T_{A1} of 23 °C.

The power acceptance at higher ambient temperatures T_{A1} shall be assigned by the manufacturer.

Preferred ratings at ambient temperatures T_{A1} are given in Table 2. See also Annex E.

T_{A2} denotes the ambient temperature inside the enclosure. It is measured at a distance of approximately 50 mm from the fuse-holder under test.

T_{S1} denotes the temperature of accessible parts on the fuse-holder surface which can be touched by means of the standard test finger according to IEC 60529, when the fuse-holder is installed and operated as in normal use, e.g. on the front panel of the enclosure (see 3.17).

T_{S2} denotes the temperature of inaccessible parts on the fuse-holder surface. It is measured on the insulating parts of the fuse-holder which are located inside the enclosure. The measuring point on the surface of the fuse-holder shall be accessible by means of a test wire of 1 mm diameter according to IEC 60529.

T_{S1} and T_{S2} shall be measured on the hottest point of the fuse-holder surface area.

The temperature measuring points should be chosen by performing a plot test (placing of thermocouples in various areas) or by the use of a thermal imaging camera to determine the approximate location of the hottest point.

T_{T1} denotes the temperature on the tag-terminals of panel fuse-holders. It is measured on the centre point of the tag-terminal surface.

T_{T2} denotes the temperature on the pin-terminals of PC-board fuse-holders. It is measured underneath the PC board on the centre point of the fillet formed by the meniscus of the solder.

Table 21 – Maximum allowable temperatures

Fuse-holder surface area		Maximum allowable temperatures	
		[b]	°C
1	Accessible parts[a]	T_{S1}	85
2	Inaccessible parts[a]		
2.1	Insulating parts	T_{S2}	[c]
2.2	Terminals:		
2.2.1	of fuse-holder for panel or base mounting: (area around the fitted conductor)	T_{T1}	[d]
2.2.2	of fuse-holder for PC board mounting: (soldered points on PC board)	T_{T2}	[d]

[a] When the fuse-holder is properly assembled, installed and operated as in normal use, e.g. on the front panel of end-product.

[b] See Figure 13.

[c] The maximum allowable temperature of the fuse-holder's insulating materials corresponds to the relative temperature index (RTI) or temperature index (TI) according to IEC 60216-1, which is based on test conditions of 20 000 h – electrical, without impact – if the insulating material is inaccessible after normal installation of the fuse-holder in the end-product. If there are no relevant IEC values available, as an alternative, comparable RTI values may be chosen from an equivalent standard.

The RTI value shall be assigned by the manufacturer.

[d] The maximum allowable temperature shall be assigned by the manufacturer, but not above 175 °C.

12.1.5 Correlation between ambient air temperature T_{A1} and the power acceptance of a fuse-holder

The rated power acceptance of a fuse-holder is determined at an ambient temperature T_{A1} of 23 °C (see 3.3).

The power acceptance at higher ambient temperatures T_{A1} shall be assigned by the manufacturer. See also Annex E.

12.1.6 Temperature measuring point for ambient air temperature T_{A1}

The measuring point for measuring the ambient air temperatures T_{A1} shall be located outside the enclosure in Figure 10.

12.1.7 Test method

The fuse-holder shall be mounted according to 12.1.2.

The dummy fuse-link corresponding to the fuse-holder to be tested shall be chosen from Table 19 or Table 20 and inserted in the holder.

For example, for a fuse-holder designed for fuse-links 5 mm × 20 mm and a rated power acceptance of 4 W at a rated current of 6,3 A, the dummy fuse-link No. A1/4063 with a resistance of 101 mΩ ± 10 % should be used.

The rated power acceptance test shall be carried out at an ambient temperature of not less than 23 °C and the result is corrected to a reference temperature of T_{A1} = 23 °C.

A test current equal to the rated current, a.c. or d.c., shall be passed through the fuse-holder. It is permissible for the test voltage to be less than the rated voltage of the fuse-holder.

Based on the dummy fuse-link resistance, the test current of the fuse-holder is adjusted within a tolerance of $^{+5}_{0}$ % of the rated current to give the nominal power dissipation P of the inserted dummy fuse-link.

NOTE For the above example the tolerances of the 101 mΩ dummy fuse-link are:

R_{min} = 90,9 mΩ, adjusted current: 6,63 A;

R_{max} = 111 mΩ, adjusted current: 6,00 A.

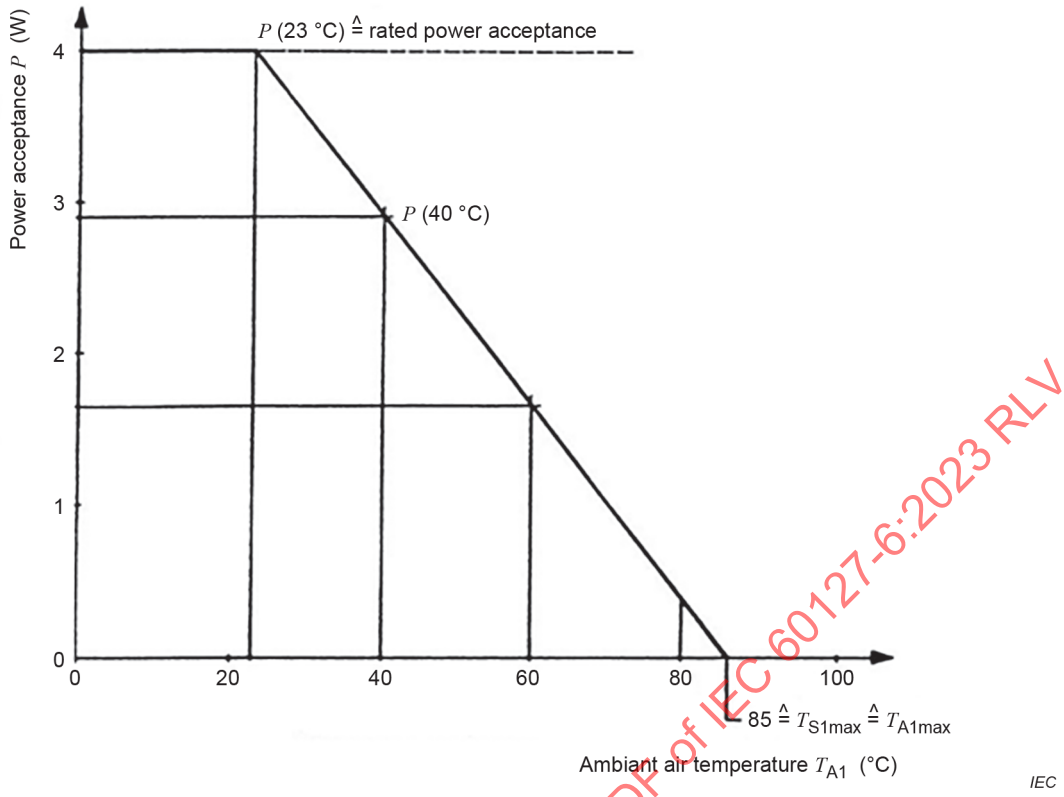
The test shall be continued until temperature stability has been reached.

Temperature stability shall be considered to have been reached when three (3) successive readings, at least 10 min apart, indicate no further temperature rise.

After temperature stability has been reached, the endurance test, according to Clause 13, shall be carried out with the same fuse-holder.

To obtain power acceptance values at higher ambient temperatures T_{A1}, tests shall be carried out at these higher temperatures following the test described above. The results can then be represented by means of a derating curve similar to the example shown in Figure 14.

Because of the maximum allowable temperature T_{S1max} = 85 °C for accessible parts, the derating curve should intersect the x-axis at the point T_{A1} = 85 °C.



Attention is drawn to the fact that this figure is an example of a derating curve. The relevant derating curve for any individual fuse-holder is assigned by the manufacturer.

Figure 14 – Example of a derating curve

12.2 Resistance to abnormal heat and fire

12.2.1 Needle-flame test

Insulation materials of fuse-holders which might be exposed to thermal stress due to electric effects and the deterioration of which might impair the safety of the end-product shall not be unduly affected by heat and by fire generated within the fuse-holder.

Compliance is checked by subjecting the fuse-holder to the needle-flame test according to IEC 60695-11-5:2016, with the following modifications:

– Clause 7: Flame application times

  The duration of application of the test flame is (10 ± 1) s.

– Clause 9: Test procedure

  The fuse-holder shall be positioned as in normal use and, at the beginning of the test, the flame is applied so that the tip of the flame is in contact with the surface of the fuse-holder. During the test, the burner shall not be moved.

– Clause 11: Evaluation of test results

  Add the following:

  There shall be no ignition of the tissue paper or scorching of the white pine board, a slight discoloration, if any, of the white pine board being neglected.

12.2.2 Glow-wire ignition test

This is not applicable for fuse-holders which represent small parts according to IEC 60695-2-11.

For fuse-holders 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

For GWFI and GWIT, reference should be made to IEC 60695-2-12 and IEC 60695-2-13 respectively. For the glow wire test, it is necessary to use material plates with the dimensions according to 4.2 of IEC 60695-2-12:2021 or IEC 60695-2-13:2021.

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

13 Endurance

13.1 General

Fuse-holders shall be sufficiently resistant to heat and to mechanical stresses which may occur in normal use.

Compliance is checked by the following test.

13.2 Endurance test

The fuse-holder shall be subjected to the rated power acceptance test according to 12.1. The test together with measurements of temperature and voltage drop shall go on continuously for a period of 500 h.

13.3 Requirements

After the test the fuse-holder shall be in a satisfactory condition. It shall not have suffered any deformation that would impair its correct operation. The requirements according to the following subclauses shall be fulfilled:

10.1.3 Insulating resistance.

10.1.4 Dielectric strength.

11.3 Compatibility between fuse-holder and fuse-link. For this test, the requirements in the second paragraph of 10.2.2.3 shall be replaced by the following: “The average of the values of the contact resistance shall not exceed 10 mΩ. The value of any individual measurement shall not exceed 15 mΩ.”

The maximum allowable temperatures according to Table 21 shall not be exceeded.

14 Additional requirements

14.1 Resistance to rusting

Ferrous parts shall be adequately protected against rusting. Compliance is checked by the following test.

All grease is removed from the parts to be tested by immersion in trichloroethane or an equivalent degreasing agent, for 10 min. The parts are then immersed for 10 min in a 10 % solution of ammonium chloride in water at a temperature of (20 ± 5) °C.

Without drying, but after shaking off any drops, the parts are placed for 10 min in a box containing air saturated with moisture at a temperature of (20 ± 5) °C.

After the parts have been dried for 10 min in a heating cabinet at a temperature of (100 ± 5) °C, their surface shall show no signs of rust.

Traces of rust on sharp edges and any yellowish film removable by rubbing are ignored.

For small springs and for inaccessible parts exposed to abrasion, a layer of grease may provide sufficient protection against rusting. Such parts are subjected to the test only if there is doubt about the effectiveness of the grease film, and the test is then made without previous removal of the grease.

14.2 Resistance to cleaning solvents

This test shall be applied to fuse-holders designed for PC board mounting.

The cleaning solvent to be used shall be propan-2-ol (isopropyl alcohol) or any similar solvent, except for solvent containing freon.

Compliance is checked by the test according to IEC 60068-2-45, with the following conditions:

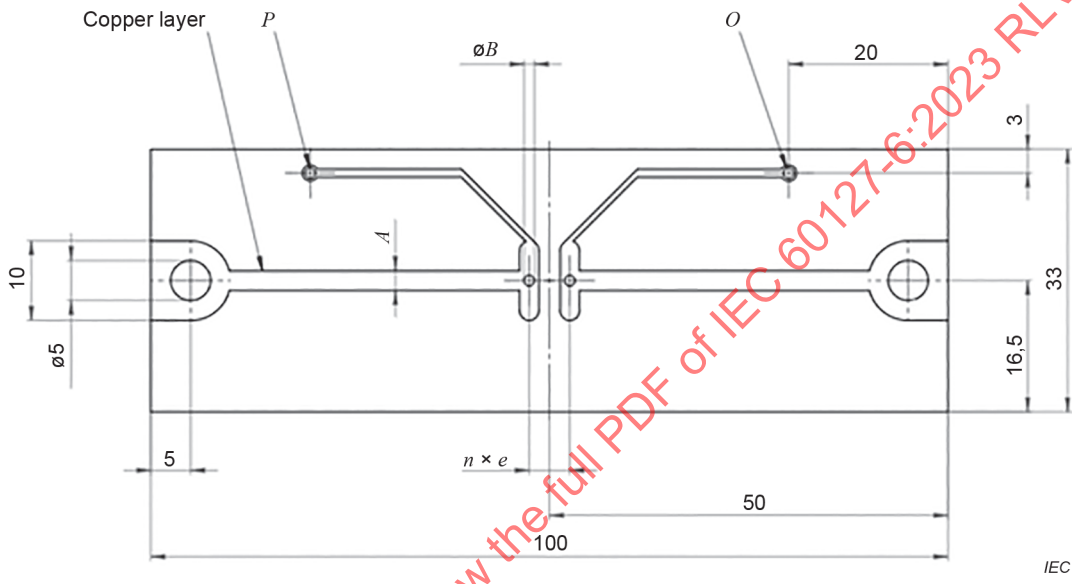
– solvent temperature: (23 ± 5) °C;
– duration of immersion: (5 ± 0,5) min;
– conditioning: Method 2 (without rubbing);
– recovery time: not less than 1 h;
– final measurement:
  - visual inspection and
  - dielectric strength test according to Table 9.

Annex A
(normative)

Test PC board for fuse-holders of rated currents up to 25 A

Figure A.1 shows an example of a test board. The number and alignment of the holes for the solder terminal of the fuse-holder may be chosen to suit the relevant fuse-holder. The dimensions of the copper layer (nominal width A, nominal thickness) and the overall dimensions (approximately 100 mm × 33 mm) shall be met.

Dimensions in millimetres



ΦB – minimum 1,3 mm or in accordance to manufacturer declaration

P/O – Connection for voltage drop measurement:

e – 2,54 mm

n – 1 to 6

Figure A.1 – Example of a test board

Base material:

– glass-fibre reinforced epoxy, temperature strength ≥150 °C;
– nominal thickness shall be 1,6 mm;
– copper layer:

Table A.1 – Copper layer for test board

Rated current of fuse-holder	Copper layer	
	Nominal width *A*	Nominal thickness
	mm	mm
<6,3 A	2,5	0,035
6,3 A to ≤10 A	5,0	0,070
>10 A to ≤16 A	10,0	0,105
>16 A to ≤25 A	15,0	0,140

Other layouts of the pc-board are acceptable, as long as the length, width and thickness of the copper layer inside the requested values.

Annex B
(normative)

Type tests, test sequences and number of samples

Table B.1 gives type tests, test sequences and number of samples. Twelve (12) spare samples shall be available.

Table B.1 – Type tests, test sequences and number of samples

Test group	Test no.	Number of samples	Parameters	Clause or Sub-clause	Acceptance criteria
		1 to 15 (15 samples)	Marking	6	All samples shall comply with the standard
1	1.1	1 to 3 (3 samples)	Protection against electric shock	8	All samples shall comply with the standard
	1.2		Clearance, creepage distances	9	
	1.3		Insulation resistance, dielectric strength, impulse withstand voltage	10.1	
	1.4		Mechanical strength of the fuse-holder fastening on panels	11.6	
2	2.1	4 to 6 (3 samples)	Contact resistance	10.2	[a]
	2.2		Compatibility between fuse-holder and fuse-link	11.3	
	2.3		Mechanical strength of the connection between fuse-base and fuse-carrier	11.4	
	2.4		Impact test	11.5	
	2.5		Terminals of fuse-bases	11.7	
3	3.1	7 to 9 (3 samples)	Rated power acceptance test including endurance test	12.1 13	[a]
	3.2		Measurement of insulation resistance	10.1.3	
	3.3		Dielectric strength test	10.1.4	
	3.4		Compatibility between fuse-holder and fuse-link with requirements according to 13.3	11.3	
4	4.1	10 to 12 (3 samples)	Resistance to abnormal heat and fire	12.2	[a]
5	5.1	13 to 15 (3 samples)	Resistance to vibration	11.8	[a]
	5.2		Resistance to rusting	14.1	
	5.3		Resistance to cleaning solvents	14.2	

[a] If one instance of non-compliance occurs, then the test shall be repeated on this parameter using the original sample size. Providing that no further instances of non-compliance occur, the fuse-holder shall be deemed to comply with this standard.

If a total of two or more instances of non-compliance occur, not necessarily for the same parameter of this group, then the fuse-holder is deemed not to comply with this standard.

Annex C
(informative)

Insulation coordination[4]

C.1 Overvoltage categories

The concept of overvoltage categories is used for equipment energized directly from the low-voltage mains.

NOTE 1 This concept of overvoltage categories is used in IEC 60364-4-44.

– Equipment of overvoltage category IV is for use at the origin of the installation.

NOTE 2 Examples of such equipment are electricity meters and primary overcurrent protection equipment.

– Equipment of *overvoltage* category III is equipment in fixed installations, and for cases where the reliability and the availability of the equipment is subject to special requirements.

NOTE 3 Examples of such equipment are switches in the fixed installation and equipment for industrial use with permanent connection to the fixed installation.

– Equipment of overvoltage category II is energy-consuming equipment to be supplied from the fixed installation.

NOTE 4 Examples of such equipment are appliances, portable tools, and other household and similar loads.

If such equipment is subjected to special requirements with regard to reliability and availability, overvoltage category III applies.

– Equipment of *overvoltage category I* is equipment for connection to circuits in which measures are taken to limit transient overvoltages to an appropriately low level.

NOTE 5 Examples are protected electronic circuits.

C.2 Degrees of pollution in the micro-environment

Pollution degree 1

No pollution or only dry, non-conductive pollution occurs. The pollution has no influence.

Pollution degree 2

Only non-conductive pollution occurs except that occasionally a temporary conductivity caused by condensation is to be expected.

Pollution degree 3

Conductive pollution occurs or dry non-conductive pollution occurs which becomes conductive due to condensation which is to be expected.

Pollution degree 4

The pollution generates persistent conductivity caused by conductive dust, or by rain or snow.

4 See IEC 60664-1.

C.3 Comparative tracking index CTI

Material groups and their CTI value as follows:

Material group I 600 ≤ CTI

Material group II 400 ≤ CTI < 600

Material group IIIa 175 ≤ CTI < 400

Material group IIIb 100 ≤ CTI < 175

The CTI values above refer to values obtained, in accordance with IEC 60112, on samples specifically made for the purpose and tested with solution A.

The proof-tracking index (PTI) is also used to identify the tracking characteristics of materials. A material may be included in one of the four groups given above on the basis that its PTI, established by the methods of IEC 60112 using solution A, is equal to or greater than the lower value specified for the group.

Annex D
(informative)

Additional tests and requirements

D.1 General

The tests mentioned in this Annex D are optional. However, if they are carried out, the following requirements shall be met.

It shall also be indicated in which lot for a type test this test shall be included.

D.2 Resistance to shock

D.2.1 General

The resistance to shock of fuse-holders shall be adequate. Compliance is checked by submitting the fuse-holder to the test in accordance with IEC 60068-2-27, test Ea, with the following general measuring requirements.

D.2.2 Mounting

According to 11.8.2.

D.2.3 Measurement and requirements

D.2.3.1 Severity (minimum level)

– Acceleration amplitude: 50 g

– Pulse duration: 11 ms

(see 4.1 of IEC 60068-2-27:2008, Table 1)

D.2.3.2 Axes of shocks

According to 11.8.3.2.

D.2.3.3 Final measurements

According to 11.8.3.4.

D.3 Verification of the degree of protection of enclosures

If the fuse-holder is qualified equipment with a degree of protection provided by enclosure according to IEC 60529, as declared by the manufacturer, the verification of the degree of protection shall be carried out according to IEC 60529.

IEC 60529 gives test conditions for each degree of protection. The conditions appropriate to the stated degree of protection should be applied, immediately followed by the dielectric strength test on the fuse holder as specified in 10.1.4.

Preferred degree of protection: Minimum IP 40.

D.4 Climatic category

D.4.1 General

The climatic category assigned to the fuse-holder by the manufacturer shall be in accordance with IEC 60068-1, as shown in Table D.1.

Table D.1 – Examples of climatic categories

Category	Temperature limits °C		Damp heat, steady state: number of days	Designation [a] of the test according to IEC 60068-2
55/125/56	-55	+125	56	A (Cold, IEC 60068-2-1) B (Dry heat, IEC 60068-2-2) C (Damp heat, steady state, IEC 60068-2-78)
40/85/56	-40	+85	56	
25/70/21	-25	+70	21	
10/55/04	-10	+55	4	
[a] The following upper case letters of tests are designated by the introduction of IEC 60068-1:2013.				

D.4.2 Test conditions and requirements

The verification of the stated climatic category shall be carried out under the conditions in the relevant IEC 60068-1 and IEC 60068-2.

The fuse-holder shall be mounted as specified in 10.1.1.

Immediately after these tests the parts of insulating material, normally accessible when in use, shall be wrapped with metal foil as shown in Figure 4 and Figure 5. After this treatment the requirements shall be in accordance with:

10.1.3 Insulation resistance

10.1.4 Dielectric strength

11.3 Compatibility between fuse-holder and fuse-link. For this test the requirements in the second paragraph of 10.2.2.3 shall be replaced by the following: “The average of the values of the contact resistance shall not exceed 10 mΩ. The value of any individual measurement shall not exceed 15 mΩ.”

Annex E
(normative)

Information for the correct application of the fuse-holder

Manufacturers shall hold available the following minimum information which is necessary for the correct application of the fuse-holder.

Table E.1 – Information for the correct application of the fuse-holder

		Ratings, characteristics	According to clauses and subclauses
1	Rated voltage		3.5 /Table 2
2	Rated current		3.4 / Table 2
3	Rated power acceptance at ambient temperature T_{A1} of 23 °C		3.3 / Table 2 / 12.1
4	Maximum allowable ambient temperature:		3.18 /12.1.3 / 12.1.4
4.1	for accessible parts (T_{A1})		
4.2	for inaccessible parts (T_{A2})		
5	Protection against electric shock Category PC1 or PC2 or PC3		Table 2 / 8
6	Protection class I or II of electrical equipment for which the fuse-holder is suitable, regarding protection against electric shock according to IEC 61140		Table 2 / 8
7	Overvoltage category and degree of pollution		3.8 / 3.10 / Table 2
8	Comparative tracking index CTI of insulation materials		3.15 / Table 2

Bibliography

IEC 60050-151:2001, *International Electrotechnical Vocabulary – Part 151: Electrical and magnetic devices*

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IEC 60060-1:2010 *High-voltage test techniques – Part 1: General definitions and test requirements*

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5 This document has been revised by ISO 21920-1:2021.

6 This document has been withdrawn in 2000.

SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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COUPE-CIRCUIT MINIATURES –

Partie 6: Ensembles-porteurs pour cartouches de coupe-circuit miniatures

AVANT-PROPOS

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L'IEC 60127-6 a été établie par le sous-comité 32C: Coupe-circuits à fusibles miniatures, du comité d'études 32 de l'IEC: Coupe-circuits à fusibles. Il s'agit d'une Norme internationale.

Cette troisième édition annule et remplace la deuxième édition parue en 2014. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) amélioration du courant assigné maximal de 16 A à 25 A à l'Article 1;
b) ajout de l'IEC 60127-4 et de l'IEC 60127-7 à l'Article 1;

c) modification de la position de marquage à l'Article 6;

d) modification de la tension assignée, du courant assigné et de la puissance admissible assignée dans le Tableau 2;

e) modification du Tableau 5, du Tableau 6, du Tableau 7, du Tableau 9, du Tableau 16 et du Tableau A.1.

Le texte de cette Norme internationale est issu des documents suivants:

Projet	Rapport de vote
32C/620/FDIS	32C/623/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

Ce document a été rédigé selon les directives ISO/IEC, Partie 2, il a été développé selon les directives ISO/IEC, Partie 1 et les directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/standardsdev/publications.

Une liste de toutes les parties de la série IEC 60127, publiées sous le titre général *Coupe-circuit miniatures*, se trouve sur le site web de l'IEC.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous webstore.iec.ch dans les données relatives au document recherché. À cette date, le document sera

- reconduit,
- supprimé, ou
- révisé.

INTRODUCTION

Selon le vœu exprimé par les utilisateurs de coupe-circuit à fusibles miniatures, toutes les normes, toutes les recommandations et autres documents concernant ces coupe-circuits à fusibles miniatures ont le même numéro de publication afin de faciliter toute référence aux coupe-circuits à fusibles dans d'autres spécifications, par exemple les spécifications de matériels.

De plus, un seul numéro de publication et la subdivision en plusieurs parties facilitent l'établissement de nouvelles normes, car il n'est pas nécessaire de répéter les articles et paragraphes qui contiennent des exigences générales.

À ce jour, la série IEC 60127 est donc subdivisée comme suit:

IEC 60127-1, *Coupe-circuits miniatures – Partie 1: Définitions pour coupe-circuits miniatures et exigences générales pour éléments de remplacement miniatures*

IEC 60127-2, *Coupe-circuit miniatures – Partie 2: Cartouches*

IEC 60127-3, *Coupe-circuit miniatures – Partie 3: Éléments de remplacement subminiatures*

IEC 60127-4, *Coupe-circuit miniatures – Partie 4: Éléments de remplacement modulaires universels (UMF) – Types de montage en surface et montage par trous*

IEC 60127-5, *Coupe-circuit miniatures – Partie 5: Lignes directrices pour l'évaluation de la qualité des éléments de remplacement miniatures*

IEC 60127-6, *Coupe-circuit miniatures – Partie 6: Ensembles-porteurs pour cartouches de coupe-circuit miniatures*

IEC 60127-7, *Coupe-circuit miniatures – Partie 7: Éléments de remplacement miniatures pour applications spéciales*

IEC 60127-8, *Coupe-circuit miniatures – Partie 8: Résistances de protection avec protection particulière contre les surintensités*

IEC 60127-10, *Coupe-circuit miniatures – Partie 10: Guide d'utilisation pour coupe-circuit miniatures*

La présente partie de l'IEC 60127 concerne les exigences, les matériels d'essai et les méthodes d'essai applicables aux ensembles-porteurs. Il s'agit d'un document indépendant qui se réfère à l'IEC 60127-1 concernant certaines définitions et les conditions d'essai atmosphériques. Ce document se réfère aussi à d'autres parties de la série IEC 60127 concernant les dimensions et les pertes maximales de puissance des éléments de remplacement.

COUPE-CIRCUIT MINIATURES –

Partie 6: Ensembles-porteurs pour cartouches de coupe-circuit miniatures

1 Domaine d'application

La présente partie de l'IEC 60127 s'applique aux ensembles-porteurs pour éléments de remplacement à cartouches conformes à l'IEC 60127-2, aux éléments de remplacement subminiatures conformes à l'IEC 60127-3, aux éléments de remplacement modulaires universels conformes à l'IEC 60127-4 et aux éléments de remplacement miniatures pour applications spéciales conformes à l'IEC 60127-7 pour la protection d'appareils électriques, de matériels électroniques et de leurs éléments constituants, normalement destinés à être utilisés à l'intérieur de bâtiments.

NOTE Les exigences relatives aux ensembles-porteurs pour éléments de remplacement miniatures conformes à l'IEC 60127-4 et à IEC 60127-7 sont à l'étude.

La présente partie de l'IEC 60269-1 ne s'applique pas aux ensembles-porteurs pour coupe-circuit à fusibles, traités par les parties suivantes de l'IEC 60269-1.

Le présent document s'applique aux ensembles-porteurs:

– de courant assigné maximal de 25 A; et
– de tension assignée maximale de 1 500 V en courant continu ou 1 000 V en courant alternatif; et
– pour une utilisation jusqu'à 2 000 m au-dessus du niveau de la mer, sauf spécification contraire.

Le présent document a pour objet d'établir des exigences uniformes relatives à la sécurité et à l'évaluation des propriétés électriques, mécaniques, thermiques et climatiques des ensembles-porteurs et à la compatibilité entre les ensembles-porteurs et les éléments de remplacement.

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60050-441, *Vocabulaire Électrotechnique International (IEV) – Partie 441: Appareillage et fusibles*

IEC 60050-581, *Vocabulaire Électrotechnique International (IEV) – Partie 581: Composants électromécaniques pour équipements électroniques*

IEC 60068-1:2013, *Essais d'environnement – Partie 1: Généralités et lignes directrices*

IEC 60068-2-6:2007, *Essais d'environnement – Partie 2-6: Essais – Essai Fc: Vibrations (sinusoïdales)*

IEC 60068-2-20:2021, *Essais d'environnement – Partie 2-20: Essais – Essais Ta et Tb: Méthodes d'essai de la brasabilité et de la résistance à la chaleur de brasage des dispositifs à broches*

IEC 60068-2-21, *Essais d'environnement – Partie 2-21: Essais – Essai U: Robustesse des sorties et des dispositifs de montage incorporés*

IEC 60068-2-27:2008, *Essais d'environnement – Partie 2-27: Essais – Essai Ea et guide: Chocs*

IEC 60068-2-45, *Essais fondamentaux climatiques et de robustesse mécanique – Partie 2-45: Essais – Essai XA et guide: Immersion dans les solvants de nettoyage*

IEC 60068-2-47, *Essais d'environnement – Partie 2-47: Essais – Fixation de spécimens pour essais de vibrations, d'impacts et autres essais dynamiques*

IEC 60068-2-75, *Essais d'environnement – Partie 2-75: Essais – Test Eh: Essais au marteau*

IEC 60127-1[1]:2006, *Miniature fuses – Part 1: Definitions for miniature fuses and general requirements for miniature fuse-links* (disponible en anglais seulement)
IEC 60127-1:2006/AMD1:2011
IEC 60127-1:2006/AMD2:2015

IEC 60127-2, *Coupe-circuit miniatures – Partie 2: Cartouches*

IEC 60127-3:2015, *Coupe-circuit miniatures – Partie 3: Éléments de remplacement subminiatures*

IEC 60216-1, *Matériaux isolants électriques – Propriétés d'endurance thermique – Partie 1: Méthodes de vieillissement et évaluation des résultats d'essai*

IEC 60529:1989, *Degrés de protection procurés par les enveloppes* (Code IP)

IEC 60664-1:2020, *Coordination de l'isolement des matériels dans les réseaux d'énergie électrique à basse tension – Partie 1: Principes, exigences et essais*

IEC 60695-4:2012, *Essais relatifs aux risques du feu – Partie 4: Terminologie relative aux essais au feu pour les produits électrotechniques*

IEC 60695-2-12:2021, *Essais relatifs aux risques du feu* – Partie 2-12: *Essais au fil incandescent/chauffant – Méthode d'essai d'indice d'inflammabilité au fil incandescent (GWFI) pour matériaux*

IEC 60695-2-13:2021, *Essais relatifs aux risques du feu* – Partie 2-13: *Essais au fil incandescent/chauffant – Méthode d'essai de température d'allumage au fil incandescent (GWIT) pour matériaux*

IEC 60695-11-5:2016, *Essais relatifs aux risques du feu – Partie 11-5: Flammes d'essai – Méthode d'essai au brûleur-aiguille – Appareillage, dispositif d'essai de vérification et lignes directrices*

IEC 60999-1, *Dispositifs de connexion – Conducteurs électriques en cuivre – Prescriptions de sécurité pour organes de serrage à vis et sans vis – Partie 1: Prescriptions générales et particulières pour les organes de serrage pour les conducteurs de 0,2 mm2 à 35 mm2 (inclus)*

IEC 61210, *Dispositifs de connexion – Bornes plates à connexion rapide pour conducteurs électriques en cuivre – Exigences de sécurité*

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[1] Il existe une version consolidée de cette publication comprenant l'IEC 60127-1:2006, l'IEC 60127-1:2006/AMD 1:2011 et l'IEC 60127-1:2006/AMD 2:2015.

3 Termes et définitions

Pour les besoins du présent document, les termes et les définitions de l'IEC 60050-441, de l'IEC 60050-581 et de l'IEC 60127-1 ainsi que les suivants s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse http://www.electropedia.org/
- ISO Online browsing platform: disponible à l'adresse http://www.iso.org/obp

3.1
ensemble-porteur
combinaison d'un socle et de son porte-fusible

Note 1 à l'article: Dans quelques conceptions d'ensemble-porteur dans lesquelles le socle et le porte-fusible ne sont pas séparés, l'ensemble-porteur peut être composé du socle seulement, sans porte-fusible.

3.1.1
socle
partie fixe d'un coupe-circuit équipée de contacts et de bornes pour le raccordement au circuit

[SOURCE: IEC 60127-1:2006, 3.10]

3.1.2
porte-fusible
partie mobile d'un coupe-circuit destinée à recevoir un élément de remplacement

[SOURCE: IEC 60127-1:2006, 3.12]

3.1.3
ensemble-porteur protégé
ensemble-porteur avec des contacts inaccessibles

3.1.4
ensemble-porteur non protégé
ensemble-porteur avec des contacts accessibles

EXEMPLE Clips.

3.2
caractéristique assignée
chacune des valeurs caractéristiques qui définissent ensemble les conditions de fonctionnement d'après lesquelles les essais sont déterminés et pour lesquelles l'ensemble-porteur a été conçu

EXEMPLE Exemples de valeurs assignées généralement indiquées pour des ensembles-porteurs:

– tension (U_N);
– courant (I_N);
– puissance admissible.

3.3
puissance admissible assignée
valeur de puissance admissible d'un ensemble-porteur assignée par le fabricant

Note 1 à l'article: Cette valeur est la puissance dissipée maximale produite par l'élément de remplacement conventionnel d'essai inséré, que l'ensemble-porteur peut admettre sans dépasser les températures spécifiées pendant l'essai au courant assigné.

Note 2 à l'article: La puissance admissible assignée se réfère à une température ambiante de 23 °C.

3.4
courant assigné
valeur du courant d'un ensemble-porteur, fixée par le fabricant, à laquelle référence est faite pour la puissance admissible assignée

3.5
tension assignée
valeur de la tension d'un ensemble-porteur, assignée par le fabricant, à laquelle renvoient le fonctionnement et les caractéristiques fonctionnelles

3.6
coordination de l'isolement
correspondance mutuelle des caractéristiques d'isolement du matériel électrique en tenant compte du micro-environnement prévu et des autres contraintes ayant une influence

[SOURCE: IEC 60664-1:2020, 3.1.3, modifié – La Note 1 à l'article a été supprimée.]

3.7
tension de tenue aux chocs
valeur de crête la plus élevée d'une tension de choc, de forme et de polarité spécifiées, qui ne provoque pas de claquage dans des conditions d'essai spécifiées

[SOURCE: IEC 60664-1:2020, 3.1.15]

3.8
catégorie de surtension
chiffre définissant une condition de surtension transitoire

Note 1 à l'article: Catégories spécifiées, voir l'Article C.1.

[SOURCE: IEC 60664-1:2020, 3.1.20, modifié – La Note 1 à l'article "Les catégories de surtension I, II, III et IV sont utilisées, voir 4.3.2" a été entièrement reformulée.]

3.9
pollution
<d'un système électrique> toute condition de matériau étranger solide, liquide ou gazeux (gaz ionisés) qui peut affecter la rigidité diélectrique ou la résistivité de surface

[SOURCE: IEC 60664-1:2020, 3.1.24]

3.10
degré de pollution
chiffre caractérisant la pollution prévue du micro-environnement

Note 1 à l'article: Voir l'Article C.2.

[SOURCE: IEC 60664-1:2020, 3.1.25, modifié – La Note 1 à l'article a été ajoutée].

3.11
micro-environnement
<d'un système électrique> conditions ambiantes qui influencent immédiatement le dimensionnement de la distance d'isolement et des lignes de fuite

[SOURCE: IEC 60664-1:2020, 3.1.23]

3.12
distance d'isolement
plus petite distance dans l'air entre deux parties conductrices

[SOURCE: IEC 60664-1:2020, 3.1.4]

3.13
ligne de fuite
distance la plus courte, le long de la surface d'un isolant solide, entre deux parties conductrices

[SOURCE: IEC 60050-151:2001, 151-15-50]

3.14
isolation solide
matériau isolant solide, ou combinaison de matériaux isolants solides, placé entre deux parties conductrices ou entre une partie conductrice et une partie du corps

[SOURCE: IEC 60664-1:2020, 3.1.6]

3.15
indice de résistance au cheminement
IRC
valeur numérique de la tension maximale, exprimée en volts, qu'un matériau peut supporter sans cheminement et sans apparition de flammes persistantes dans des conditions d'essai spécifiées

Note 1 à l'article: L'essai pour déterminer l'indice de résistance au cheminement conformément à l'IEC 60112 est conçu de façon à comparer le comportement de divers matériaux isolants placés dans des conditions d'essai. Il consiste à faire tomber des gouttes d'un liquide aqueux contaminant sur une surface horizontale pour donner des groupes de matériaux de conduction électrolytique et leurs valeurs IRC, voir l'Article C.3.

[SOURCE: IEC 60050-212:2010, 212-11-59, modifié – La Note 1 à l'article a été ajoutée]

3.16
partie active
conducteur ou partie conductrice destiné à être sous tension dans des conditions de fonctionnement normal, y compris le conducteur neutre, mais par convention, excepté le conducteur PEN, le conducteur PEM ou le conducteur PEL

Note 1 à l'article: Cette notion n'implique pas nécessairement l'existence d'un risque de choc électrique.

[SOURCE: IEC 60050-826:2022, 826-12-08, modifié – la partie "<installations et matériels électriques>" a été supprimée, la définition a été reformulée et la note à l'article a été ajoutée.]

3.17
catégories de protection de l'ensemble-porteur contre les chocs électriques
désignation qui caractérise le degré de protection de l'ensemble-porteur contre les chocs électriques

3.18
température maximale admissible de l'air ambiant
température de l'air la plus élevée, à proximité immédiate, que l'ensemble-porteur peut supporter à une puissance admissible assignée par le fabricant de l'ensemble-porteur sans que les températures maximales admissibles sur les surfaces accessibles et inaccessibles soient dépassées

3.19
indice relatif de température
fondé sur l'IEC 60216-1, indice de température d'un matériau d'essai obtenu à partir du temps qui correspond à l'indice connu de température d'un matériau de référence lorsque les deux matériaux sont soumis aux mêmes méthodes de vieillissement et de diagnostic dans des essais comparables

3.20
isolant
partie d'un produit électrotechnique qui sépare les pièces conductrices portées à des potentiels différents au cours du fonctionnement ou isole ces pièces de l'environnement

Note 1 à l'article: Pour plus de précisions, voir l'IEC 61140 et l'IEC 60664-1.

[SOURCE: IEC 60050-212:2010, 212-11-07, modifié – Le terme "isolant électrique" a été remplacé par "isolant".]

3.20.1
isolation fonctionnelle
isolation entre parties conductrices qui est uniquement nécessaire pour le bon fonctionnement du matériel

[SOURCE: IEC 60664-1:2020, 3.1.29]

3.20.2
isolation principale
isolation des parties actives dangereuses qui assure la protection principale

Note 1 à l'article: Cette notion n'est pas applicable à l'isolation exclusivement utilisée à des fins fonctionnelles.

[SOURCE: IEC 60050-826:2022, 826-12-14, modifié – Dans la définition, le terme "isolation" a été remplacé par "isolation des parties actives dangereuses".]

3.20.3
isolation supplémentaire
isolation indépendante prévue, en plus de l'isolation principale, en tant que protection en cas de défaut

[SOURCE: IEC 60050-826:2022, 826-12-15]

3.20.4
double isolation
isolation comprenant à la fois une isolation principale et une isolation supplémentaire

[SOURCE: IEC 60050-826:2022, 826-12-16]

3.20.5
isolation renforcée
isolation des parties actives dangereuses assurant un degré de protection contre les chocs électriques équivalant à celui d'une double isolation

Note 1 à l'article: L'isolation renforcée peut comporter plusieurs couches qui ne peuvent pas être soumises aux essais séparément en tant qu'isolation principale ou isolation supplémentaire.

[SOURCE: IEC 60050-826:2022, 826-12-17, modifié – Dans la définition, le terme "isolation" a été remplacé par "isolation des parties actives dangereuses".]

3.21
partie inaccessible
surface inaccessible
partie ou surface à l'intérieur du matériel, avec laquelle le doigt d'épreuve normalisé conforme à l'IEC 60529 ne peut entrer en contact

3.22
partie accessible
surface accessible
toute partie ou surface qui peut être touchée avec le doigt d'épreuve normalisé conforme à l'IEC 60529, lorsque l'ensemble-porteur est installé et actionné comme en usage normal, par exemple sur le panneau avant d'un matériel

3.23
calibre
élément de remplacement pour les essais, sans élément de fusion

4 Exigences générales

Les ensembles-porteurs doivent être conçus et construits de façon que la performance soit sûre et sans danger pour l'utilisateur ou l'entourage lorsqu'ils sont utilisés normalement et installés selon les instructions données par le fabricant.

En règle générale, la vérification est effectuée en réalisant la totalité des essais appropriés spécifiés.

Les exigences et essais supplémentaires peuvent être ajoutés conformément à la déclaration du fabricant, comme cela est présenté à l'Annex D.

Des exemples de types d'ensembles-porteurs dont les caractéristiques sont différentes sont indiqués dans le Tableau 1.

Tableau 1 – Caractéristiques des ensembles-porteurs protégés ou non protégés

N°	Description
1	*Types de montage* – Montage sur panneau et plaque de base – Montage sur carte de circuit imprimé
2	*Méthodes de fixation*: – Méthodes de fixation sur panneau: • Fixation par écrou (écrou taraudé) • Fixation par encliquetage: a) Socle à système à ressort intégré b) Socle à écrou ressort séparé (écrou réalisé, par exemple, en acier à ressort fin avec un logement conçu pour recevoir la pièce qui s'emboîte).
	– Méthodes de fixation sur carte de circuit imprimé (PC - printed circuit): • Fixation par brasage • Fixation à fiches
3	*Méthodes d'insertion du porte-fusible dans le socle:* – Insertion à vis – Insertion à baïonnette – Insertion à fiches

N°	Description
4	*Types de bornes:* – Bornes à vis – Bornes à braser – Bornes pour connexion rapide – Autres bornes sans brasure: • bornes à sertissage • bornes pour connexion enroulée
5	*Protection contre les chocs électriques* – Ensemble-porteur sans protection intégrée contre les chocs électriques – Ensemble-porteur avec protection intégrée contre les chocs électriques – Ensemble-porteur avec protection intégrée renforcée contre les chocs électriques
NOTE Cette liste n'est pas exhaustive et les ensembles-porteurs qui n'y sont pas énoncés ne sont pas nécessairement exclus du présent domaine d'application.	

5 Caractéristiques assignées et classifications préférentielles pour les ensembles-porteurs

Le Tableau 2 présente les valeurs pour les caractéristiques assignées et les classifications préférentielles.

Tableau 2 – Valeurs pour les caractéristiques assignées et les classifications préférentielles

Caractéristiques assignées et classifications pour les ensembles-porteurs	Pour éléments de remplacement conformes à	
	l'IEC 60127-2	l'IEC 60127-3
Tension assignée	250 V et 500 V	125 V et 250 V
Courant assigné	6,3 A / 10 A / 12,5 A / 16 A / 20 A / 25 A	6,3 A / 10 A
Puissance admissible assignée à une température ambiante T_{A1} de 23 °C	1,6 W / 2,5 W / 3,2 W / 4 W /5 W / 6 W / 8 W	1,6 W / 2,0 W
Catégories de protection de l'ensemble-porteur contre les chocs électriques	Catégorie PC1 Catégorie PC2 Catégorie PC3	
Protection contre les chocs électriques relative aux matériels, conformément à l'IEC 61140	Classe I ou II	
Coordination de l'isolement conformément à l'IEC 60664-1: a) Catégorie de surtension b) Degré de pollution c) Indice de résistance au cheminement IRC	 II ou III 2 ou 3 IRC ≥ 150	

En référence aux caractéristiques assignées (tension, courant, puissance admissible), si d'autres valeurs sont exigées, il convient de les choisir dans la série R10 selon l'ISO 3. Pour les classifications (coordination de l'isolement conformément à l'IEC 60664-1, voir le Tableau 2) d'autres valeurs peuvent être spécifiées.

Le fabricant donne toutes les informations sur les caractéristiques assignées et les classifications, conformément à l'Annex E.

6 Marquage

6.1 Les ensembles-porteurs doivent porter un marquage avec les indications suivantes:

– le nom du fabricant ou la marque de fabrique;
– la référence catalogue ou la référence de type.

Le fabricant doit fournir les marquages ci-dessous sur la plus petite des étiquettes de l'emballage. Il peut également apposer ces marquages sur l'ensemble-porteur.

– la tension assignée en volts;
– la puissance admissible en watts;
– le courant assigné en ampères.

Dans le cas des ensembles-porteurs montés sur panneau, ces marquages ne doivent pas être placés sur la face frontale de l'ensemble-porteur. Cette exigence est destinée à éviter l'installation d'un élément de remplacement de rechange dont la caractéristique assignée est incorrecte.

Exemples de Marquage: 250 V 4 W/6,3 A ou 250 V 4 W 6,3 A.

Le marquage doit être indélébile et facilement lisible.

6.2 La vérification est effectuée par inspection et en frottant le marquage à la main pendant 15 s avec un morceau de tissu imbibé d'eau, puis à nouveau 15 s avec un morceau de tissu imbibé d'essence de pétrole.

Pour l'essence de pétrole, l'utilisation d'un solvant aliphatique hexane avec une teneur maximale en aromatiques d'au moins 0,1 %, un indice de kauributanol de 29, une température d'ébullition initiale d'environ 65 °C, un point sec d'environ 69 °C et une gravité spécifique d'environ 0,68.

NOTE Dans le cas où un code couleur est utilisé, il n'est pas nécessaire d'appliquer l'essai destiné à vérifier le marquage indélébile.

7 Généralités sur les essais

7.1 Nature des essais

Les essais mentionnés dans la présente norme sont des essais de type.

Les séquences d'essai et le nombre d'échantillons à soumettre à l'essai sont indiqués dans l'Annex B.

7.2 Conditions atmosphériques normalisées pour les mesurages et les essais

Sauf spécification contraire, tous les essais doivent être effectués dans les conditions atmosphériques selon 7.1 de l'IEC 60127-1:2006.

7.3 Préconditionnement des échantillons d'essai

Sauf spécification contraire, les échantillons d'essai doivent être maintenus 4 h au moins dans les conditions atmosphériques normalisées, avant que les mesurages ne soient effectués.

7.4 Nature de l'alimentation

Dans le cas d'essais en courant alternatif, la tension d'essai doit être de forme pratiquement sinusoïdale avec une fréquence comprise entre 45 Hz et 62 Hz.

7.5 Calibres d'essai

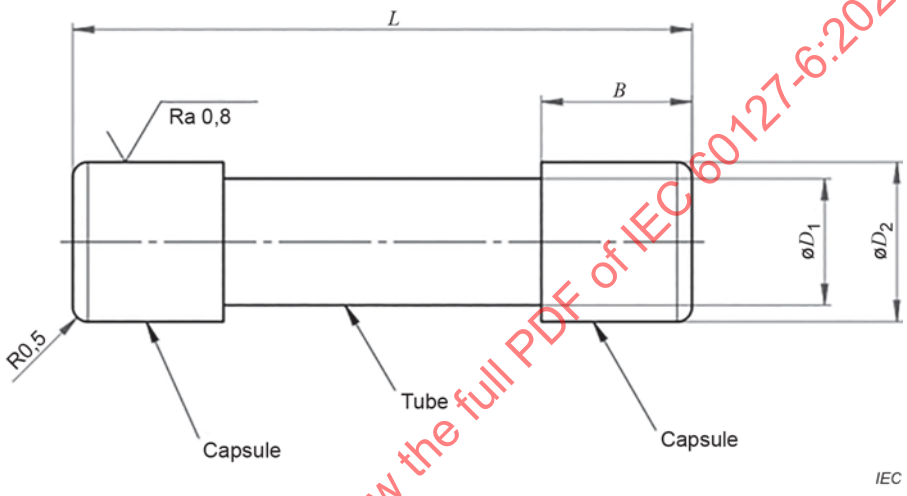
7.5.1 Calibres conformes à l'IEC 60127-2

Pour les essais qui nécessitent un calibre (Figure 1), les calibres appropriés mentionnés dans le Tableau 3 doivent être utilisés. Les calibres, ou leurs parties, en laiton doivent être recouverts d'un premier dépôt de nickel de 8 µm et d'un dépôt final d'or de 4,5 µm.

Il ne doit pas y avoir de trou dans les extrémités des calibres.

Les calibres doivent avoir une composition homogène, à l'exception des calibres numéros 3 et 6.

Dimensions en millimètres



NOTE Le symbole qui précise la rugosité, N6, est conforme à l'ISO 1302[2].

Figure 1 – Profil des calibres et des éléments de remplacement conventionnels d'essai conformes à l'IEC 60127-2

Le Tableau 3 présente les dimensions et les matériaux pour les calibres selon l'IEC 60127-2.

2 Le présent document a été révisé par l'ISO 21920-1:2021.

Tableau 3 – Dimensions et matériaux pour les calibres selon l'IEC 60127-2

Type de cartouche			*L*	*D*1	*D*2	*B*	Poids approximatif	Matériaux des pièces	
Élément de remplacement mm	Calibre N°	Taille	mm	mm	mm	mm	g	Capsule	Tube
5 × 20	1	maximale	$20{,}54\ ^{0}_{-0{,}04}$	$5{,}3\ ^{+0{,}01}_{0}$	4,2 ± 0,1	$5\ ^{+0{,}1}_{0}$	–	Acier[a]	
	2	Minimale	$19{,}46\ ^{+0{,}04}_{0}$	$5{,}0\ ^{0}_{-0{,}01}$	4,2 ± 0,1	$5\ ^{+0{,}1}_{0}$	2,5	Laiton[b]	
	3	–	$20{,}54\ ^{0}_{-0{,}04}$	$5{,}3\ ^{+0{,}01}_{0}$	4,2	$6{,}2\ ^{+0{,}1}_{0}$	–	Capsules de laiton[b]	Tube de verre ou céramique
6,3 × 32	4	maximale	$32{,}64\ ^{0}_{-0{,}04}$	$6{,}45\ ^{+0{,}01}_{0}$	5,5 ± 0,1	$6\ ^{+0{,}1}_{0}$	–	Acier[a]	
	5	minimale	$30{,}96\ ^{+0{,}04}_{0}$	$6{,}25\ ^{0}_{-0{,}01}$	5,5 ± 0,1	$6\ ^{+0{,}1}_{0}$	6	Laiton[b]	
	6	–	$32{,}64\ ^{0}_{-0{,}04}$	$6{,}45\ ^{+0{,}01}_{0}$	5,5	$8{,}3\ ^{+0{,}1}_{0}$	–	Capsules de laiton[b]	Tube de verre ou céramique

[a] Dur.

[b] Teneur en cuivre de 58 % à 70 %.

7.5.2 Calibres conformes à l'IEC 60127-3

Pour les essais qui nécessitent un calibre (Figure 2 et Figure 3), les calibres appropriés mentionnés dans le Tableau 4 doivent être utilisés.

Les calibres, ou leurs parties, en laiton doivent être recouverts d'un premier dépôt de nickel de 8 µm et d'un dépôt final d'or de 4,5 µm.

Les calibres doivent avoir une composition homogène, à l'exception des calibres numéros 3 et 6.

Dimensions en millimètres

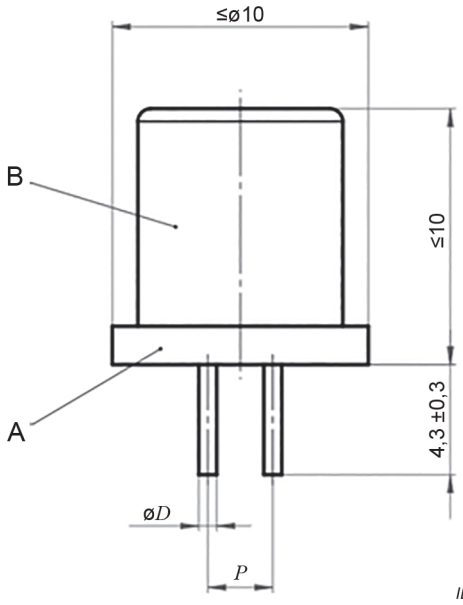


Figure 2 – Profil des calibres et des éléments de remplacement conventionnels d'essai conformes à la feuille de norme 1 de l'IEC 60127-3:2015

Dimensions en millimètres

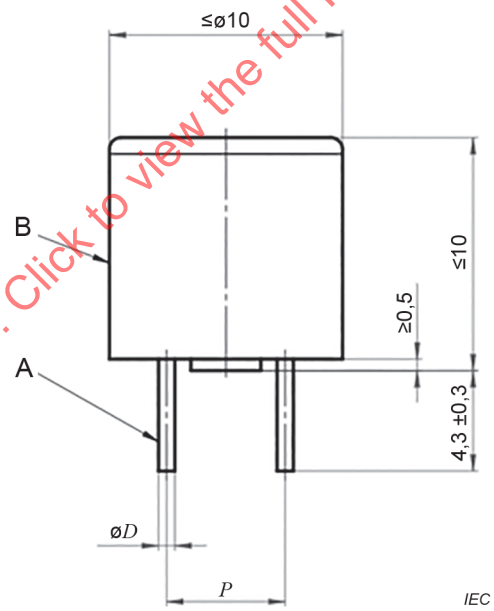


Figure 3 – Profil des calibres et des éléments de remplacement conventionnels d'essai conformes aux feuilles de norme 3 et 4 de l'IEC 60127-3:2015

Tableau 4 – Dimensions et matériaux pour les calibres selon l'IEC 60127-3

Type de			*D*	*P*	Matériaux des pièces	
Élément de remplacement subminiature	**Calibre N°**	**Taille**	mm	mm	**A**	**B**
Feuille de norme 1	1	maximale	$0{,}70\ ^{0}_{-0{,}02}$	$2{,}54\ ^{+0{,}17}_{-0{,}09}$	Acier[a]	
	2	minimale	$0{,}55\ ^{0}_{-0{,}02}$		Laiton[b]	
	3	–	$0{,}70\ ^{0}_{-0{,}02}$		Laiton[b]	Matériau isolant
Feuilles de norme 3 et 4	4	maximale	$0{,}63\ ^{0}_{-0{,}02}$	$5{,}08 \pm 0{,}1$	Acier[a]	
	5	minimale	$0{,}56\ ^{0}_{-0{,}02}$		Laiton[b]	
	6	–	$0{,}60\ ^{0}_{-0{,}02}$		Laiton	Matériau isolant

[a] Dur.

[b] Teneur en cuivre de 58 % à 70 %.

8 Protection contre les chocs électriques

8.1 Catégorie PC1: Ensembles-porteurs sans protection intégrée contre les chocs électriques

Les ensembles-porteurs de la catégorie PC1 sont appropriés uniquement à des applications dans lesquelles des moyens correspondants complémentaires sont prévus pour assurer la protection contre les chocs électriques.

8.2 Catégorie PC2: Ensembles-porteurs avec protection intégrée contre les chocs électriques

8.2.1 L'ensemble-porteur doit être conçu de façon que:

– les parties actives ne soient pas accessibles lorsque l'ensemble-porteur est fixé et installé correctement sur le panneau avant d'un matériel avec un porte-fusible et un calibre numéro 3 ou numéro 6 selon le Tableau 3 ou le Tableau 4 introduits dans le socle;

– les parties actives ne deviennent accessibles ni pendant l'introduction ou l'extraction du porte-fusible à la main ou à l'aide d'un outil ni après son extraction.

8.2.2 La vérification est effectuée en utilisant le doigt d'épreuve normalisé spécifié dans l'IEC 60529. Ce doigt d'épreuve est appliqué sans force appréciable dans toutes les positions possibles. Si l'ensemble-porteur a un porte-fusible, le calibre numéro 3 ou numéro 6 selon le Tableau 3 ou le Tableau 4 doit être placé dans le porte-fusible au cours de l'essai. En ce qui concerne l'indication du contact avec la partie appropriée, il est recommandé d'utiliser un indicateur électrique avec une tension d'environ 40 V.

8.3 Catégorie PC3: Ensembles-porteurs avec protection intégrée renforcée contre les chocs électriques

Les exigences relatives à cette catégorie sont identiques à celles relatives à 8.2 (Catégorie PC2), mais l'essai est effectué à l'aide d'un fil rigide d'essai de 1 mm de diamètre conforme au Tableau VI de l'IEC 60529:1989, à la place du doigt d'épreuve normalisé.

9 Distances d'isolement et lignes de fuite

9.1 Généralités

Les distances d'isolement et les lignes de fuite doivent être vérifiées lorsque l'ensemble-porteur est assemblé correctement, installé comme en utilisation normale et équipé d'un calibre numéro 3 ou numéro 6 selon le Tableau 3 ou le Tableau 4.

La vérification est effectuée par mesurage.

9.2 Exigences minimales pour les ensembles-porteurs en fonction du niveau d'isolation

9.2.1 Le Tableau 5 présente des types d'isolation entre des parties actives différentes et des parties accessibles.

Tableau 5 – Types d'isolation entre des parties actives différentes et des parties accessibles

Type d'isolation Isolation entre:	Fonctionnelle	Principale	Supplémentaire	Renforcée	Double
a) Parties actives de potentiel différent	X				
b) Parties actives et plaque métallique de fixation ou toute autre partie métallique qui peut entrer en contact avec la plaque de fixation, par exemple des dispositifs de fixation des socles.					
Épaisseur de la plaque de fixation conforme à 10.1.1					
– ensembles-porteurs conformes à 9.2.2		X	(X)[a]		
– ensembles-porteurs conformes à 9.2.3				X	X
c) Parties actives et toutes les parties avec lesquelles le doigt d'épreuve peut entrer en contact (parties accessibles)					
– ensembles-porteurs conformes à 9.2.2		X	(X)[a]		
– ensembles-porteurs conformes à 9.2.3				X	X

[a] L'isolation supplémentaire ne s'applique qu'en plus de l'isolation principale, alors que l'isolation principale peut être appliquée sans l'isolation supplémentaire.

9.2.2 Les ensembles-porteurs prévus pour le matériel de la classe I doivent avoir au moins l'isolation principale entre des parties actives et des parties métalliques accessibles. Ces parties métalliques doivent être telles qu'elles assurent une connexion solide au circuit de terre de protection du matériel dans lequel l'ensemble-porteur est destiné à être utilisé.

9.2.3 Les ensembles-porteurs prévus pour le matériel de la classe II doivent avoir une double isolation ou une isolation renforcée entre des parties actives et des parties accessibles.

9.3 Distances d'isolement

Les distances d'isolement doivent être dimensionnées de façon que l'ensemble-porteur supporte les surtensions attendues au cours de l'usage normal. Les distances d'isolement doivent être vérifiées par un mesurage de dimensions et l'essai de tension de tenue aux chocs selon 10.1.5, lorsque cet essai est exigé.

Les distances d'isolement égales à celles qui sont spécifiées dans le Tableau 7 ou dans le Tableau 8 doivent être considérées comme étant conformes à cette exigence. Dans ce cas, l'essai de tension de tenue aux chocs selon 10.1.5 n'est pas exigé.

Les distances d'isolement peuvent être inférieures aux valeurs spécifiées dans le Tableau 7 et dans le Tableau 8, mais pas inférieures aux valeurs déterminées pour les conditions de champ homogène selon le Tableau F.2 de l'IEC 60664-1:2020. Dans ce cas, les distances d'isolement doivent être considérées comme étant conformes à cette exigence tant qu'il ne se produit aucun cas de non-conformité dans l'essai de tension de tenue aux chocs selon 10.1.5.

Les distances d'isolement inférieures aux valeurs déterminées pour les conditions de champ homogène selon le Tableau F.2 de l'IEC 60664-1:2020 doivent être considérées comme étant conformes à cette exigence.

Tableau 6 – Tensions de tenue aux chocs exigées pour les distances d'isolement

Tension assignée V		**Tensions de tenue aux chocs exigées** $\hat{U}$ **1,2/50** [1] kV	
Catégorie de surtension		**Isolation fonctionnelle, principale ou supplémentaire**	**Isolation renforcée ou double isolation**
II	**III**		
≤ 50	-	0,5	0,8
> 50 à ≤ 100	-	0,8	1,5
> 100 à ≤ 150	-	1,5	2,5
> 150 à ≤ 300	≤ 150	2,5	4,0
> 300 à ≤ 600	> 150 à ≤ 300	4,0	6,0
–	> 300 à ≤ 600	6,0	8,0
–	> 600 à ≤ 1 000	8,0	1,2

[1] Conformément à l'IEC 60060-1. $\hat{U}$ 1,2/50 définit la forme de l'onde de choc: durée d'établissement de 1,2 µs et durée jusqu'à la mi-valeur de la queue de 50 µs.

De plus en plus de matériels qui fonctionnent à des tensions inférieures à 125 V sont utilisés. Les ensembles-porteurs spécifiquement conçus pour le fonctionnement à ces tensions plus basses doivent satisfaire aux prescriptions indiquées dans ce tableau, afin qu'ils soient conformes à l'IEC 60664-1.

L'attention est attirée sur le fait que les spécifications de matériels peuvent comporter des exigences qui s'ajoutent à celles qui sont spécifiées dans le Tableau 5, le Tableau 6, le Tableau 7 et le Tableau 8 ou qui en diffèrent.

Le Tableau 7 et le Tableau 8 donnent les distances minimales d'isolement dans l'air en fonction de la tension assignée, de la catégorie de surtension et du degré spécifié de pollution.

NOTE Distances minimales d'isolement dans l'air en millimètres jusqu'à 2 000 m au-dessus du niveau de la mer pour des conditions de champ hétérogène conformément au Tableau F.2 de l'IEC 60664-1:2020.

Tableau 7 – Distances minimales d'isolement dans l'air sous la catégorie de surtension II

Tension assignée V		Distances d'isolement dans l'air mm	
Isolation fonctionnelle, principale ou supplémentaire	Isolation renforcée ou double isolation	Degré de pollution	
		2	3
≤ 50	–	0,2	0,8
> 50 à ≤ 100	≤ 50	0,2	0,8
> 100 à ≤ 150	> 50 à ≤ 100	0,5	0,8
> 150 à ≤ 300	> 100 à ≤ 150	1,5	1,5
> 300 à ≤ 600	> 150 à ≤ 300	3,0	3,0
–	> 300 à ≤ 600	5,5	5,5
–	> 600 à ≤ 1 000	8,0	8,0

Tableau 8 – Distances minimales d'isolement dans l'air sous la catégorie de surtension II

Tension assignée V		Distances d'isolement dans l'air mm	
Isolation fonctionnelle, principale ou supplémentaire	Isolation renforcée ou double isolation	Degré de pollution	
		2	3
≤ 150	–	1,5	1,5
> 150 à ≤ 300	≤ 150	3,0	3,0
> 300 à ≤ 600	> 150 à ≤ 300	5,5	5,5
–	> 300 à ≤ 600	8,0	8,0
–	> 600 à ≤ 1 000	11	11

9.4 Lignes de fuite

9.4.1 Les lignes de fuite pour l'isolation principale ou supplémentaire, déterminées à partir de la tension assignée, doivent être choisies dans le Tableau 9. Les facteurs d'influence suivants doivent être pris en considération:

– tension assignée;
– degré de pollution;
– forme de la surface isolante;
– indice de résistance au cheminement (IRC).

9.4.2 Mesurage des lignes de fuite et des distances d'isolement, forme de la surface isolante: exigences selon 6.2 de l'IEC 60664-1:2020.

9.4.3 Les lignes de fuite pour l'isolation renforcée ou la double isolation doivent être de deux fois la valeur spécifiée dans le Tableau 9.

9.4.4 Une ligne de fuite ne peut pas être inférieure à la valeur associée de distance d'isolement. En conséquence, la ligne de fuite la plus courte possible est égale à la distance d'isolement exigée.