IEC 61058-1

Edition 4.0 2016-07
REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

Switches for appliances –
Part 1: General requirements

IEC 61058-1:2016-07 RLV(en)

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

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

About the IEC
The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications
The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue
The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub
The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,…). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished
Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org
The world's leading online dictionary of electronic and electrical terms containing 20 000 terms and definitions in English and French, with equivalent terms in 15 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary
65 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc
If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.

IEC 61058-1

Edition 4.0 2016-07
REDLINE VERSION

INTERNATIONAL STANDARD

Switches for appliances –
Part 1: General requirements

colour
inside

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 29.120.40

ISBN 978-2-8322-3544-7

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

SWITCHES FOR APPLIANCES –

Part 1: General requirements

FOREWORD

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

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

International Standard IEC 61058-1 has been prepared by subcommittee 23J: Switches for appliances, of IEC technical committee 23: Electrical accessories.

This fourth edition cancels and replaces the third edition published in 2000, Amendment 1:2001 and Amendment 2:2007. This edition constitutes a technical revision.

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

a) requirements for mechanical switches are now given in IEC 61058-1-1;
b) requirements for electronic switches are now given in IEC 61058-1-2.

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

FDIS	Report on voting
23J/401/FDIS	23J/405/RVD

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

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

A list of all parts in the IEC 61058 series, published under the general title *Switches for appliances*, can be found on the IEC website.

In this part, the following print types are used:

- requirements proper: roman type;
- test specifications: *italic type*;
- notes: smaller roman type.

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

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

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

SWITCHES FOR APPLIANCES –

Part 1: General requirements

1 Scope

~~1.1~~ This part of IEC 61058 applies to switches ~~(mechanical or electronic)~~ for appliances ~~actuated by hand, by foot or by other human activity~~. The switches are intended to ~~operate or~~ control electrical appliances and other equipment for household or similar purposes with a rated voltage not exceeding ~~440~~ 480 V and a rated current not exceeding 63 A.

Switches for appliances are intended to be operated by

- a person via an actuating member ~~or by~~,
- indirect actuation,
- an actuating sensing unit.

~~The actuating member or sensing unit can be integral with or arranged separately, either physically or electrically, from the switch and may involve transmission of a signal, for example electrical, optical, acoustic or thermal, between the actuating member or sensing unit and the switch.~~

~~Switches which incorporate additional control functions governed by the switch function are within the scope of this standard.~~

~~This standard also covers the indirect actuation of the switch when the operation of the actuating member or sensing unit is provided by a remote control or a part of an appliance or equipment such as a door.~~

~~NOTE 1 Electronic switches may be combined with mechanical switches giving full disconnection or micro-disconnection.~~

~~NOTE 2 Electronic switches without a mechanical switch in the supply circuit provide only electronic disconnection. Therefore, the circuit on the load side is always considered to be live.~~

~~NOTE 3 For switches used in tropical climates, additional requirements may be necessary.~~

~~NOTE 4 Attention is drawn to the fact that the standards for appliances may contain additional or alternative requirements for switches.~~

~~NOTE 5 Throughout this standard, the word "appliance" means "appliance or equipment".~~

~~NOTE 6 This part of IEC 61058 is applicable when testing incorporated switches. When other types of switches for appliances are tested, this part is applicable together with the relevant IEC 61058-2.~~

~~This part may, however, be applied for other types of switches which are not mentioned in IEC 61058-2, provided that the electrical safety is not disregarded.~~

~~1.2 This standard applies to switches intended to be incorporated in, on or with an appliance.~~

~~1.3 This standard also applies to switches incorporating electronic devices.~~

~~1.4 This standard also applies to switches for appliances such as~~

- ~~switches intended to be connected to a flexible cable (cord switches);~~

~~NOTE In this document, the word "cable" means "cable or cord".~~

– ~~switches integrated in an appliance (integrated switches);~~

– ~~switches intended to be mounted apart from the appliance (independently mounted switches) other than those within the scope of IEC 60669-1;~~

– ~~change-over selectors for which, however, particular requirements are given in IEC 61058-2.~~

~~**1.5** This standard does not contain requirements for isolating switches.~~

~~NOTE Requirements for isolating switches are under consideration.~~

~~**1.6** This standard does not apply to devices which control appliances and equipment not actuated intentionally by a person. These are covered by IEC 60730.~~

Transmission of a signal between the actuating member or sensing unit and the switch may be connected by optical, acoustic, thermal, electrical or other relevant connection and may include remote controlled units.

This part of IEC 61058 applies to switches for appliances provided with additional control functions governed by the switch provided with electronic circuits and devices that are necessary for the intended and/or correct operation of the switch.

This part of IEC 61058 applies to circuitry when evaluated with a switch and necessary for the switching function.

This part of IEC 61058 applies in general to switches for appliances in conjunction with the following parts:

– *Part 1-1: Requirements for mechanical switches*, and/or

– *Part 1-2: Requirements for electronic switches*.

This part of IEC 61058 does not apply to devices covered by:

– IEC 60669 (all parts), *Switches for household and similar fixed-electrical installations*, and

– IEC 60730 (all parts), *Automatic electrical controls*.

This part of IEC 61058 does not contain requirements for safety isolating switches (IEC 60050-811:1991, 811-29-17).

NOTE 1 For switches used in tropical climates, additional requirements may be necessary.

NOTE 2 Attention is drawn to the fact that the end product standards for appliances may contain additional or alternative requirements for switches.

NOTE 3 Throughout this part of IEC 61058, the word "appliance" means "appliance or equipment".

2 Normative references

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

~~IEC 60034-1:1996, *Rotating electrical machines – Part 1: Rating and performance* [1]~~
~~Amendment 1 (1997)~~
~~Amendment 2 (1999)~~

~~[1] There is a consolidated edition 10.2 (1999) that includes IEC 60034-1 and its amendments 1 (1997) and 2 (1999).~~

IEC 60038~~:1983~~, *IEC standard voltages*

~~IEC 60050(151):1978, *International Electrotechnical Vocabulary (IEV) – Chapter 151: Electrical and magnetic devices*~~

~~IEC 60050(411):1973, *International Electrotechnical Vocabulary (IEV) – Chapter 411: Rotating machinery*~~

~~IEC 60050(441):1984, *International Electrotechnical Vocabulary (IEV) – Chapter 441: Switchgear, controlgear and fuses*~~

~~IEC 60050(826):1982, *International Electrotechnical Vocabulary (IEV) – Chapter 826: Electrical installations of buildings*~~
~~Amendment 1 (1990)~~
~~Amendment 2 (1995)~~

IEC 60060-1~~:1989~~, *High-voltage techniques – Part 1: General definitions and test requirements*

IEC 60065:2014, *Audio, video and similar electronic apparatus – Safety requirements*

~~IEC 60068-2-20:1979, *Environmental testing – Part 2-20: Tests – Test T: Soldering*~~

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

~~IEC 60085:1984, *Thermal evaluation and classification of electrical insulation*~~

IEC 60112:~~1979~~ 2003, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials ~~under moist conditions~~*
Amendment 1:2009

IEC 60127 (all parts), *Miniature fuses*

IEC 60127-2~~:1989~~, *Miniature fuses – Part 2: Cartridge fuse-links*

~~IEC 60228:1978, *Conductors of insulated cables*~~

~~IEC 60228A:1982, *Conductors of insulated cables – First supplement: Guide to the dimensional limits of circular conductors*~~

~~IEC 60269-1:1998, *Low-voltage fuses – Part 1: General requirements*~~

IEC 60269-3, *Low-voltage fuses – Part 3: Supplementary requirements for fuses for use by unskilled persons (fuses mainly for household or similar applications) – Examples of standardized systems of fuses A to F*

~~IEC 60269-3-1:1994, *Low-voltage fuses – Part 3-1: Supplementary requirements for fuses for use by unskilled persons (fuses mainly for household and similar applications) – Sections I to IV*~~

~~IEC 60335-1:1991, *Safety of household and similar electrical appliances – Part 1: General requirements*~~
~~Amendment 1 (1994)~~

~~IEC 60335 (all parts 2), *Safety for household and similar electrical appliances*~~

~~IEC 60364-4-41:1992, *Electrical installations of buildings – Part 4: Protection for safety – Chapter 41: Protection against electric shock* 2)~~
~~Amendment 1 (1996)~~
~~Amendment 2 (1999)~~

~~IEC 60364-4-442:1993, *Electrical installations of buildings – Part 4: Protection for safety – Chapter 44: Protection against overvoltage – Section 442: Protection of low-voltage installations against faults between high-voltage systems and earth* 3)~~
~~Amendment 1 (1995)~~
~~Amendment 2 (1999)~~

~~IEC 60364-4-443:1995, *Electrical installations of buildings – Part 4: Protection for safety – Chapter 44: Protection against overvoltages – Section 443: Protection against overvoltages of atmospheric origin or due to switching* 4)~~
~~Amendment 1 (1998)~~

IEC 60384-14~~:1993~~, *Fixed capacitors for use in electronic equipment – Part 14: Sectional specification – Fixed capacitors for electromagnetic interference suppression and connection to the supply mains*

IEC 60417, *Graphical symbols for use on equipment* (available at: http://www.graphical-symbols.info/equipment)

~~IEC 60417-1:1998, *Graphical symbols for use on equipment – Part 1: Overview and application*~~

IEC 60529:1989, *Degree of protection provided by enclosures (IP code)*
Amendment 1:1999
Amendment 2:2013

IEC 60617, *Graphical symbols for diagrams* (available at: http://std.iec.ch/iec60617)

~~IEC 60617-2:1996, *Graphical symbols for diagrams – Part 2: Symbol elements, qualifying symbols and other symbols having general application*~~

~~IEC 60664-1:1992, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*~~

IEC 60664-3:~~1992~~2003, *Insulation coordination for equipment within low-voltage systems – Part 3: Use of coating~~s to achieve insulation coordination of printed board assemblies~~, potting or molding for protection against pollution*
Amendment 1:2010

~~IEC 60669-1:1998, *Switches for household and similar fixed electrical installations – Part 1: General requirements*~~

IEC 60691~~:1993~~, *Thermal-links – Requirements and application guide*

~~IEC 60695-2-1 (all sheets), *Fire hazard testing – Part 2-1: Test methods*~~

~~2) There is a consolidated edition 3.2 (1999) that includes IEC 60364-4-41 and its amendments 1 (1996) and 2 (1999).~~

~~3) There is a consolidated edition 1.2 (1999) that includes IEC 60364-4-442 and its amendments 1 (1995) and 2 (1999).~~

~~4) There is a consolidated edition 3.2 (1999) that includes IEC 60364-4-443 and its amendment 1 (1998).~~

IEC 60695-2-11, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products*

IEC 60695-10-2, *Fire hazard testing – Part 10-2: Abnormal heat – Ball pressure test method*

IEC 60695-11-10, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods*

IEC 60695-11-20, *Fire hazard testing – Part 11-20: Test flames – 500 W flame test method*

~~IEC 60707:1999, *Flammability of solid non-metallic materials when exposed to flame sources – List of methods*~~

IEC 60730 (all parts), *Automatic electrical controls ~~for household and similar use~~*

IEC 60730-1:~~1999~~ 2013, *Automatic electrical controls ~~for household and similar use~~ – Part 1: General requirements*

IEC 60730-2-9:~~2000~~ 2015, *Automatic electrical controls ~~for household and similar use~~ – Part 2-9: Particular requirements for temperature sensing control~~s~~*

IEC 60738-1~~:1998~~, *Thermistors – Directly heated positive ~~step-function~~ temperature ~~efficient thermistors~~ coefficient – Part 1: Generic specification*

~~IEC 60760:1989, *Flat, quick-connect terminations*~~

~~IEC 60893-1:1987, *Specification for industrial rigid laminated sheets based on thermosetting resins for electrical purposes – Part 1: Definitions, designations and general requirements*~~

~~IEC 60998-2-3:1991, *Connecting devices for low-voltage circuits for household and similar purposes – Part 2-3: Particular requirements for connecting devices as separate entities with insulation piercing clamping units*~~

~~IEC 61000 (all parts), *Electromagnetic compatibility (EMC)*~~

IEC 61000-3-2~~:1995~~, *Electromagnetic compatibility (EMC) – Part 3.2: Limits – Limits for harmonic current emissions (equipment input current ≤16 A per phase~~)~~* ~~[5]~~
~~Amendment 1 (1997)~~
~~Amendment 2 (1998)~~

IEC 61000-3-3~~:1994~~, *Electromagnetic compatibility (EMC) – Part 3-3: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage ~~power~~ supply systems, for equipment with rated current ≤16 A per phase and not subject to conditional connection*

IEC/~~TR2~~ TS 61000-3-5~~:1994~~, *Electromagnetic compatibility (EMC) – Part 3-5: Limits – Limitation of voltage fluctuations and flicker in low-voltage power supply systems for equipment with rated current greater than ~~16~~ 75 A*

~~IEC 61000-4-1:1992, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 1: Overview of immunity tests. Basic EMC publication*~~

~~[5] There is a consolidated edition 1.2 (1998) that includes IEC 61000-3-2 and its amendments 1 (1997) and 2 (1998).~~

IEC 61000-4-2~~:1995~~, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*~~. Basic EMC publication~~ ~~[6]~~
~~Amendment 1 (1998)~~

IEC 61000-4-3~~:1995~~, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test* ~~[7]~~
~~Amendment 1 (1998)~~

IEC 61000-4-4~~:1995~~, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*~~. Basic EMC publication~~

IEC 61000-4-5, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

~~IEC 61000-4-6:1996, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 6: Immunity to conducted disturbances, induced by radio-frequency fields*~~

IEC 61000-4-8, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test*

IEC 61000-4-11~~:1994~~, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests*

IEC 61032:1997, *Protection of persons and equipment by enclosures – Probes for verification*

IEC 61058-1-1, *Switches for appliances – Part 1-1: Requirements for mechanical switches*

IEC 61058-1-2, *Switches for appliances – Part 1-2: Requirements for electronic switches.*

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

CISPR 14-1, *Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus – Part 1: Emission*

CISPR 15:2013, *Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment*

~~ISO 1456:1988, *Metallic coatings – Electrodeposited coatings of nickel plus chromium and of copper plus nickel plus chromium*~~

~~ISO 2081:1986, *Metallic coatings – Electroplated coatings of zinc of iron or steel*~~

~~ISO 2093:1986, *Electroplated coatings of tin – Specification and test methods*~~

~~ISO 4046:1978, *Paper, board, pulp and related terms – Vocabulary*~~

~~[6] There is a consolidated edition 1.1 (1999) that includes IEC 61000-4-2 and its amendment 1 (1998).~~

~~[7] There is a consolidated edition 1.1 (1998) that includes IEC 61000-4-3 and its amendment 1 (1998).~~

3 Terms and definitions

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

3.1 General terms and definitions

3.1.1
mechanical switching device
switching device designed to close and open one or more electric circuits by means of separable contacts

Note 1 to entry: In the IEC 61058 series the terms "switching devices" and "switches" are used interchangeably.

[SOURCE: IEC 60050-441:1984, 441-14-02]

~~3.1.2~~
~~**switch (mechanical)**~~
~~a mechanical switching device capable of making, carrying and breaking currents under normal circuit conditions which may include specified operating overload conditions and also carrying for a specified time currents under specified abnormal circuit conditions such as those of short circuit~~

~~NOTE A switch may be capable of making but not breaking short-circuit currents.~~

~~[IEV 441-14-10]~~

3.1.2
conductive part
part which is capable of conducting current although it may not necessarily be used for carrying service current

[SOURCE: IEC 60050-441:1984, 441-11-09]

3.1.3
live part
conductor or conductive part intended to be energized in normal ~~use~~ operation, including a neutral conductor, but by convention not a PEN/PEM/PEL conductor

~~[IEV 826-03-01]~~

Note 1 to entry: For appliance switches, "live part" implies a risk of electric shock.

Note 2 to entry: Unless otherwise specified, parts connected to a SELV supply or equal to or less than 24 V are not considered to be live parts.

3.1.4
pole of a switch
~~the part of the~~ portion of a switching device associated exclusively with one electrically separated conducting path of ~~the switch~~ its main circuit and excluding those portions which provide a means for mounting and operating all poles together

~~NOTE 1 Those parts that provide a means for mounting and operating all poles together are excluded from the definition of a pole.~~

Note 1 to entry: A switch is called "single pole" if it has only one pole. If it has more than one pole, it may be called "multipole" (two-pole, three-pole, etc.) provided that the poles are coupled in such a manner as to operate together.

[SOURCE: IEC 60050-441:1984, 441-15-01, modified — Pole of a switching device replaced by pole of a switch]

~~3.1.6~~
~~**clearance**~~
~~the shortest distance in air between two conductive parts~~

~~3.1.7~~
~~**creepage distance**~~
~~the shortest distance along the surface of the insulation material between two conductive parts~~

~~[IEV 151-03-37]~~

3.1.5
detachable part
part which is removable without the use of a tool when the switch is mounted as in normal use

3.1.6
tool
screwdriver, coin, or any other object which may be used to operate a nut, a screw or a similar part

~~3.1.10~~
~~**special purpose tool**~~
~~tool which is unlikely to be readily available in a normal household, for example, a key for a three-angle headed screw~~

~~NOTE Tools such as coins, screwdrivers and spanners designed to operate square or hexagonal nuts are not special purpose tools.~~

3.1.7
normal use
use of the switch for the purpose for which it was made and declared

~~3.1.12~~
~~**ambient air temperature**~~
~~the temperature or temperatures, determined under prescribed conditions, of the air surrounding the switch when mounted as declared by the manufacturer~~

~~3.1.13~~
~~**proof tracking index (PTI)**~~
~~the numerical value of the proof voltage in volts, at which a material withstands 50 drops of test solution without tracking~~

3.1.8
unique type reference
UT
identification marking on a switch such that by quoting it in full to the switch manufacturer ~~the electrical, mechanical, dimensional and functional parameters of the original switch can be unequivocally specified~~ a unique switch model can be identified

Note 1 to entry: This note applies to the French language only.

3.1.9
common type reference
CT
identification marking on a switch which does not require any further specific information additional to that provided by the marking requirements of this part of IEC 61058 for selection, installation and use in accordance with this part of IEC 61058

Note 1 to entry: This note applies to the French language only.

3.1.10
cover
cover plate
protective cover
~~part~~ cover made of insulating material, used to cover live parts in order to avoid accidental electric contact and which is accessible when the switch is mounted as in normal use but which can be removed with the aid of a tool

3.1.11
signal indicator
device associated with a switch to indicate the circuit state visually

Note 1 to entry: The device may or may not be controlled by the switch.

3.1.12
unprepared conductor
a conductor which has been cut and the insulation of which has been removed for insertion into a ~~clamping unit~~ terminal

~~NOTE A conductor the shape of which is arranged for introduction into a clamping unit or the strands of which are twisted to consolidate the end, is considered to be an unprepared conductor.~~

[SOURCE: IEC 60050-442:1998, 442-01-26]

3.1.13
prepared conductor
a conductor the ~~stripped~~ end of which is fitted with an attachment such as eyelet, ~~a terminal end,~~ sleeve or ~~a~~ cable lug~~, etc.~~

[SOURCE: IEC 60050-442:1998, 442-01-27]

~~**3.1.20**~~
~~**base material**~~
~~insulating material, supporting electronic circuits~~

~~**3.1.21**~~
~~**printed board**~~
~~a sized base material including holes, if any, and bearing at least one conductive pattern~~

~~**3.1.22**~~
~~**printed board assembly**~~
~~printed board with electrical and mechanical components and/or other printed boards attached to it, with all manufacturing processes, soldering, coating etc. completed~~

~~**3.1.23**~~
~~**insulation distance**~~
~~the shortest distance of a coated printed board between conductive parts located on the base material.~~
~~See figure Q.1.~~

3.1.14
polarity reversal
change of the polarity on the terminals connected to the load by a switching action

~~**3.1.25**~~
~~**semiconductor switching device**~~
~~a switching device designed to make, carry, break and/or control the current in an electric circuit by means of the controlled conductivity of a semiconductor~~

~~**3.1.26**~~
~~**electronic step-down convertor (convertor)**~~
~~unit inserted between the supply and one or more tungsten-halogen or other filament lamps which serves to supply the lamp(s) with its (their) rated voltage, generally at high frequency. The unit may consist of one or more separate components~~

3.1.15
semiconductor device
SD
device whose essential characteristics are due to the flow of charge carriers within a semiconductor

Note 1 to entry: Previous editions of IEC 61058-1 refer to a semiconductor device as a "semiconductor switching device or solid state device (SD)".

[SOURCE: IEC 60050-521:2002, 521-04-01]

3.1.16
semiconductor circuit
circuit containing multiple components, where at least one is a semiconductor device

3.1.17
electronic switch
~~a device capable of making, carrying, breaking and/or controlling currents under normal circuit conditions which may include specified operating overload conditions and also carrying for a specified time currents under specified abnormal circuit conditions such as those of a short circuit. The device contains actuating members, actuating means and switching devices which may be mechanical or electronic. At least one of these must be electronic~~
switch for appliances provided with a semiconductor device or a semiconductor circuit in its intended load path

Note 1 to entry: The electronic switch may be provided with series and/or parallel mechanical contacts. See examples in Table 15 in IEC 61058-1-2:2016.

3.1.18
duty
statement of the load~~(s)~~ to which the ~~electronic~~ switch is subjected, including, if applicable, making, controlling and breaking and including their durations and sequence in time
~~[IEV 411-21-07, modified]~~

3.1.19
duty-type
~~a~~ continuous, short-time or periodic duty comprising one or more loads remaining constant for the duration specified, or a non-periodic duty in which generally the load varies within the permissible operating range

[SOURCE: IEC 60050-411:1996, 411-51-13, modified – "speed" is deleted]

~~**3.1.30**~~
~~**cyclic duration factor**~~
~~the ratio between the period of loading, including making and breaking, and the duration of the duty cycle, expressed as a percentage~~
~~[IEV 411-21-10, modified]~~

3.1.20
protective impedance
~~an impedance connected between live parts and accessible conductive parts, of such value that the current, in normal use and under likely fault conditions in the electronic switch, is limited to a safe value; it is so constructed that the reliability is maintained throughout the life of the electronic switch~~

component or assembly of components whose impedance and construction are intended to limit steady-state touch current and electric charge to non-hazardous levels

~~NOTE Details of the likely fault conditions, the safe current and the requirements for reliability are as given in this IEC standard.~~

3.2 Terms and definitions relating to voltage~~s,~~ and current~~s and wattage~~

~~NOTE Where the terms "voltage" and "current" are used, they imply the r.m.s. values unless otherwise specified.~~

3.2.1
rated voltage~~, current, frequency, wattage etc.~~
voltage~~, current, frequency, wattage etc. assigned to a switch by the manufacturer and to which operation and performance characteristics are referred~~ assigned by the manufacturer for a specified operating condition

Note 1 to entry: It is measured in r.m.s. unless specifically indicated otherwise.

Note 2 to entry: This value is the maximum value and covers all lower values.

3.2.2
safety extra-low voltage
SELV
voltage which does not exceed 50 V AC r.m.s. or 120 V DC between conductors or between any conductor and earth in a circuit which is insulated from the supply mains

Note 1 to entry: SELV is an unearthed extra low voltage (see IEC ~~60364-4-41~~ 61140).

3.2.3
rated current
current assigned by the manufacturer for a specified operating condition

Note 1 to entry: It is measured in r.m.s. unless specifically indicated otherwise.

Note 2 to entry: This value is the maximum value and covers all lower values.

3.2.4
rated load
type of load assigned ~~to the switch~~ by the manufacturer, according to classifications

3.2.5
over-current
~~a~~ current exceeding the rated current

[SOURCE: IEC 60050-441:1984, 441-11-06]

3.2.6
overload
operating conditions in an electrically undamaged circuit, which cause an over-current

[SOURCE: IEC60050-441:1984, 441-11-08]

~~**3.2.5**~~
~~**short-circuit current**~~
~~an over-current resulting from a short circuit due to a fault or an incorrect connection in an electric circuit~~
~~[IEV 441-11-07]~~

3.2.7
working voltage
highest r.m.s. value of the AC or DC voltage across any particular insulation which can occur when the switch is supplied at rated voltage

Note 1 to entry: Transients are disregarded.

Note 2 to entry: Both open-circuit conditions and normal operating conditions are taken into account.

3.2.8
overvoltage
~~any~~ voltage having a peak value exceeding the corresponding peak value of maximum steady-state voltage at normal operating conditions

~~**3.2.8**~~
~~**recurring peak voltage (**~~$\cancel{U_{rp}}$~~**)**~~
~~maximum peak value of periodic excursions of the voltage waveform resulting from distortion of an a.c. voltage or from a.c. components superimposed on a d.c. voltage~~

~~NOTE Random overvoltages, for example due to occasional switching, are not considered to be recurring peak voltages.~~

~~**3.2.9**~~
~~**temporary overvoltage**~~
~~overvoltage at a power frequency of relatively long duration~~

~~**3.2.9.1**~~
~~**short-term temporary overvoltage**~~
~~temporary overvoltage with a duration not exceeding 5 s~~

~~NOTE The voltage values for short-term temporary overvoltage are higher than the voltage value for long-term temporary overvoltage (see 3.3.3.2.2 of IEC 60664-1).~~

~~**3.2.9.2**~~
~~**long-term temporary overvoltage**~~
~~temporary overvoltage with duration exceeding 5 s~~

3.2.9
overvoltage category
numeral defining a transient overvoltage condition

Note 1 to entry: ~~Overvoltage categories I, II and III are used (~~See annex E~~)~~.

3.2.10
impulse withstand voltage
highest peak value of impulse voltage of prescribed form and polarity which does not cause breakdown of insulation under specified conditions

3.2.11
minimum load
load at which when declared, the electronic switch still operates correctly

3.2.12
thermal current
continuous resistive current which, under the test conditions declared by the manufacturer (which may also include the ambient temperature), generates, without forced cooling, the same heating as when the electronic switch is operating under specified ambient conditions at rated load~~, and/or duty type~~ in the appliance with forced cooling present, if any

Note 1 to entry: The concept “thermal current” allows simplified testing of electronic switches, which in normal application have complex cooling conditions. The thermal current will always be determined by tests of the switch positioned on a table or in a simple test rig and comparative tests in the appliance in question. Consequently, the thermal current will normally be lower than the rated current. This necessitates additional tests of the terminals, contacts, etc., in order to verify that they will be able to carry the rated current, when the electronic switch is mounted in the appliance. These additional tests are specified in Clauses 16 and 17 in IEC 61058-1-1:2016 or IEC 61058-1-2:2016.

3.3 Terms and definitions relating to the different types of switches

3.3.1
incorporated switch
switch intended ~~to be incorporated~~ for incorporation in or ~~fixed to~~ on an appliance, which however can be tested separately

[SOURCE: IEC 60050-442:1998, 442-04-01]

3.3.2
integrated switch
switch, the function of which is depending on its correct mounting and fixing in an appliance, and which can be tested only in combination with the relevant parts of that appliance

[SOURCE: IEC 60050-442:1998, 442-04-02]

3.3.3
rotary switch
switch where the actuating member is a shaft or a spindle which has to be rotated to one or more indexed positions in order to achieve a change in contact state

Note 1 to entry: The rotation of the actuating member may be unlimited or restricted in either direction.

3.3.4
lever switch
switch where the actuating member is a lever which has to be moved (tilted) to one or more indexed positions in order to achieve a change in contact state

3.3.5
rocker switch
switch where the actuating member is a low profile lever (rocker) which has to be tilted to one or more indexed positions in order to achieve a change in contact state

3.3.6
push-button switch
switch where the actuating member is a button which has to be pushed in order to achieve a change in contact state

Note 1 to entry: The switch may be provided with one or more actuating members.

3.3.7
cord-operated switch
switch where the actuating member is a pull-cord which has to be pulled in order to achieve a change in contact state

[SOURCE: IEC 60050-442:1998, 442-04-08, modified — "operating means" changed to "actuating member"]

3.3.8
push-pull switch
switch where the actuating member is a rod which has to be pulled or pushed to one or more indexed positions in order to achieve a change in contact state

3.3.9
biased switch
switch where the contacts and actuating member return to a predetermined position when the actuating member is released from the actuated position

3.4 Terms and definitions relating to the operation of the switch

3.4.1
actuation
movement of the actuating member of the switch by hand, by foot, or by any other human activity

3.4.2
indirect actuation
movement of the actuating member of the switch ~~provided~~ indirectly by a part of an appliance into which the switch is incorporated or integrated

Note 1 to entry: For example, a switch can be incorporated or integrated in the door of an appliance.

3.4.3
actuating member
part which is pulled, pushed, turned or otherwise ~~moved~~ influenced to cause an operation

3.4.4
actuating means
~~any~~ part which may be interposed between the actuating member and the contact mechanism in order to achieve contact operation

3.4.5
disconnection
interruption of an electrical circuit in a pole so as to provide insulation between the supply and those parts intended to be disconnected from the supply

3.4.6
micro-disconnection
disconnection that provides correct functional performance by contact separation in the case of long-term temporary overvoltage

3.4.7
electronic-disconnection
disconnection that provides a non-cycling correct functional performance by a semiconductor ~~switching~~ device (SD) in the case of long-term temporary overvoltage

3.4.8
full-disconnection
disconnection that provides correct functional performance by contact separation in the case of short-term and long-term temporary overvoltage and impulse withstand voltage equivalent to basic insulation

3.4.9
all-pole disconnection single-phase
~~for single-phase a.c. appliances and for d.c. appliances, a disconnection of both supply conductors substantially at the same time by a single switching action or, for appliances to be connected to more than two supply conductors, a disconnection of all supply conductors, except the earthed conductor substantially at the same time by a single switching action~~
concurrent disconnection of all supply conductors, except the earthed conductor, by a single switching action for AC and DC appliances

~~**3.4.10**~~
~~**operation**~~
~~transfer of the moving contact(s) from one position to an adjacent position~~

3.4.10
operating cycle
succession of operations from one position to another and back to the first position through all other positions, if any

[SOURCE: IEC 60050-441:1984, 441-16-02]

3.4.11
electronic actuating member
part, component or component group which controls the actuating means or the switching device

Note 1 to entry: An optical or acoustic sensing unit is an example of a component group.

3.4.12
electronic actuating means
part, component or component group which controls electronically the switching device

3.4.13
abnormal conditions
conditions leading to reduced safety, which may occur in the appliance or in the switch during normal operation

Note 1 to entry: These conditions (e.g. rise in temperature, lack of protection against shock) may be the consequence of faults of the switch or related ambient conditions, which in case of defects or deteriorated operation of other components of the application are foreseeable. (Intended) misuse is not covered.

3.4.14
sensing unit
unit adjustable by other than mechanical means containing electronic components and controlling the output via electronic components or unit that is activated by any physical phenomenon or combination of ~~those~~ phenomena

3.4.15
fault conditions
abnormal conditions which are caused by a failure within the switch, which can be simulated by modifications of the switch

3.5 Terms and definitions relating to connections to the switch

3.5.1
external conductor
~~any cable, cord, core or conductor, a part of which is external to a switch, or to an appliance in or on which the switch is mounted. Such a conductor may be a supply lead or interconnecting cord between separate parts of an appliance or it may form part of the fixed wiring~~
cable, cord or conductor which is external to a switch

3.5.2
integrated conductor
conductor which is either inside a switch or is used to permanently interconnect terminals or terminations of a switch

~~3.5.3~~
~~**internal conductor**~~
~~any cable, cord, core or conductor which is internal to an appliance, but is neither an external conductor nor an integrated conductor~~

~~**3.5.4 Methods of attachment for cords**~~

~~3.5.4.1~~
~~**type X attachment**~~
~~method of attachment such that the cord can be replaced without the aid of special purpose tools by a cord not requiring special preparation~~

~~3.5.4.2~~
~~**type Y attachment**~~
~~method of attachment such that the cord can only be replaced with the aid of special purpose tools normally available to the manufacturer or his agent~~

~~NOTE Such a method of attachment may be used either with common cords or with special cords.~~

~~3.5.4.3~~
~~**type Z attachment**~~
~~method of attachment such that the cord cannot be replaced without destroying the integrity of the switch~~

3.6 Terms and definitions relating to terminals and terminations

3.6.1
terminal
conductive part of a switch, provided for ~~reusable electrical connections without the use of a special purpose tool or a special process~~ connecting the switch to one or more external conductors

3.6.2
screw type terminal
terminal for the connection and/or interconnection and subsequent disconnection of one or more conductors, the connection being made directly or indirectly by means of screws or nuts of any kind

Note 1 to entry: Examples of screw type terminals include those in Figures 1 through 5.

~~3.6.3~~
~~**pillar terminal**~~
~~screw-type terminal in which the conductor(s) is (are) inserted into a hole or cavity, where it is (they are) clamped under the shank of the screw. The clamping pressure may be applied directly by the shank of the screw, or through an intermediate clamping member to which pressure is applied by the shank of the screw~~

~~Examples of pillar terminals are shown in figure 1~~

3.6.3
screwless terminal
terminal for the connection and/or interconnection and subsequent disconnection of one or more conductors, the connection being made, directly or indirectly, by means other than screws

~~NOTE The following terminals are not regarded as screwless terminals:~~

- ~~terminals requiring fixing of special devices to the conductors before clamping them into the terminal, for example flat quick-connect terminations;~~
- ~~terminals requiring wrapping of the conductors, for example those with wrapped joints;~~

~~– terminals providing direct contact to the conductors by means of edges or points penetrating the insulation.~~

Note 1 to entry: Examples of screwless type terminals are shown in Figure 6.

Note 2 to entry: Push-in terminals, which are wire terminals that lock a stripped conductor when inserted in the terminal, are covered by the definition of screwless terminals.

~~3.6.4~~
~~screw terminal~~
~~screw-type terminal in which the conductor(s) is (are) clamped under the head of the screw. The clamping pressure may be applied directly by the head of the screw or through an intermediate part, such as a washer, clamping plate or anti-spread device~~

~~Examples of screw terminals are shown in figure 2~~

~~3.6.5~~
~~stud terminal~~
~~screw-type terminal in which the conductor(s) is (are) clamped under a nut. The clamping pressure may be applied directly by a suitably shaped nut or through an intermediate part, such as a washer, clamping plate or anti-spread device~~

~~Examples of stud terminals are shown in figure 2~~

~~3.6.6~~
~~saddle terminal~~
~~screw-type terminal in which the conductor(s) is (are) clamped under a saddle by means of two or more screws or nuts~~

~~Examples of saddle terminals are shown in figure 3~~

~~3.6.7~~
~~lug terminal~~
~~screw-type terminal designed for clamping a cable lug or bar directly or indirectly by means of a screw or nut~~

~~Examples of lug terminals are shown in figure 4~~

~~3.6.8~~
~~mantle terminal~~
~~screw-type terminal in which the conductor(s) is (are) clamped against the base of a slot in a threaded stud by means of a nut. The conductor is clamped against the bottom of the slot by a suitably shaped washer under the nut, by a central peg if the nut is a cap nut, or by equally effective means for transmitting the pressure from the nut to the conductor within the slot~~

~~Examples of mantle terminals are shown in figure 5~~

3.6.4
termination
~~connection between two or more conductive parts which can only be made or replaced by either a special purpose tool or a special process~~
arrangement provided for making the connections between the switch internal leads and the external conductors

3.6.5
flat quick-connect termination
electrical connection consisting of a male tab and a female connector which can be ~~readily~~ inserted and withdrawn with or without the use of a tool~~s~~

[SOURCE: IEC 60050-442:1998, 442-06-07]

3.6.6
tab
portion of a flat quick-connect termination which is inserted into the female connector and is a part integral with the switch

Note 1 to entry: Examples of tabs are shown in ~~figure 7~~ IEC 61210.

3.6.7
female connector
portion of a flat quick-connect termination which is pushed onto the tab

Note 1 to entry: An example of a female connector is shown in Figure 7.

3.6.8
solder terminal
conductive part of a switch provided to enable a termination to be made by means of solder

3.7 Terms and definitions relating to insulation

3.7.1
basic insulation
insulation applied to live parts to provide basic protection against electric shock

3.7.2
supplementary insulation
independent insulation applied in addition to the basic insulation in order to provide protection against electric shock in the event of a failure of the basic insulation

3.7.3
double insulation
insulation comprising both basic insulation and supplementary insulation

3.7.4
reinforced insulation
single insulation system applied to live parts which provides a degree of protection against electric shock equivalent to double insulation

Note 1 to entry: The term "insulation system" does not imply that the insulation ~~must be~~ is one homogeneous piece. It may ~~comprise~~ consist of several layers which cannot be tested separately as supplementary or basic insulation.

3.7.5
functional insulation
insulation between live parts which is necessary only for the proper functioning of the switch

3.7.6
coating
solid insulating material laid on one or both sides of the surface of the printed board

Note 1 to entry: Coating can be varnish, a dry film applied to the printed board or can be achieved by thermal deposition.

Note 2 to entry: Coating and base material of the printed board form an insulating system that may have properties similar to solid insulation.

3.7.7
solid insulation
insulation material interposed between two conductive parts

Note 1 to entry: In the case of a printed board assembly with a coating, solid insulation consists of the printed board itself as well as the coating. In other cases, solid insulation consists of the encapsulating material.

3.7.8
class 0 appliance
appliance in which protection against electric shock relies upon basic insulation, which implies that there are no means for the connection of accessible conductive parts, if any, to the protective conductor in the fixed wiring of the installation, reliance in the event of a failure of the basic insulation being placed upon the environment

3.7.9
class I appliance
appliance in which protection against electric shock does not rely on basic insulation only, but which includes an additional safety precaution in such a way that means are provided for the connection of conductive parts (which are not live parts) to the protective (earthing) conductor in the fixed wiring in such a way that these parts cannot become live in the event of a failure of the basic insulation

3.7.10
class II appliance
appliance in which protection against electric shock does not rely on basic insulation only, but in which additional safety precautions such as double insulation or reinforced insulation are provided, there being no provision for protective earthing or reliance upon installation conditions

Note 1 to entry: A class II appliance may be provided with means for maintaining the continuity of protective circuits, provided that such means are within the appliance and are insulated from accessible surfaces according to the requirements of class II.

3.7.11
class III appliance
appliance in which protection against electric shock relies on supply at SELV and in which voltages higher than those of SELV are not generated

3.7.12
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

[SOURCE: IEC 60050-212: 2010,212-11-59]

3.8 Terms and definitions relating to pollution

3.8.1
pollution
~~any~~ addition of solid, liquid, or gaseous foreign matter that can result in a reduction of dielectric strength or surface resistivity of the insulation

3.8.2
micro-environment
immediate environment of the insulation which particularly influences the dimensioning of creepage distances

Note 1 to entry: For self-produced pollution in arc chambers of switches, see Annex F.

3.8.3
macro-environment
environment of the room or other location in which the switch is installed or used

3.8.4
pollution degree
numeral characterizing the expected pollution of the micro-environment

Note 1 to entry: Pollution degree 1, 2 and 3 are used (see 7.8, 7.9 and Annex F).

3.9 Terms and definitions relating to manufacturers' tests

3.9.1
routine test
test to which each individual switch for appliances is subjected during and/or after manufacture to ascertain whether it complies with the relevant requirements of this part of IEC 61058 (see Annex K).

3.9.2
sampling test
test on a number of switches taken at random from a batch

Note 1 to entry: Sampling tests are specified in Annex L.

[SOURCE: IEC 60050-811:1991, 811-10-06, modified — "devices" replaced by "switches"]

3.9.3
type test
test of one or more switches made to a certain design to show that the design meets certain specifications

[SOURCE: IEC 60050-811:1991, 811-10-04, modified — "devices" replaced by "switches"]

4 General requirements

Switches shall be designed and constructed so that in normal use they function safely so as to cause no danger to persons or surroundings even in the event of such careless use as may occur in normal use, as specified in the IEC 61058-1 series ~~and any appropriate part 2~~.

~~In general,~~ Compliance is checked by carrying out all the relevant tests.

5 General ~~notes~~ information on tests

5.1 Testing shall be performed according to the general guideline information provided in Clause 5

~~**5.1** *Tests according to this standard are type tests.*~~

5.1.1 *In general, the test conditions for higher ratings of a switch may represent test conditions for lower ratings. See 5.2.*

5.1.2 *In all tests, the measuring instruments or the measuring means shall be such as not to affect appreciably the quantity being measured.*

5.1.3 *If only one of the specimen does not satisfy the requirements of a test in Clauses 14, 15, 16 and 17 (Clause 17 in IEC 61058-1-1:2016 or IEC 61058-1-2:2016), that test and any preceding which may have influenced the results of the test shall be repeated and also the tests which follow shall be carried out in the required sequence with new specimens, all of which shall comply with the requirements.*

5.1.4 *Unless otherwise specified in this standard, the specimens are tested as delivered, at an ambient temperature of 25 °C ± 10 °C.*

5.1.5 *The specimens are mounted as declared by the manufacturer, but, if significant, using the most unfavourable method if more than one method is declared.*

~~NOTE In case of doubt, the tests are made at an ambient temperature of 20 °C ± 5 °C.~~

5.1.6 *For the tests of this standard, actuation may be performed by test equipment. Actuation may be applied to either the actuating member or the actuating means. A switch is not required to provide the actuating member if it is declared to be detachable.*

5.1.7 *Switches to be used with a non-detachable conductor are tested with the appropriate conductor connected.*

5.1.8 *If the switches are provided with tabs, for the tests according to Clauses 16 (in IEC 61058-1) and 17 (in IEC 61058-1-1:2016 or IEC 61058-1-2:2016), new female connectors shall be used. The female connectors shall be of a type suitable for the rated ambient temperature of the switch, and the crimped conductors shall be soldered or welded to the crimping area of the female connector, if any.*

~~*The envelope dimensions of female connectors for flat quick-connect terminations used for tests shall be in accordance with figure 8.*~~

~~NOTE A method of selection of female test connectors for flat quick-connect terminations is given in annex H.~~

5.1.9 *If it is necessary to have parts with double insulation or reinforced insulation in switches for class 0 or class I appliances, such parts are checked for compliance with the requirements specified for switches for class II appliances. Similarly if it is necessary to have parts in switches operating at SELV, such parts are also checked for compliance with the requirements specified for switches for class III appliances.*

~~**5.5** *Unless otherwise specified the tests are carried out in the order of the clauses of this standard.*~~

~~*The number of test specimens required and the relevant clauses are as follows.*~~

~~NOTE A survey of test specimens and related clauses is given in table 1.~~

~~**5.5.1** *Switches with the following ratings:*~~

- ~~*d.c. only;*~~
- ~~*both a.c. and d.c.,*~~

~~*the tests being carried out on d.c., provided that the d.c. voltage and current ratings are equal to, or greater than, the a.c. ratings.*~~

~~*For these ratings, the following specimens are used:*~~

- ~~*clauses 6 to 12 and 23: specimen No. 1;*~~
- ~~*clauses 19 to 22: specimen No. 2; where clearances according to 20.1 are tested in accordance with annex M, three additional specimens are used;*~~
- ~~*clauses 13 to 18:*~~
  - ~~*with polarity marking: specimens Nos. 3 to 5;*~~
  - ~~*without polarity marking: specimens Nos. 3 to 5 with one polarity and specimens Nos. 6 to 8 with the opposite polarity;*~~
- ~~*clause 25: three additional specimens.*~~

~~**5.5.2** *Switches with the following ratings:*~~

- ~~*a.c. only;*~~
- ~~*both a.c. and d.c., but not meeting the provisions of 5.5.1.*~~

~~*For these ratings, the following specimens are used:*~~

~~– clauses 6 to 12 and 23: specimen No. 1;~~

~~– clauses 19 to 22: specimen No. 2; where clearances according to 20.1 are tested in accordance with annex M, three additional specimens are used;~~

~~– clauses 13 to 18:~~

- ~~for a.c. rating: specimens Nos. 3 to 5;~~
- ~~for d.c. rating with marked polarity: specimens Nos. 6 to 8;~~
- ~~for d.c. rating without marked polarity: specimens Nos. 6 to 8 with one polarity and specimens Nos. 9 to 11 with the opposite polarity;~~

~~– clause 25: three additional specimens.~~

~~**5.5.3** *Switches with more than one rated voltage and/or rated current combination within one nature of supply*~~

~~*For these ratings, the following specimens are used:*~~

~~– clauses 6 to 12 and 23: specimen No. 1;~~

~~– clauses 19 to 22: specimen No. 2; where clearances according to 20.1 are tested in accordance with annex M, three additional specimens are used;~~

~~– clauses 13 to 18:~~

- ~~for the combination with the highest current rating: specimens Nos. 3 to 5;~~
- ~~for the second combination: specimens Nos. 6 to 8;~~
- ~~for further combinations: specimens Nos. 9 to 11, etc.~~

~~NOTE For switches having one rated current for more than one voltage rating, the switch shall be tested at the highest voltage rating for each type of load.~~

~~– clause 25: three additional specimens.~~

~~**Table 1 – Test specimens**~~

~~Clause~~		~~Specimens to be tested 1)~~	~~Notes~~
~~6~~	~~Rating~~	~~1~~	
~~7~~	~~Classification~~	~~1~~	
~~8~~	~~Marking and documentation~~	~~1~~	
~~9~~	~~Protection against electric shock~~	~~1~~	
~~10~~	~~Provision for earthing~~	~~1~~	
~~11~~	~~Terminals and terminations~~	~~1~~	~~2)~~
~~12~~	~~Construction~~	~~1~~	
~~13~~	~~Mechanism~~	~~3 4 5 6 7 8~~	~~3)~~
~~14~~	~~Protection against solid foreign objects, ingress of dust, water and humid conditions~~	~~3 4 5 6 7 8~~	~~3)~~
~~15~~	~~Insulation resistance and dielectric strength~~	~~3 4 5 6 7 8~~	~~2) 3)~~
~~16~~	~~Heating~~	~~3 4 5 6 7 8~~	
~~17~~	~~Endurance~~	~~3 4 5 6 7 8~~	~~3)~~
~~18~~	~~Mechanical strength~~	~~3 4 5~~	
~~19~~	~~Screws, current-carrying parts and connections~~	~~2~~	
~~20~~	~~Clearances, creepage distances solid, insulation and coatings of rigid printed board assemblies~~	~~2~~	~~4) 5)~~
~~21~~	~~Resistance to heat and fire~~	~~2~~	
~~22~~	~~Resistance to rusting~~	~~2~~	
~~23~~	~~Abnormal operation and fault conditions for electronic switches~~	~~1~~	

~~25~~	~~EMC requirements~~	~~three additional samples~~	

~~1) For the purpose of selection of female test connectors according to annex H, additional specimens may be necessary.~~

~~2) Three additional new specimens may be required according to 11.1.1.3.4 or table 12, note 2).~~

~~3) The further specimens 9 to 11, etc., are tested in the same combination of clauses as specimens 6 to 8.~~

~~4) Three additional new specimens may be required according to 20.1 for the test according to annex M.~~

~~5) For testing coatings on printed boards according to 20.4, the following number of printed boards are needed:~~

~~– 13 specimens for type A coating;~~

~~– 17 specimens for type B coating.~~

~~**5.6** *Switches with a rated frequency are tested at that frequency. Switches without a rated frequency are tested at 50 Hz. Switches with a rated frequency range are tested at the most unfavourable frequency within that range.*~~

~~**5.7** *If not more than one specimen fails during the tests of clauses 13 to 18 inclusive such as to cause non-compliance with the appropriate clause, the tests which caused the failure, and those preceding, which may have influenced the result of that test, are repeated on another set of identical specimens, all of which shall then comply with the repeated tests. No failure shall occur during the tests of clauses 6 to 12 inclusive and 19 to 22 inclusive.*~~

~~NOTE The applicant may submit, together with the first set of specimens, an additional set of specimens which may be needed in case one specimen fails.~~

~~The testing authorities will then, without further request, test the additional specimens and will only reject if a further failure occurs.~~

~~If the additional set of specimens is not submitted at the same time, a failure of one specimen will entail a rejection.~~

~~**5.8** *If it is necessary to have parts with double insulation or reinforced insulation in switches for Class 0 or Class I appliances, such parts are checked for compliance with the requirements specified for switches for Class II appliances.*~~

~~*Similarly, if it is necessary to have parts in switches operating at SELV, such parts are also checked for compliance with the requirements specified for switches for Class III appliances.*~~

~~**5.9** *For the tests of this standard, actuation may be performed by test equipment. Tests at high speed, however, have to be performed according to 17.2.4.*~~

~~*For switches with electronic actuating members, actuation shall be performed according to the manufacturer's declarations.*~~

~~**5.10** *As far as possible, signal indicators shall be tested together with the switches.*~~

~~*With the exception of the luminosity which can be disregarded, the lamp shall function unless otherwise specified. The test may be performed with test samples simulating the electrical, mechanical and thermal influences of the original indicator lamp. Replaceable indicator lamps may be replaced during the tests. Signal indicators, the function of which is independent from the function of the switch, are operated continuously.*~~

~~*The results of the tests for switches with indicator lamps shall be considered to apply to switches of equivalent construction without indicator lamps, or to indicator lamps of equivalent construction without the switching mechanism.*~~

~~**5.11** *Switches intended to be operated from a specific supply, are tested with that specific supply.*~~

~~**5.12** *In all tests, the measuring instruments or the measuring means shall be such as not to affect appreciably the quantity being measured.*~~

~~**5.13** *For electronic switches, it may be necessary to disconnect or short-circuit electronic components for the purpose of the tests.*~~

~~**5.14** *For the tests of 23.1.1.1, additional specimens may be necessary.*~~

5.2 Electrical information

5.2.1 *When more than one rating is combined or represented by testing as described below, the following applies to all testing.*

Dielectric strength test (Clause 15 and TE3) – based on the highest voltage.

Heating/temperature rise (Clause 16 and TE2) – based on the highest current rating.

5.2.2 *Representative endurance testing for the same classified load type (see 7.2) is allowed according to the following conditions:*

a) *Voltage – testing required for ratings at a higher voltage represents testing required for ratings at a lower voltage.*

NOTE For example 5 A, 125 V AC and 5 A, 250 V AC is tested as 5 A, 250V AC.

b) *Current – testing at a higher current represent testing at a lower current.*

NOTE For example 10 A, 250 V AC and 5 A, 250 V AC is tested as 10 A, 250 V AC.

5.2.3 *Switches with 2 or more ratings are endurance tested for each rating on an additional 3 specimens unless permitted to use representative testing.*

5.2.4 *DC polarity rated switches without polarity markings are endurance tested with 3 specimens with one polarity and an additional 3 specimens with the opposite polarity.*

5.2.5 *DC and AC rated switches are endurance tested with DC voltage to represent AC if the DC voltage and current ratings for the classified load type (see 7.2) are equal to or greater than the AC ratings.*

NOTE For example AC and DC rating 4 A 48 V AC as well as 4 A 48 V DC are endurance tested 4 A 48 V DC.

5.2.6 *AC only rated switches for each type of load with 2 or more current ratings, rated nominal 100 – 480 V AC, at the same power, are tested at the highest voltage.*

NOTE *For example AC rating 10 A 125 V AC as well as 5 A 250 V AC as well as 4,5 A 277 V AC are tested at 4,5 A 277 V AC.*

5.2.7 *AC only rated switches for each type of load, with 2 or more current ratings, rated nominal 20 up to 100 V AC, at the same power, are endurance tested at the highest current.*

NOTE *For example AC rating 10 A 24 V AC / 5 A 48 V AC is endurance tested at 10 A 24 V AC.*

5.2.8 *Switches with a rated frequency are endurance tested at that frequency. Switches without a rated frequency are tested at 50 Hz. Switches with a rated frequency range are tested at the most unfavourable frequency within that range.*

NOTE For example a switch classified as 50 Hz to 60 Hz is tested at 50 Hz.

5.2.9 *Switches intended to be operated from a specific supply, are tested with that specific supply.*

5.3 Test loads on multiway switches

Multiway switches are loaded according to Table 1. The load for the other switch positions is that resulting from the loads necessary to achieve the conditions specified above.

Table 1 – Test loads for multiway switches

Operating cycles	Switch position of	Load
First half	Highest load	I_R
	Next lower load	$0{,}8 \times I_R$
	Further next lower load	$0{,}533 \times I_R$
Second half	Highest load	I_R
	Next lower load	$0{,}5 \times I_R$
	Further next lower load	$0{,}333 \times I_R$

5.4 Test specimens

The minimum number of test specimens shall be according to IEC 61058-1-1 or IEC 61058-1-2. Unless otherwise stated testing may be carried out in any order.

6 Rating

6.1 The maximum rated voltage is ~~440~~ 480 V.

~~NOTE Preferred values are 50 V, 125 V, 230 V, 250 V, 400 V, 440 V.~~

6.2 The maximum rated current is 63 A.

6.3 Switches with signal indicators may have different rated voltages for the signal indicators.

Compliance with 6.1 to 6.3 is checked by inspection ~~of marking and documentation~~ in conjunction with Clause 8.

~~NOTE Preferred values are 1 A, 2 A, 4 A, 6 A, 10 A, 16 A, 20 A, 25 A, 40 A and 63 A.~~

6.4 A switch having more than one circuit needs not have the same classification for each circuit. Annex D may be used for determining whether a particular switch rating is suitable for controlling the circuit in the actual application.

7 Classification

~~7.1 Classification of switches~~

7.1 According to nature of supply

7.1.1 switches for AC only

7.1.2 switches for DC only;

7.1.3 switches for both AC and DC

7.2 According to type of load to be controlled by each circuit of the switch

~~NOTE 1 A switch having more than one circuit need not have the same classification for each circuit.~~

~~NOTE 2 Annex F, may be used for determining whether a particular switch rating is suitable for controlling the circuit in the actual application.~~

7.2.1 circuit for a substantially resistive load with a power factor not less than 0,9;

7.2.2 circuit for either a resistive load, a motor load with a power factor not less than 0,6, or a combination of both;

7.2.3 circuit for a combination of resistive and capacitive ~~a.c.~~ loads;

7.2.4 circuit for ordinary tungsten filament lamp load;

7.2.5 circuit for a declared specific load;

7.2.6 circuit for a current not exceeding 20 mA.

7.2.7 circuit for specific lamp load;

7.2.8 circuit for an inductive load with a power factor of not less than 0,6;

7.2.9 circuit for specific load of motor with a locked rotor and with a power factor not less than 0,6.

~~**7.1.2.10** – minimum load for electronic switches.~~

7.2.10 general purpose load with a power factor of not less than 0,75;

7.3 According to ambient temperature

~~**7.1.3.1** – switches at which the complete switch, including the actuating member, is intended to be used in an ambient temperature between a minimum value of 0 °C and a maximum value of 55 °C;~~

~~**7.1.3.2** – switches at which the complete switch, including the actuating member, is intended to be used in an ambient temperature higher than 55 °C or lower than 0 °C, or both;~~

~~**7.1.3.3** – switches intended to be used with the actuating member and other accessible parts in an ambient temperature between 0 °C and 55 °C, and the remainder of the switch in an ambient temperature higher than 55 °C:~~

- ~~preferred values of maximum ambient temperature are 85 °C, 100 °C, 125 °C and 150 °C;~~
- ~~preferred values of minimum ambient air temperature are –10 °C, –25 °C and –40 °C;~~
- ~~values differing from these preferred values are allowed, as long as the values are multiples of 5 °C.~~

~~**7.1.3.4** Electronic cord switches and electronic independently mounted switches are classified for a maximum ambient temperature of 35 °C.~~

~~NOTE The classification using the ambient air temperature 35 °C may also be used for other electronic switches under the provision that they are properly marked according to No. 3.2 in table 3.~~

~~**7.1.3.4.1** – electronic cord switches and electronic independently mounted switches, in which the complete switch, including the actuating member, is intended to be used in an ambient air temperature between a minimum value of 0 °C and a maximum value of 35 °C.~~

~~NOTE The decrease of ambient temperature from 55 °C to 35 °C is caused by the fact that components of electronic switches have a larger heat dissipation than components of mechanical switches.~~

~~**7.1.3.4.2** – electronic cord switches and electronic independently mounted switches, in which the complete switch including the actuating member is intended to be used in an ambient air temperature higher than 35 °C, or a minimum value lower than 0 °C, or both:~~

- ~~preferred values of maximum ambient air temperature are 55 °C, 85 °C, 100 °C and 125 °C;~~
- ~~preferred values of minimum ambient air temperature are –10 °C, – 25 °C and – 40 °C;~~
- ~~values differing from these preferred values are allowed, as long as the values are multiples of 5 °C.~~

7.3.1 Switches with all parts intended to be used 0 °C ≤ T ≤ 55 °C.

7.3.2 Switches not classified as 7.3.1 and 7.3.3.

7.3.3 Switches with accessible parts in one ambient temperature and non-accessible parts in a different ambient temperature according to

- accessible member and parts 0 °C ≤ T ≤ 55 °C, and
- other parts of the switch not classified to the range of 0 °C ≤ T ≤ 55 °C.

7.4 According to number of operating cycles

7.4.1 100 000 operating cycles;

7.4.2 50 000 operating cycles;

7.4.3 25 000 operating cycles;

7.4.4 10 000 operating cycles;

7.4.5 6 000 operating cycles;

7.4.6 3 000 operating cycles;

7.4.7 1 000 operating cycles;

7.4.8 300 operating cycles.

7.4.9 Operating cycles – as declared for a specific application.

~~**7.1.5 According to degree of protection provided by the switch, when mounted as declared, as part of an appliance enclosure**~~

7.5 Degree of protection against solid foreign objects ~~(according to IEC 60529)~~

NOTE Determined according to IEC 60529 with the switch mounted as declared.

7.5.1 if no declaration, the switch is non-protected against solid foreign objects (IP0X);

7.5.2 protected against solid foreign objects of 50 mm diameter and greater (IP1X);

7.5.3 protected against solid foreign objects of 12,5 mm diameter and greater (IP2X);

7.5.4 protected against solid foreign objects of 2,5 mm diameter and greater (IP3X);

7.5.5 protected against solid foreign objects of 1,0 mm diameter and greater (IP4X);

7.5.6 dust-protected (IP5X);

7.5.7 dust-tight (IP6X).

7.6 Degree of protection against ingress of water ~~(according to IEC 60529)~~

NOTE Determined according to IEC 60529 with the switch mounted as declared.

7.6.1 if no declaration, the switch is non-protected against ingress of water (IPX0);

7.6.2 protected against vertically falling water drops (IPX1);

7.6.3 protected against vertically falling water drops when enclosure tilted up to 15° (IPX2);

7.6.4 protected against spraying water (IPX3);

7.6.5 protected against splashing water (IPX4);

7.6.6 protected against water jets (IPX5);

7.6.7 protected against powerful water jets (IPX6);

7.6.8 protected against the effects of temporary immersion in water up to 1 m (IPX7).

7.6.9 protected against the effects of immersion in water greater than 1 m (IPX8).

7.6.10 protected against the effects of high pressure water (IPX9).

7.7 According to degree of protection against electric shock for an incorporated switch for use in

7.7.1 a class 0 appliance;

7.7.2 a class I appliance;

7.7.3 a class II appliance;

7.7.4 a class III appliance.

~~NOTE Switches for use in Class II appliances may be used without additional protection in all other appliances, independently of class.~~

NOTE Explanations of classes are given in 3.7.8, 3.7.9, 3.7.10 and 3.7.11.

7.8 According to degree of pollution inside the switch

7.8.1 Micro-environment pollution degree 1

7.8.2 Micro-environment pollution degree 2

7.8.3 Micro-environment pollution degree 3

~~NOTE 1 Details for the pollution degrees are specified in annex L.~~

~~NOTE 2 A switch suitable for use in a particular situation may be used in a less polluted situation.~~

~~NOTE 3 A switch may be used in a more polluted situation than that for which it is designed if the appropriate additional protection is applied by the appliance.~~

7.9 According to degree of pollution outside the switch

7.9.1 Macro-environment pollution degree 1

7.9.2 Macro-environment pollution degree 2

7.9.3 Macro-environment pollution degree 3

NOTE Details for the micro and macro pollution degrees are specified in 3.8 and Annex F.

~~**7.1.7 According to the method of actuating the switch:**~~

~~NOTE This classification is not restrictive. Push-button switches may have more than one push button.~~

~~**7.1.7.1** – rotary switch;~~

~~**7.1.7.2** – lever switch;~~

~~**7.1.7.3** – rocker switch;~~

~~**7.1.7.4** – push-button switch;~~

~~**7.1.7.5** – cord-operated switch;~~

~~**7.1.7.6** – push-pull switch;~~

~~**7.1.7.7** – electronic switches operated via a sensing unit (for example touching, approaching, turning, optical, acoustic, thermal or any other influences).~~

7.10 According to marking

7.10.1 Switch with limited marking UT (unique type reference, UT);

7.10.2 Switch with full marking CT (common type reference, CT).

NOTE Explanations of type references are given in 3.1.8 and 3.1.9.

~~**7.1.9 According to application level for resistance to heat and fire:**~~

~~**7.1.9.1** – level 1 switch;~~

~~**7.1.9.2** – level 2 switch;~~

~~**7.1.9.3** – level 3 switch.~~

~~NOTE For guidance concerning the levels, see clause 21.~~

7.11 According to resistance to ignitability by the glow wire temperature

7.11.1 650 °C;

7.11.2 750 °C;

7.11.3 850 °C;

7.11.4 960 °C.

The resistance to abnormal heat for the switch represents the lowest glow wire temperature of the materials of parts which are in contact with, maintain or retain in position electrical connections including those parts which maintain an electrical connection under spring force.

7.12 According to the rated impulse withstand voltage

7.12.1 330 V;

7.12.2 500 V;

7.12.3 800 V;

7.12.4 1 500 V;

7.12.5 2 500 V;

7.12.6 4 000 V.

NOTE The relation between rated impulse withstand voltage, rated voltage and overvoltage category is given in Annex E.

7.13 According to the rated overvoltage category

7.13.1 Category I

7.13.2 Category II

7.13.3 Category III

NOTE The relation between rated impulse withstand voltage, rated voltage and overvoltage category is given in Annex E.

7.14 According to type of disconnection

7.14.1 electronic disconnection;

7.14.2 micro disconnection;

7.14.3 full disconnection.

7.14.4 switches with a combination of disconnections shall be declared specifically depending on their construction.

NOTE Explanations of disconnections are given in 3.4.6, 3.4.7 and 3.4.8.

7.15 According to the type of coating for rigid printed board assemblies

7.15.1 type 1 coating;

7.15.2 type 2 coating.

NOTE Explanations for type 1 and type 2 coating are given in Annex I.

7.16 According to type and/or connection of switches

~~Details for types of switches and connections are specified in table 2.~~

~~**7.1.13.1 One-way switches:**~~

~~**7.1.13.1.1** – declared specific type and/or connection;~~

~~**7.1.13.1.2** – single pole, single load (single-pole disconnection);~~

~~**7.1.13.1.3** – double pole, single load (all-pole disconnection);~~

~~**7.1.13.1.4** – double pole, double load (single-pole disconnection);~~

~~**7.1.13.1.5** – double pole, double load (single-pole disconnection, load connected to opposite polarity);~~

~~**7.1.13.1.6** – three pole, three loads, unswitched neutral (three-pole disconnection);~~

~~**7.1.13.1.7** – four-pole, three-load switched neutral (four-pole disconnection);~~

~~**7.1.13.1.8** – three pole, three load (three-pole disconnection).~~

~~**7.1.13.2 Two-way switches:**~~

~~**7.1.13.2.1** – declared specific type and/or connection;~~

~~**7.1.13.2.2** – single pole, single load (single-pole disconnection);~~

~~**7.1.13.2.3** – single pole, double load (single-pole disconnection, for specific circuits and loads only);~~

~~**7.1.13.2.4** – double pole, single load (all-pole disconnection);~~

~~**7.1.13.2.5** – double pole, double load (all-pole disconnection, for specific circuits and loads only);~~

~~**7.1.13.2.6** – double pole, single load with polarity reversal;~~

~~**7.1.13.2.7** – double pole, four load (single-pole disconnection, load connected to opposite polarity, for specific circuits and loads only);~~

~~**7.1.13.2.8** – double pole, double load (single-pole disconnection, load connected to opposite polarity);~~

~~**7.1.13.2.9** – double pole, four load (single-pole disconnection for specific circuits and loads only).~~

~~**7.1.13.3 Two-way switches with centre position for disconnection:**~~

~~**7.1.13.3.1** – declared specific type and/or connection;~~

~~**7.1.13.3.2** – single pole, single load (single-pole disconnection);~~

~~**7.1.13.3.3** – single pole, double load (single-pole disconnection);~~

~~**7.1.13.3.4** – double pole, single load (all-pole disconnection);~~

~~**7.1.13.3.5** – double pole, double load (all-pole disconnection);~~

~~**7.1.13.3.6** – double pole, single load with polarity reversal (all-pole disconnection);~~

~~**7.1.13.3.7** – double pole, four load (single-pole disconnection, load connected to opposite polarity);~~

~~**7.1.13.3.8** – double pole, double load (single-pole disconnection, load connected to opposite polarity);~~

~~**7.1.13.3.9** – double pole, four load (single-pole disconnection).~~

~~**7.1.13.4 Multiway switches:**~~

~~**7.1.13.4.1** – the number of poles, type of connection and load as declared;~~

~~**7.1.13.4.2** – single pole, four positions with polarity reversal (single-pole disconnection, for resistive load according to 7.1.2.1);~~

~~**7.1.13.4.3** – double pole, four positions with polarity reversal (all-pole disconnection, for resistive load according to 7.1.2.1);~~

~~**7.1.13.4.4** – double pole, five positions with polarity reversal (all-pole disconnection, for resistive load according to 7.1.2.1);~~

~~**7.1.13.4.5** – double pole, seven positions with polarity reversal (all-pole disconnection, for resistive load according to 7.1.2.1).~~

~~NOTE Switches classified in 7.1.13.4.2 to 7.1.13.4.5 are designed for the step-wise increase or decrease of the resulting wattage of a combination of resistors (R_1 to R_3) according to table 2.~~

7.16.1 number of poles

7.16.2 number of ways

7.16.3 polarity reversal

7.16.4 all-pole disconnection

7.16.5 number of non-switchable through connections

7.16.6 according to code of switch type given in Table 2

NOTE Details for types of switches and connections are specified in Table 2.

~~**7.1.14 According to switching device for electronic switches:**~~

~~**7.1.14.1** – with semiconductor switching device;~~

~~**7.1.14.2** – with mechanical switching device.~~

7.17 According to configuration of switching device

7.17.1 electronic switch with SD without mechanical switching device;

7.17.2 electronic switch with SD with series mechanical switching device;

7.17.3 electronic switch with SD with parallel mechanical switching device;

7.17.4 electronic switch with SD with series and parallel mechanical switching device;

7.17.5 electronic switch with only mechanical switching device without SD. SD to be provided in the end application;

7.17.6 mechanical switch with or without electronics, which does not impact the safety of the switch;

7.17.7 mechanical switch with electronics, which impacts the safety of the switch.

7.18 According to duty type ~~for electronic switches~~

7.18.1 continuous duty – Duty type S1 (see Figure 12);

7.18.2 short-time duty – Duty type S2 with defined ON and OFF times (see Figure 13);

7.18.3 intermittent periodic duty – Duty type S3 with defined ON and OFF times (see Figure 14).

~~NOTE 1 The different types of duty-type are illustrated in figures 14 to 16.~~

7.18.4 as declared for a specific application.

NOTE The concept duty-type is taken from IEC 60034-1.

~~**7.1.17 According to test conditions for electronic switches:**~~

~~**7.1.17.1** – functional test conditions with thermal current or maximum rated resistive current;~~

~~NOTE This test condition reflects the proper functioning of the switch. This test does not simulate the actual load of the end application.~~

~~**7.1.17.2** – simulated test conditions with type of load as classified in 7.1.2;~~

~~NOTE This test condition reflects the proper functioning of the switch. It also simulates all conditions of the end application.~~

~~**7.1.17.3** – specific test conditions of end application, i.e. in or together with the appliance and under the cooling conditions of the appliance;~~

~~**7.1.17.4** – test conditions according to duty-type.~~

7.19 According to linkage between contact and actuator speed

7.19.1 Speed of contact closure or opening is dependent on the actuator speed.

7.19.2 Speed of contact closure and opening is independent of the actuator speed.

7.20 ~~Classification~~ According to the type of terminals

7.20.1 Terminals intended for the connection of unprepared conductors ~~and not requiring the use of any special purpose tool~~;

7.20.2 Terminals intended for the connection of prepared conductors ~~and/or requiring the use of a special purpose tool~~;

NOTE Twisting of a stranded conductor to consolidate the end is not considered as special preparation.

~~**7.2.3** – terminals suitable for the connection of supply cables or cords with unprepared conductors and not requiring the use of any special purpose tool;~~

~~**7.2.4** – terminals suitable for the connection of supply cables or cords with prepared conductors and/or requiring the use of a special purpose tool;~~

~~**7.2.5** terminals suitable for the interconnection of two or more conductors;~~

~~**7.2.6** – terminals intended for the connection of rigid, solid conductors;~~

~~**7.2.7** – terminals intended for the connection of rigid, solid and stranded conductors;~~

~~**7.2.8** – terminals intended for the connection of flexible conductors;~~

~~**7.2.9** – terminals suitable for the connection of both flexible and rigid (solid and stranded) conductors;~~

~~**7.2.10** – solder terminals intended for soldering by hand with a soldering iron;~~

~~**7.2.11** – solder terminals intended for soldering with a solder bath;~~

~~**7.2.12** – solder terminals with provisions for securing the conductor by mechanical means and providing circuit continuity by soldering;~~

~~**7.2.13** – solder terminals without provisions for securing the conductor by mechanical means. The circuit continuity is ensured by soldering solely.~~

7.20.3 Terminals intended for the connection of flexible stranded conductors;

7.20.4 Terminals intended for the connection of rigid stranded conductors;

7.20.5 Terminals intended for the connection of solid conductors,

7.20.6 Terminals intended for conductor size range according to Table 4;

7.20.7 Terminals intended for a declared limited conductor size range;

7.20.8 Terminals intended for the connection of only one conductor;

7.20.9 Terminals intended for the interconnection of two or more conductors;

7.20.10 Terminals intended for assembling one time.

7.20.11 Terminals intended for assembling and disassembling more than one time.

NOTE A push-in terminal intended for only one insertion (no disconnection means) is considered to be intended for assembling one time. A push-in terminal with a disconnect means or screw terminal is considered to be intended for assembling and disassembling more than one time.

7.20.12 Screw terminals and connections;

7.20.13 Push-in terminals and connections;

7.20.14 Flat quick-connect termination;

NOTE Standard termination dimensions are found in IEC 61210.

7.20.15 Solder terminals

7.20.16 Welding or ridged terminals

7.20.17 Wires for connections;

7.20.18 Terminals for piercing conductors

7.20.19 Terminals as declared by the manufacturer.

NOTE Terminals may have multiple characteristics.

~~**7.2.14 According to the resistance to soldering heat:**~~

~~**7.2.14.1** – solder terminals type 1;~~

~~7.2.14.2 – solder terminals type 2.~~

7.21 According to the type of built in protection ~~for electronic switches~~

7.21.1 Built in protection provided

7.21.2 None provided

NOTE Explanations of testing for Built in Protection are given in Clause 23.

7.22 According to the ~~condition of cooling for electronic switches~~ type of forced cooling

7.22.1 Not requiring forced cooling.

7.22.2 Forced cooling required, with description of forced cooling.

NOTE Explanations of testing for forced cooling are given in Clause 23.

7.23 According to the capacitor provided with the switch

7.23.1 Capacitor class X1,

7.23.2 Capacitor class X2,

7.23.3 Capacitor class X3,

7.23.4 Capacitor class Y2,

7.23.5 Capacitor class Y4.

NOTE 1 Capacitor class definitions are given in IEC 60384-14.

NOTE 2 Explanations of capacitor requirements are given in 24.3.

Table 2 – Type and connection of switches *(1 of 8)*

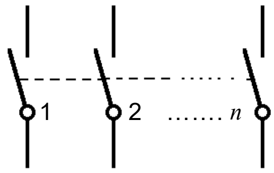
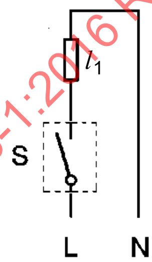
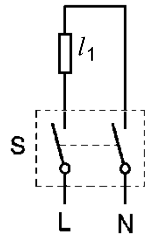
~~Classification~~	Code[1)]	Type of switch	Type of connection	Test circuit[2)]
		One-way switch		
~~7.1.13.1~~		Principle of one-way switches with one to *n* poles		
~~7.1.13.1.1~~	1.1	The number of poles, type of connection and load as declared		
~~7.1.13.1.2~~	1.2	Single pole	Single load (single-pole disconnection)	 S = Specimen
~~7.1.13.1.3~~	1.3	Double pole	Single load (all-pole disconnection)	 S = Specimen

Table 2 *(2 of 8)*

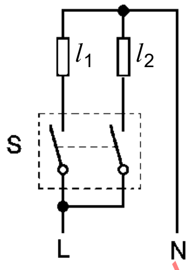
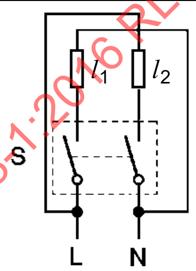
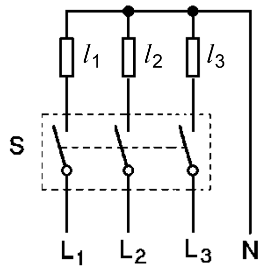
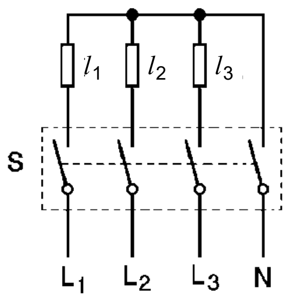
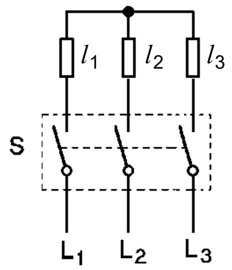
~~Classification~~	Code[1)]	Type of switch	Type of connection	Test circuit[2)]
~~7.1.13.1.4~~	1.4 [1.2]	Double pole	Double load (single-pole disconnection)	 S = Specimen
~~7.1.13.1.5~~	1.5 [1.2] [1.4]	Double pole	Double load (single-pole disconnection, load connected to opposite polarity)	 S = Specimen
~~7.1.13.1.6~~	1.6	Three pole	Three loads unswitched neutral. (three-pole disconnection)	 S = Specimen
~~7.1.13.1.7~~	1.7	Four pole	Three loads switched neutral. (four-pole disconnection)	 S = Specimen
~~7.1.13.1.8~~	1.8	Three pole	Three loads (three-pole disconnection)	 S = Spécimen

Table 2 *(3 of 8)*

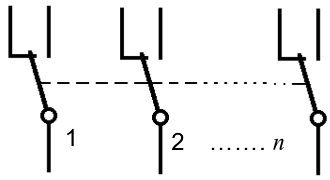
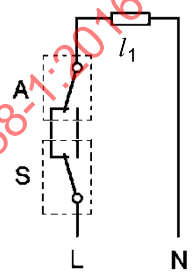
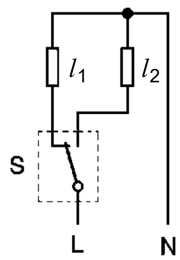
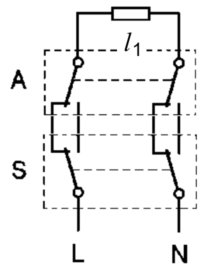
~~Classification~~	Code[1)]	Type of switch	Type of connection	Test circuit[2)]
	~~Two~~ One-way switch			
~~7.1.13.2~~		Principle of ~~two~~ one-way switches with one to *n* poles		
~~7.1.13.2.1~~	2.1	The number of poles, type of connection and load as declared		
~~7.1.13.2.2~~	2.2 [1.2]	Single pole	Single load (single-pole disconnection)	 S = Specimen A = Auxiliary switch
~~7.1.13.2.3~~ ~~2)~~	2.3	Single pole	Double load (single-pole disconnection)	 S = Specimen
~~7.1.13.2.4~~	2.4 [1.3]	Double pole	Single load (all-pole disconnection)	 S = Specimen A = Auxiliary switch

Table 2 *(4 of 8)*

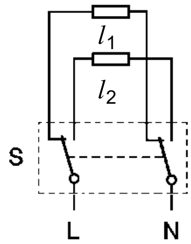
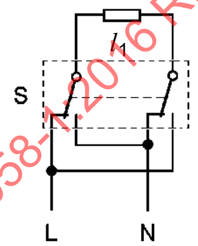
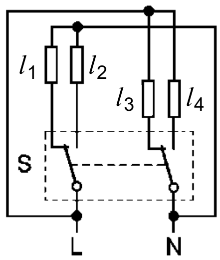
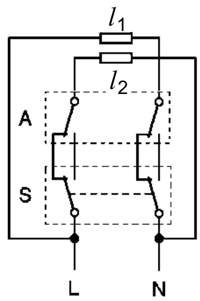
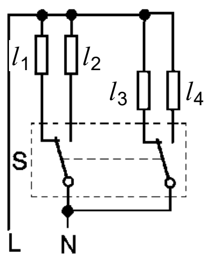
~~Classification~~	Code[1)]	Type of switch	Type of connection	Test circuit[2)]
~~7.1.13.2.5 2)~~	2.5	Double pole	Double load (all-pole disconnection)	 S = Specimen
~~7.1.13.2.6 2)~~	2.6	Double pole	Single load with polarity reversal	 S = Specimen
~~7.1.13.2.7 2)~~	2.7	Double pole	Four load (single-pole disconnection, load connected to opposite polarity)	 S = Specimen
~~7.1.13.2.8~~	2.8	Double pole	Double load (single-pole disconnection, load connected to opposite polarity)	 S = Specimen A = Auxiliary switch
~~7.1.13.2.9 2)~~	2.9	Double pole	Four load (single-pole disconnection)	 S = Specimen

Table 2 *(5 of 8)*

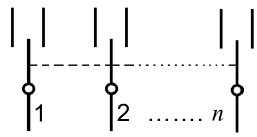
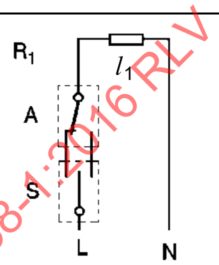
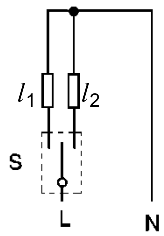
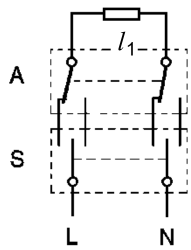
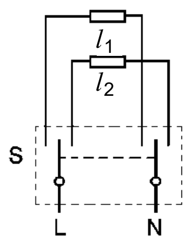
~~Classification~~	Code[1)]	Type of switch	Type of connection	Test circuit[2)]
	Two-way switch with centre position for disconnection			
~~7.1.13.3~~		Principle of two-way switches with center position and one to *n* poles		
~~7.1.13.3.1~~	3.1	The number of poles, type of connection and load as declared		
~~7.1.13.3.2~~	3.2	Single pole	Single load (single-pole disconnection)	 S = Specimen A = Auxiliary switch
~~7.1.13.3.3~~	3.3	Single pole	Double load (single-pole disconnection)	 S = Specimen
~~7.1.13.3.4~~	3.4	Double pole	Single load (all-pole disconnection)	 S = Specimen A = Auxiliary switch
~~7.1.13.3.5~~	3.5	Double pole	Double load (all-pole disconnection)	 S = Specimen

Table 2 *(6 of 8)*

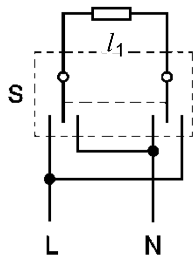
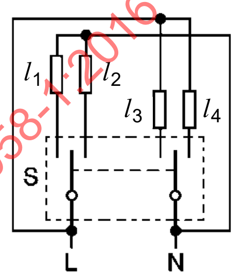
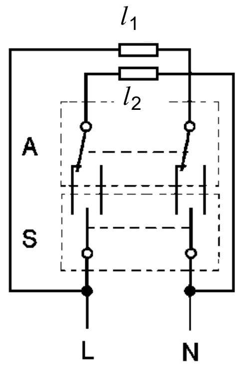
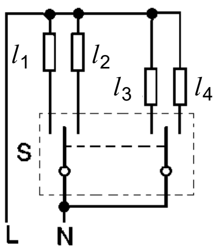
~~Classification~~	Code1)	Type of switch	Type of connection	Test circuit2)
~~7.1.13.3.6~~	3.6	Double pole	Single load with polarity reversal (all-pole disconnection)	 S = Specimen
~~7.1.13.3.7~~	3.7 [3.3]	Double pole	Four load (single-pole disconnection, load connected to opposite polarity)	 S = Specimen
~~7.1.13.3.8~~	3.8	Double pole	Double load (single-pole disconnection, load connected to opposite polarity)	 S = Specimen A = Auxiliary switch
~~7.1.13.3.9~~	3.9 [3.3]	Double pole	Four load (single-pole disconnection)	 S = Specimen

Table 2 *(7 of 8)*

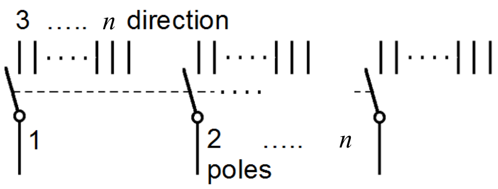
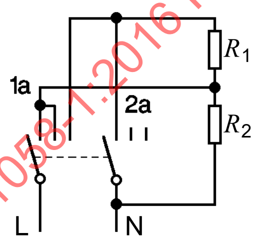
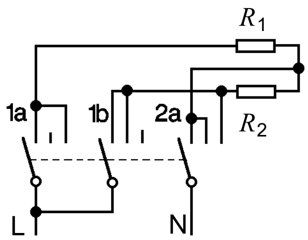
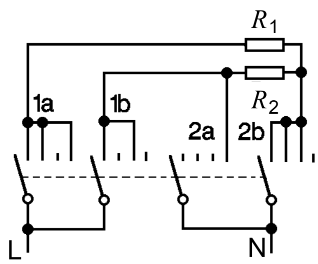
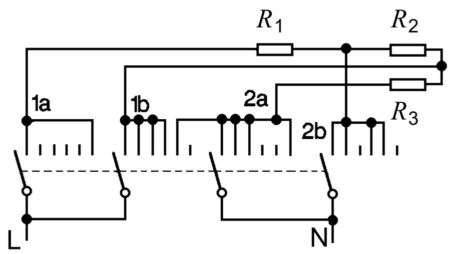
~~Classification~~	Code[1)]	Type of switch	Type of connection	Test circuit[2)]
	Multiway switches			
~~7.1.13.4~~		Principle of multiway switches with 3 to *n* ways and 1 to *n* poles		
~~7.1.13.4.1~~	4.1	The number of poles, type of connection and load as declared		
~~7.1.13.4.2~~	4.2	Single pole Four positions with polarity reversal (single-pole disconnection)		
~~7.1.13.4.3~~	4.3	Double pole Four positions with polarity reversal (all-pole disconnection)		
~~7.1.13.4.4~~	4.4	Double pole Five positions with polarity reversal (all-pole disconnection)		
~~7.1.13.4.5~~	4.5	Double pole Seven positions with polarity reversal (all-pole disconnection)		

Table 2 *(8 of 8)*

1) For switches of the same basic design, the test is considered to cover the tests for the code of switch given in square brackets. Switches are considerd to be the same basic design if: – all parts are the same, except those which have to be different because of the different poles and number of contact paths; – the basic dimensions and mechanical constructions are the same; – multipole switches are either composed of single-pole switches or built up from the same components as the single-pole switches, having the same overall dimensions per pole. A separate test on a switch with momentary action (monostable switch) is not necessary, if it can be shown that the contact function is equivalent to a bistable switch of equivalent construction.
~~2) For specific circuits and loads only.~~
2) The indication of L and N only symbolizes the connection to the mains.

8 Marking and documentation

8.1 Switch information

8.1.1 General

The switch manufacturer shall provide adequate information to ensure that

– the appliance manufacturer can select and install a switch;
– the end user can use a switch as intended by the switch manufacturer;
– the corresponding tests can be performed in accordance with this standard.

The information shall be provided in a clear and unambiguous manner.

This information shall be provided in one or more of the following ways by marking and/or documentation and as detailed in Table 3.

8.1.2 By switch marking ~~(Ma)~~

The information shall be provided by marking on the switch itself.

8.1.3 By documentation ~~(Do)~~

The information shall be provided by separate documentation, which may consist of ~~a leaflet,~~ a specification sheet, or a drawing, etc.

The content of the documentation shall be made available to the appliance manufacturer or end-user as appropriate in any suitable format.

NOTE 1 Where Marking/Documentation is indicated, the information can be provided by either marking or documentation.

NOTE 2 The format in which this information is presented is not within the scope of this standard.

Table 3 – Switch information and loads placed in groups

No	Characteristic	Subclause	Means of information	
			Common type reference CT (7.10.2)	Unique type reference UT (7.10.1)
1	**SWITCH IDENTIFICATION**			
1.1	Manufacturer's or responsible vendor's identification mark (name or trade mark)	8.1	Marking	Marking
1.2	Switch identifier such as type reference	8.1	Marking	Marking
2	**SWITCH ENVIRONMENT/MOUNTING**			
2.1	Degree of protection provided for the switch when mounted according to documentation (IP Code of IEC 60529) ~~NOTE Additional letters listed in IEC 60529 are not used.~~	7.5 and 7.6	Documentation	Documentation
2.2	Degree of protection against electric shock, from outside an appliance	7.7	Documentation	Documentation
2.3	Method of mounting and actuating the switch and method of providing earthing, if appropriate. The intended method(s) of mounting and the intended orientation(s) shall be declared. The declared methods of mounting, together with any earthing terminal, are deemed to be the methods of earthing conductive parts unless otherwise specified.	7.1.7 and 7.1.7.7	Documentation	Documentation
2.4	Pollution degree micro	7.8	Documentation	Documentation
2.5	Pollution degree macro	7.9	Documentation	Documentation
3	**TEMPERATURE**			
3.1	Ambient temperature limits if different from 0 °C to 55 °C	7.3	Marking	Documentation
~~3.2~~	~~Ambient air temperature for electronic switches~~ ~~– cord switches and independently mounted switches if different from 0 °C to 35 °C~~ ~~– other switches, if different from 0 °C to 55 °C~~	~~7.1.3.4.1 or 7.1.3.4.2~~ ~~7.1.3.2 or 7.1.3.3~~	~~Ma~~ ~~Ma~~	~~Do~~ ~~Do~~
4	**ELECTRICAL LOAD~~/CONNECTION~~**			
4.1	Rated voltage or rated voltage range	6.1	Marking	Documentation
4.2	Nature of supply if the switch is not intended for both AC and DC or if the rating is different for AC and DC	7.1	Marking	Documentation
4.3	Frequency or frequency range if different from 50 Hz or 50 Hz to 60 Hz	5.2.8	Marking	Documentation
~~4.4~~	~~For circuits of substantially resistive loads, the rated current of the rated load~~	~~7.1.2.1~~	~~Ma~~	~~Do~~
~~4.5~~	~~For circuits for resistive and motor load with a power factor not less than 0,6, the rated current and, for electronic switches, the minimum current (or power)~~	~~7.1.2.2~~	~~Ma/Do~~	~~Do~~
~~4.6~~	~~For circuits for resistive and capacitive load, the rated current and rated peak surge current and, for electronic switches, the minimum current (or power)~~	~~7.1.2.3~~	~~Ma/Do~~	~~Do~~
~~4.7~~	~~For circuits for tungsten filament lamp load, the rated current, and, for electronic switches, the minimum current (or power)~~	~~7.1.2.4~~	~~Ma/Do~~	~~Do~~

No	Characteristic	Subclause	Means of information	
			Common type reference CT (7.10.2)	Unique type reference UT (7.10.1)
~~4.8~~	~~For circuits for declared specific loads, relevant details of the appliance to be controlled, or other specific load~~	~~7.1.2.5~~		~~Do~~
4.4	The rated current and the electrical load type	7.2	Marking	Documentation
4.5	For switches for more than one circuit, the current applicable to each circuit and to each terminal. If these are different from each other, then it shall be made clear to which circuit or which terminal the information applies	7.16 and 5.2 if applicable	Marking / Documentation	Documentation
4.6	Rated impulse withstand voltage Note: not required when 4.7 is declared	7.12	Documentation	Documentation
~~4.11~~	~~For electronic switches, the thermal current~~	~~8.4.7~~	~~Ma~~	~~Do~~
~~4.12~~	~~For electronic switches, the duty type~~	~~7.1.16~~	~~Do~~	~~Do~~
4.7	Overvoltage category	7.13	Documentation	Documentation
4.8	~~For electronic switches,~~ Duty-type and relevant (ON/OFF-time)	7.18	Documentation	Documentation
4.9	Type and/or connection of switch	7.16	Documentation	Documentation
~~4.15~~	~~For circuits for specific lamp load, the rated current and the inrush current~~	~~7.1.2.7~~	~~Do~~	~~Do~~
~~4.16~~	~~For circuits for an inductive load with a power factor not less than 0,6~~	~~7.1.2.8~~	~~Ma~~	~~Do~~
~~4.17~~	~~For circuits for specific load of motor with a locked rotor and with a power factor not less than 0,6~~	~~7.1.2.9~~	~~Ma~~	~~Do~~
4.10	configuration of switching device	7.17	Documentation	Documentation
5	**TERMINALS/CONDUCTORS**			
5.1	All terminals shall be suitably identified, or their purpose self-evident, or the switch circuitry visually apparent. For terminals intended for the connection of supply conductors, the identification may take the form of a letter L, a number or of an arrow	8.1	Marking	Marking
5.2	Terminals for the connection of earthing conductors shall be marked with the protective earth symbol	8.2	Marking	Marking
~~5.3~~	~~Information for the connection of a conductor to the terminal if this needs prepared conductors or the use of a special purpose tool~~	~~7.2~~	~~Do~~	~~Do~~
5.3	The method of connection and disconnection for ~~screwless~~ push-in terminals.	11.2.2	Documentation	Documentation
5.4	The type of conductor to be connected to the terminal (solid or stranded)	7.20	Documentation	Documentation
5.5	The suitability of the terminal for connection of conductors indicated (maximum and minimum conductor diameter).	7.20	Documentation	Documentation
5.6	The suitability of the terminal for two or more conductors	7.20	Documentation	Documentation
5.7	The type of solder terminal mechanical securement before soldering, iron, bath, etc.	7.20	Documentation	Documentation
5.8	For terminals with specific connection method, such as solder temperatures or process shall be declared.	7.20	Documentation	Documentation
~~5.8~~	~~The suitability of the terminal for connection of unprepared supply conductors~~	~~7.2.3~~	~~Do~~	~~Do~~

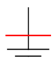
No	Characteristic	Subclause	Means of information	
			Common type reference CT (7.10.2)	Unique type reference UT (7.10.1)
~~5.9~~	~~The suitability of the terminal for connection of prepared supply conductors~~	~~7.2.4~~	~~Do~~	~~Do~~
5.9	Terminals for prepared conductors indicate the method for preparing the conductors, (such as solder dipped, crimp connector, etc).	7.20	Documentation	Documentation
5.10	For tabs with dimensions other than those according to IEC 61210, the appropriate female connector (size, material, insulation if applicable, etc.).	7.20	Documentation	Documentation
6	**OPERATING CYCLES/SEQUENCE**			
6.1	Number of operating cycles	7.4	Marking	Documentation
6.2	Operating sequence for switches with more than one circuit, if significant. For multi-circuit switches the operating sequence of the pairs of contacts shall be declared if this is of importance for the safety of the user. Contacts which "make before break" or "break before make" are examples.	13.5 and 5	Documentation	Documentation
6.3	Forces applied to end stops or full travel of actuating member (optional)	17.4 IEC 61058-1-1 or IEC 61058-1-2	Documentation	Documentation
7	**SIGNAL INDICATORS**			
7.1	Maximum power of tungsten filament signal lamps. The marking shall be visible when replacing the lamp	6.3	Marking	Marking
7.2	Intended function or operation of the signal indicator	8.1 and 12.2.5	Documentation	Documentation
8	**CIRCUIT DISCONNECTION**			
8.1	Electronic disconnection	7.14.1	Marking	Documentation
8.2	Micro disconnection	7.14.2	Marking	Documentation
8.3	Full disconnection	7.14.3	Documentation	Documentation
8.4	Combination	7.14.4	Documentation	Documentation
9	**INSULATING MATERIALS**			
9.1	Tracking PTI or CTI	20.4	Documentation	Documentation
9.2	~~Level of~~ Glow-wire ~~test~~ temperatures	7.11	Documentation	Documentation
9.3	Type of coating for rigid printed board assemblies	7.15	Documentation	Documentation
10	**COOLING CONDITION**			
10.1	Not requiring forced cooling	7.22	Documentation	Documentation
10.2	Requiring cooling	7.22	Documentation	Documentation
10.3	Direction of air for forced cooling	7.22	Documentation	Documentation
10.4	Speed of air for forced cooling	7.22	Documentation	Documentation
10.5	Thermal resistance of heat sink	7.22	Documentation	Documentation
10.6	Incoming temperature, density and other details of the air stream	7.22	Documentation	Documentation
11	**PROTECTIVE DEVICE**			

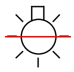
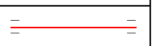
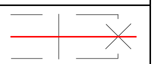
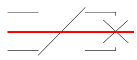
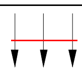
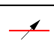
No	Characteristic	Subclause	Means of information	
			Common type reference CT (7.10.2)	Unique type reference UT (7.10.1)
11.1	Rated current/fusing characteristic/breaking capacity of replaceable built-in protection	7.21	Marking	Documentation
11.2	Type/function of non-replaceable built-in protection	7.21	Documentation	Documentation
11.3	External protective device rated current, fusing characteristic, breaking capacity	24.2	Documentation	Documentation
12	**TEST CONDITIONS**			
12.1	Test condition for switches having a contact making and breaking speed independent from the speed of actuation	7.19	Documentation	Documentation
12.2	Special requirements for testing such as minimum electric load as defined in 3.2.11, thermal current (3.2.12)		Documentation	Documentation

~~**8.2 (vacant)**~~

8.2 ~~When symbols are used, they shall be as follows (see note 1):~~ Symbols

When symbols are used, they shall be in accordance with IEC 60417, IEC 60529 and IEC 60617, examples include the following.

Ampere~~s~~ – current		A
Volt~~s~~ – voltage		V
Watt~~s~~ – power		W
Volt-Amperes – power of AC loads		VA
Alternating Current (single-phase) “AC”, ”a.c.” or “ac” or symbol or combination of one set of characters and symbol, with or without punctuation.		∿
	example	∿ AC
	example	AC
~~Alternating Current (three-phase)~~		~~3 ∿~~
	~~or~~	~~3 ∿ AC~~
	~~or~~	~~3AC~~
~~Alternating Current (three-phase with neutral)~~		~~3 N ∿~~
	~~or~~	~~3 N ∿ AC~~
	~~or~~	~~3 N AC~~
Direct Current “DC”, ”d.c.” or “dc” or symbol or combination of one set of characters and symbol, with or without punctuation.		⎓
	example	⎓ DC
	example	DC
Symbol for tungsten filament lamp load		⊗
~~Earth symbol (see note 2)~~		
Protective earth symbol ~~(see note 2)~~		

~~Non-protected against solid foreign solid objects~~		~~IP0X~~
~~Protected against solid foreign objects of 50 mm ∅ and greater~~		~~IP1X~~
~~Protected against solid foreign objects of 12 mm ∅ and greater~~		~~IP2X~~
~~Protected against solid foreign objects of 2,5 mm ∅ and greater~~		~~IP3X~~
~~Protected against solid foreign objects of 1,0 mm ∅ and greater~~		~~IP4X~~
~~Dust-protected~~		~~IP5X~~
~~Dust-tight~~		~~IP6X~~
~~Non-protected against ingress of water~~		~~IPX0~~
~~Protected against vertically falling water drops~~		~~IPX1~~
~~Protected against vertically falling water drops when enclosure tilted up to 15°~~		~~IPX2~~
~~Protected against spraying water~~		~~IPX3~~
~~Protected against splashing water~~		~~IPX4~~
~~Protected against water jets~~		~~IPX5~~
~~Protected against powerful water jets~~		~~IPX6~~
~~Protected against the effects of temporary immersion of water~~		~~IPX7~~
~~Ambient temperature limit(s) of switch~~		~~T~~
Hertz – Frequency of supply		Hz
Number of operating cycles		See 8.5
Symbol for micro disconnection		µ
Symbol for the "OFF" position or the direction of actuation to the "OFF" position ~~(a circle)~~	circle	
Symbol for the "ON" position or the direction of actuation to the "ON" position ~~(a straight bar)~~	straight bar	
Electronic disconnection	Greek epsilon	ε
~~Type of load~~		
~~Incandescent lamp load~~		
~~Fluorescent lamp load~~		
~~Transformer connection~~		
~~Iron core transformer with low-voltage tungsten filament lamp load~~		
~~Electronic step-down convertor with low-voltage tungsten filament lamp load~~		
~~Direction of air for forced cooling~~		
~~Speed of air for forced cooling~~		~~m/s~~
~~Thermal resistance of heat sink~~		~~K/W~~
~~Cyclic duration factor~~		~~%~~
~~Terminal for regulated load~~		

~~NOTE 1 The symbols used shall be in accordance with IEC 60417-1, IEC 60529 and IEC 60617-2.~~

~~NOTE 2 Preferably, the protective earth symbol in a circle should be used.~~

8.3 Load rating

8.3.1 General

~~8.4~~ Information about rated current and rated voltage may be provided by using figures alone, the figure for the rated current preceding or being placed above that for the rated voltage and separated from it by a line.

In cases where the switch is rated for more than one type of load as specified in 7.2, several different current/ load type/voltage figures given by appropriate markings are permitted.

~~8.4.1 For circuits for resistive load and for motor load, the rated current for motor load is placed between round brackets and immediately follows the rated current for resistive load. The symbol for the nature of the supply is placed before or after the current and voltage ratings.~~

~~Current, voltage and nature of supply may accordingly be indicated as follows:~~

~~16(3) A 250 V ~~~

~~or 16(3) / 250 ~~~

~~or~~ $\frac{16(3)}{250}$ ~~~~

~~8.4.2 For circuits for resistive load and for capacitive load, the marking of the peak surge current is separated from the marking of the rated current for resistive load by a stroke and follows immediately the rated current for resistive load. The symbol for the nature of the supply is placed after the current and voltage ratings.~~

~~Resistive current, peak surge current, voltage and nature of supply may be indicated accordingly as follows:~~

~~2/8 A 250 V ~~~

~~or~~ $\frac{2/8}{250}$ ~~~~

~~8.4.3 For circuits for resistive load and for tungsten filament lamp load, the peak surge current for tungsten filament lamp load is placed between square brackets and follows immediately the rated current for resistive load. The symbol for the nature of the supply is placed after the current and voltage ratings.~~

~~Resistive current, peak surge current, voltage and nature of supply may be indicated accordingly as follows:~~

~~6[3] A 250 V ~~~

~~or 6[3] / 250 ~~~

~~or~~ $\frac{6[3]}{250}$ ~~~~

~~In cases where the switch is rated for more than one type of load as specified in 7.1.2.2, 7.1.2.3 and 7.1.2.4, several different current figures given in appropriate brackets are permitted.~~

~~**8.4.4** Information concerning declared specific loads may be given by reference to drawings or to types, for example:~~

~~"Electric motor, drawing number ……, parts list No. ……., made by……", or "5 × 80 W fluorescent lamp load".~~

~~**8.4.5** For circuits for inductive load according to 7.1.2.8, the rated current for inductive load is placed between double, pointed brackets. The symbol for the nature of the supply is placed before or after the current and voltage ratings.~~

~~Current, voltage and nature of supply may accordingly be indicated as follows:~~

~~"4 A" 250 V~~~

~~or "4" /250~~~

~~or~~ $\frac{\text{"4"}}{250}$ ~~~~~

~~**8.4.6** For circuits for specific load of motor (locked rotor) according to 7.1.2.9, the rated current of the motor shall be provided by adding the rated current of the motor (for example, 3 A) as a second value within round brackets, separated by a stroke.~~

~~Current, voltage and nature of supply may accordingly be indicated as follows:~~

~~6 (3/3) A 250 V~~~

~~or 6 (3/3) / 250~~~

~~or~~ $\frac{6\,(3/3)}{250}$ ~~~~~

~~**8.4.7** The thermal current, if applicable, as well as the test conditions for verifying the thermal current shall be specified.~~

~~Information concerning the thermal current shall be given, together with the maximum rated current and marked as the following example shows:~~

~~3 < 12 / 250 ~~~

~~If a minimum power is specified, it shall be indicated together with the maximum power and marked as the following example shows:~~

~~20 W / 100 W~~

~~NOTE In this example the number 3 indicates the thermal current.~~

~~**8.5** Information about rated ambient temperature shall be provided by indicating the lower temperature value preceding the letter "T", the higher temperature value following the letter "T". If no lower temperature value is given, the lower temperature value is 0 °C:~~

~~25 T 85 (meaning –25 °C up to +85 °C)~~

~~T 85 (meaning 0 °C up to +85 °C)~~

~~If no information is given, the rated ambient temperature range is 0 °C up to 55 °C.~~

~~**8.5.1** For switches only partially suitable for a rated ambient temperature higher than 55 °C (according to 7.1.3.3), the information shall be provided as follows:~~

~~T 85/55 (meaning up to 85 °C for the switch body and up to 55 °C for the actuating member).~~

~~**8.5.2** For switches only partially suitable for a rated ambient temperature higher than 55 °C or 35 °C (see 7.1.3.3 and 7.1.3.4), the information shall be provided as follows:~~

~~T 85/35 (meaning up to 85 °C for the switch body and up to 35 °C for the actuating member).~~

~~**8.6** The symbol for Class II construction shall not be used for switches.~~

~~**8.7** Information about the rated operating cycles shall be provided in a scientific manner by using symbol "E", indicating the exponent. For switches for 10 000 operating cycles according to 7.1.4.4, this information is not necessary:~~

~~1E3 = 1 000 25E3 = 25 000 1E5 = 100 000~~

~~**8.8** Required marking on a switch shall preferably be on the body of the switch. It may, however, be placed on non-detachable parts but not on screws, removable washers or other parts which might be removed when connecting conductors and during installation of the switch. The marking for characteristics of any replaceable fuse incorporated in an electronic switch shall be placed on the fuse-holder or in the proximity of the fuse. The characteristics may be indicated by symbols (see IEC 60127).~~

~~For switches of small dimensions, the marking may be on different surfaces.~~

~~**8.9** The required marking shall be legible and durable.~~

~~*Compliance with the requirements of 8.1 to 8.8 is checked by inspection and by rubbing the marking by hand as follows:*~~

~~*a) 15 back-and-forth movements in about 15 s with a piece of cloth soaked with distilled water, followed by*~~

~~*b) 15 back-and-forth movements in about 15 s with a piece of cloth soaked with petroleum spirit.*~~

~~*During the tests, the soaked piece of cloth shall be pressed on the marking with a pressure of about 2 N/cm².*~~

~~*After these tests, the marking shall still be legible.*~~

~~NOTE The petroleum spirit used is defined as an aliphatic solvent hexane with a content of aromatics of maximum 0,1 volume %, a kauributanol value of 29, initial boiling point approximately 65 °C, dry point approximately 69 °C and specific gravity of 0,68.~~

~~**8.10** For switches with their own enclosure and not intended to be incorporated in an appliance, the "OFF" position shall be clearly indicated. Switches with micro-disconnection or electronic disconnection shall not be marked with the symbol "O" for the "OFF" position. For switches where the marking of the switch position is impossible or leads to misunderstanding, for example rocker switches or push-button switches with more than one biased push-button, the direction of actuation(s) shall be marked. For switches having more than one actuating member, this marking shall indicate, for each of the actuating members, the effect achieved by its operation.~~

~~For push-button switches with a single button the OFF position need not be marked.~~

~~NOTE The symbol "O" is used only for full disconnection.~~

~~**8.11** For electronic cord switches and independently mounted switches if there are more than two terminals, the load terminal shall be marked with an arrow pointing away from the~~

~~terminal or with one of the symbols mentioned in 8.3 and any other terminals shall be marked corresponding to the installation instructions.~~

~~Unless the installation of the electronic switch is made clear by the markings of the terminals, a wiring diagram shall be provided with each switch.~~

8.3.2 Substantially resistive load

For switches classified to operate substantially resistive load according to 7.2.1, the rated current is marked first, followed by the rated voltage. The symbol for the nature of the supply is placed after the voltage rating.

Resistive current, voltage and nature of supply may be indicated as in the following examples:

For substantially resistive loads, it is recommended to use V AC (instead of V ~).

16 RA 250 V AC

or 16 / 250 ~

or 16 A 250 V ~

or $\frac{16}{250\sim}$

8.3.3 Resistive load and motor load

For switches classified to operate resistive load and motor load according to 7.2.2, the rated current for motor load is placed between round brackets and immediately follows the rated current for resistive load. The symbol for the nature of the supply is placed before or after the current and voltage ratings.

Current, voltage and nature of supply may accordingly be indicated as in the following examples:

16(3) A 250 V ~

or 16(3) / 250 ~

or $\frac{16(3)}{250\sim}$

8.3.4 Resistive load and capacitive load

For switches classified to operate resistive load and capacitive load according to 7.2.3, the marking of the peak surge current is separated from the marking of the rated current for resistive load by a stroke and follows immediately the rated current for resistive load. The symbol for the nature of the supply is placed after the current and voltage ratings.

Resistive current, peak surge current, voltage and nature of supply may be indicated accordingly as in the following examples:

2/8 A 250 V ~

$$\text{or} \quad \frac{2/8}{250\sim}$$

Figure 8,9 and 10 indicate the current time characteristics of capacitive loads.

8.3.5 Resistive load and tungsten filament lamp load

For switches classified to operate resistive load and tungsten filament lamp load according to 7.2.4, the marking shall be according to a) or b):

The marking in item b) is not recommended for new designs.

a) The rated current for tungsten filament lamp load is placed after the symbol for tungsten filament lamp and follows immediately the rated current for resistive load. The symbol for the nature of the supply is placed after the current and voltage ratings.

Resistive current, current for tungsten filament lamp load, voltage and nature of supply may be indicated accordingly as in the following examples:

6⊗1 A 250 V ~

or 6⊗1/ 250 ~

$$\text{or} \quad \frac{6\otimes 1}{250\sim}$$

b) The peak surge current for tungsten filament lamp load is placed between square brackets and follows immediately the rated current for resistive load. The symbol for the nature of supply is placed after the current and voltage ratings.

Resistive current, peak surge current, voltage and nature of supply may be indicated accordingly as in the following examples:

6[16] A 250 V ~

or 6[16] / 250 ~

$$\text{or} \quad \frac{6[16]}{250\sim}$$

8.3.6 Declared specific load

For switches classified to operate declared specific loads according to 7.2.5, the information may be given by reference to drawings or to types, for example:

"Electric motor, drawing number ......, parts list No. ...., made by......", or "5 × 80 W fluorescent lamp load".

8.3.7 Inductive loads

For switches classified to operate inductive load according to 7.2.8, the marking shall be according to method a) or b):

The marking in item b) is not recommended for new designs.

a) For circuits for inductive load according to 7.2.8, the rated current for inductive load is followed by the upper case letter “L” (indicating Inductance) followed by the letter “A”. See examples.

4LA 250 V ~

or 4L/ 250 ~

b) For inductive loads using the historical marking indication, the rated current for inductive load placed between double, pointed brackets. The symbol for the nature of the supply is placed before or after the current and voltage ratings. See examples.

The marking “b” is not recommended for new designs.

[[4 A]] 250 V ~

8.3.8 General Purpose loads

For switches classified to operate General Purpose loads according to 7.2.10, the symbol “GP” follows the Amp symbol. See example.

10 A GP 250 V ~

8.4 Temperature rating

8.4.1 Information about rated ambient temperature shall be provided by indicating the negative (less than zero degrees Celsius) temperature value preceding the letter "T", the higher temperature value (greater than 55 °C) following the letter "T".

If no lower temperature value is given, the lower temperature value is 0 °C:

25T85 (meaning –25 °C up to +85 °C)

T85 (meaning 0 °C up to +85 °C)

If no information is given, for mechanical switches and electronic switches the rated ambient temperature range is 0 °C up to 55 °C.

8.4.2 For switches only partially suitable for a rated ambient temperature higher than 55 °C (according to 7.3.3), the information shall be provided as follows:

T 85/55 (meaning up to 85 °C for the switch body and up to 55 °C for the actuating member).

Examples:

25T85/55

or T65/55.

8.5 Operating cycles

Information about the rated operating cycles shall be provided in a scientific manner by using symbol "E", indicating the exponent. For switches for 10 000 operating cycles according to 7.4.4, this information is not necessary:

Examples:

1E3 = 1 000 25E3 = 25 000 1E5 = 100 000

8.6 Switches intended for use in Class II equipment or appliances

The symbol ⧈ (symbol 5172 of IEC 60417) shall not be marked on the switch. This symbol applies to equipment or an appliance, and not an individual switch.

8.7 Required marking

Required marking on a switch shall preferably be on the body of the switch. It may, however, be placed on non-detachable parts but not on screws, removable washers or other parts which might be removed when connecting conductors and during installation of the switch. The marking for characteristics of any replaceable fuse incorporated in a switch shall be placed on the fuse-holder or in the proximity of the fuse. The characteristics may be indicated by symbols (see IEC 60127).

For switches of small dimensions, the marking may be on different surfaces.

8.8 Legibility and durability of marking

The required marking shall be legible and durable.

Compliance with the requirements of 8.1 to 8.8 is checked by inspection and by rubbing the marking by hand as follows:

The test is made by rubbing the marking by hand for 15 s with a piece of cotton cloth soaked with water, and again for 15 s with a piece of cotton cloth soaked with aliphatic solvent hexane with a content of aromatics of maximum 0,1 % by volume, a kauributanol value of 29, an initial boiling point approximately 65 °C, a dry-point of approximately 69 °C and a density of approximately 0,68 g/cm³.

Marking made by impressing, moulding, laser or engraving is not subjected to this test.

After this test, the marking shall be easily legible.

8.9 Switches with their own enclosure

For switches with their own enclosure and not intended to be incorporated in an appliance, the "OFF" position shall be clearly indicated. Switches with micro-disconnection or electronic disconnection shall not be marked with the symbol "O" for the "OFF" position. For switches where the marking of the switch position is impossible or leads to misunderstanding, for example rocker switches or push-button switches with more than one biased push-button, the direction of actuation(s) shall be marked. For switches having more than one actuating member, this marking shall indicate, for each of the actuating members, the effect achieved by its operation.

For switches classified as unique type, 7.10.1, the OFF marking is to be according to the manufacturer's declaration.

For push-button switches with a single button, the OFF position is not required to be marked.

NOTE The symbol "O" is used only for full disconnection.

9 Protection against electric shock

9.1 Switches shall be constructed so that there is adequate protection against contact with live parts in any position of use when the switch is mounted and operated as in normal use, and after any detachable parts have been removed, except lamps with caps.

For switches for class II appliances, this requirement applies also to contact with metal parts separated from live parts by basic insulation only, or with basic insulation itself.

NOTE For the purpose of this standard, metal-sensing surfaces which are connected to live parts by means of protective impedance (see 9.1.1) are considered to offer protection against electric shock.

Compliance is checked by inspection and by the following test:

a) *The test is applied to those parts of the switch which are accessible when it is mounted in any position in accordance with the manufacturer's documentation, with any detachable parts, except lamps with caps, removed;*

~~*b) the jointed test finger of IEC 60529 is applied without force in every possible position. Openings preventing the entry of the finger are further tested by means of a straight unjointed test finger of the same dimensions as the jointed test finger of IEC 60529, which is applied with a force of 20 N. If the unjointed test finger then enters the opening, the test is repeated with the jointed finger in the angled position. An electrical contact indicator is used to show contact;*~~

b) *The insulating properties of lacquer, enamel, paper, cotton, oxide film on metal parts, beads and sealing compounds which soften in heat shall not be relied upon to give the required protection against contact with live parts.*

~~*c) in addition, openings in insulating material and in unearthed metal parts are tested by applying the test pin according to figure 13 without force in every possible position;*~~

c) *Probe B according to IEC 61032 (IEC 60529:1989, Figure 1) jointed test finger is applied without force in every possible position. If Probe B is able to enter the opening, the finger is repeated with an electrical contact indicator to show contact, the test allows the finger to be in the angled position. It is recommended to use a lamp for the indication of contact at a voltage not less than 40 V.*

d) *Probe 11 according to IEC 61032 straight unjointed test finger is applied with 20 N of force to any opening that prevents the entry of probe B.*

e) *Test pin Probe 13 according to IEC 61032 is applied to openings in insulation materials and unearthed metal parts without force in every possible position.*

f) *In case of doubt the tests are repeated under the conditions for the test of Clause 16.*

~~Unless otherwise specified, parts connected to a SELV supply not exceeding 24 V are not considered to be live parts.~~

~~NOTE It is recommended to use a lamp for the indication of contact at a voltage not less than 40 V.~~

It shall not be possible ~~with either the standard test finger or the test pin~~ to touch bare live parts.

For switches which have any parts of double insulation construction, it shall not be possible to touch with the ~~standard~~ jointed test finger unearthed metal parts which are only separated from live parts by basic insulation, or by the basic insulation itself.

9.1.1 Accessible metal parts which are needed for the operation of a~~n electronic~~ switch (for example, sensing surfaces) may be connected to live parts by means of a protective impedance.

The protective impedance shall consist of resistors and/or capacitors and shall comply with one of the following:

a) At least two independent resistors of the same nominal value in series. The resistors shall comply with the requirements given in 24.4;

b) At least two independent capacitors in series, of the same value. The capacitors shall comply with the requirements for class Y2 according to IEC 60384-14;

c) At least one resistor complying with 24.4 and one capacitor complying with the requirements for class Y2 according to IEC 60384-14 in series. The impedance of the resistor and capacitor should be approximately equal.

The removal of protective impedances, or their short-circuiting, shall be possible only by destruction of the ~~electronic~~ switch or by rendering the ~~electronic~~ switch obviously unusable. The protective impedances shall be so designed and arranged that along their surfaces and between their surfaces, the requirements according to Clause 20 are met.

Compliance is checked by inspection and by the tests in 24.4.

9.1.2 If a cover or cover-plate or a fuse can be removed without the use of a tool or if the instruction for use specifies that, for the purpose of maintenance, when replacing the fuse, covers ~~and~~ or cover-plates fastened by means of a tool have to be removed, the protection against contact with live parts shall be assured even after removal of the cover or cover-plate.

~~NOTE~~ If this requirement is achieved after a switch is built into an appliance, the switch itself does not have to comply with this requirement.

~~*Compliance is checked with the standard test finger, test probe B according to IEC 61032.*~~

~~**9.1.3** If a switch is provided with a hole which is accessible to the user – when mounted as declared – for adjusting the setting of the switch and this hole is indicated as such, the adjustment shall not involve the risk of an electric shock.~~

Compliance is checked by applying ~~a test pin~~ Access Probe C according to Figure 3 IEC 61032:1997, through the hole, applying up to 20 N of force. The pin shall not touch live parts.

9.1.3 An actuating member shall be fixed adequately if the removal of the actuating member gives access to live parts. An actuating member is considered to be fixed adequately if access to live parts can be gained only by breaking or cutting or by dismantling with the aid of a ~~special-purpose~~ tool.

Compliance is checked by inspection, during the tests according to Clause 18 and by applying the ~~jointed~~ test ~~finger~~ probe B according to IEC ~~60529~~ 61032 without force.

9.2 For switches for appliances other than those of class III, accessible parts of actuating members shall be of one of the following types:

a) insulating material;

b) metal separated from basic insulated parts by supplementary insulation;

c) metal separated from live parts by double or reinforced insulation;

~~d) for electronic switches,~~

d) metal separated from live parts by protective impedances.

Compliance for items a) to c) is checked by inspection, measurement and test as appropriate.

Compliance for item d) is checked as follows:

The measurements are carried out between either a single accessible metal part or any combination of accessible metal parts and earth, through a non-inductive resistor of 2 kΩ at *rated voltage (and rated load in ON-state), in ON- and OFF-state, and/or at lowest and highest setting value. During the measurements, each one of the resistors and all other components, if any, in the protective impedance, are short-circuited one at a time.*

The current ~~must~~ shall not exceed, in any measurement, 0,7 mA (peak value) for AC up to 1 kHz or 2 mA for DC.

For frequencies above 1 kHz, the limit of 0,7 mA is multiplied by the value of the frequency in kHz, but shall not exceed 70 mA.

9.3 Capacitors shall not be connected to unearthed metal parts which are accessible when the switch is mounted in accordance with the manufacturer's declarations. Metal casing of capacitors shall be separated by supplementary insulation from accessible unearthed metal parts, when the switch is mounted in accordance with the manufacturer's declarations.

Compliance is checked by inspection and according to the requirements in Clauses 15 and 20.

10 Provision for earthing

10.1 Switches for class II appliances shall have no provision for earthing the switch or parts thereof. Interconnections for maintaining the earthing circuit are permitted.

Compliance is checked by inspection.

10.2 Earthing terminals, earthing terminations and other earthing means shall not be connected electrically to any neutral terminal.

Compliance is checked by inspection.

10.3 Accessible metal parts of switches for class I appliances which may become live in the event of an insulation fault shall have provision for earthing.

Compliance is checked by inspection.

10.3.1 Parts separated from live parts by double insulation or reinforced insulation, and parts screened from live parts by metal parts connected to an earthing terminal, earthing termination, or other earthing means are not regarded as likely to become live in the event of an insulation fault.

10.3.2 Accessible metal parts of switches may be connected to earth through their fixing means, provided that provision is made for clean metallic surfaces at the connection points.

10.4 The connection between an earthing terminal, earthing termination or other earthing means and parts required to be connected thereto shall be of low resistance.

Compliance is checked by the following test:

a) *a current of 1,5 times the rated current but not less than 25 A, derived from an AC source, with a no-load voltage not exceeding 12 V, is passed between the earthing terminal, earthing termination, or other earthing means, and each of the parts in turn;*
b) *the voltage drop between the earthing terminal, earthing termination, or other earthing means, and each part connected thereto is measured when steady-state conditions have been achieved and the resistance is calculated on the basis of the current and this voltage drop.*

In no case shall the resistance exceed 50 mΩ.

~~NOTE Care has to be taken that the contact resistance between the tip of the measuring probe and the metal part under test does not influence the test results.~~

10.5 Earthing terminals of all types for unprepared conductors shall be of a size equal to, or larger than that required for the corresponding current-carrying terminal. It shall not be possible to loosen the clamping means without the aid of a tool, and they shall be adequately locked against unintentional loosening.

Compliance is checked by inspection, by manual test and by the appropriate tests of Clause 11.

10.5.1 In general, the designs commonly used for terminals according to 11.1 and 11.2 provide sufficient resilience to comply with the requirement for adequate locking against unintentional loosening.

10.5.2 If the switch is subjected to excessive vibration or temperature cycling, special provisions, such as the use of an adequately resilient part (for example, a pressure plate), may be necessary if pillar terminals are used (See Figure 1).

10.6 Thread-cutting and thread-forming screws may be used to provide earthing continuity, provided that it is not necessary to disturb the connection in normal use and at least two screws are used for each connection.

Compliance is checked by inspection and during the tests of 19.2.

10.7 All parts of an earthing terminal shall be such that there is no risk of corrosion resulting from contact between those parts and the copper of the earthing conductor, or any other metal that is in contact with those parts.

10.8 The body of an earthing terminal shall be of brass or other metal no less resistant to corrosion, unless it is a part of the enclosure, when any screws or nuts shall be of brass, plated steel complying with 19.3, or other metal no less resistant to corrosion and rusting.

Compliance is checked by inspection, in case of doubt, compliance is checked by the testing of Clause 22.

10.9 If the body of an earthing terminal is part of a frame or enclosure of aluminium or aluminium alloy, precautions shall be taken to avoid risk of corrosion resulting from contact between copper and aluminium or its alloys.

Compliance with the requirements of 10.7, 10.8 and 10.9 is checked by inspection and in cases of doubt by analysis of the materials and their coatings or platings.

11 Terminals and terminations

~~NOTE A schematic diagram of families of terminals is given in annex G.~~

~~11.1 Terminals for copper conductors~~

~~11.1.1 Terminals for unprepared copper conductors and not requiring the use of a special purpose tool~~

~~11.1 Common requirements~~

~~**11.1.1.1.1** Terminals shall be such that connection is made by means of screws, nuts, springs, wedges, eccentrics, cones or equally effective means or methods, but without requiring a special-purpose tool for connection or disconnection.~~

~~*Compliance is checked by inspection.*~~

~~**11.1.1.1.2** Terminals shall be fixed in such a way that they will not work loose when the clamping means are tightened or loosened.~~

~~This requirement does not preclude floating terminals or terminals mounted on floating elements, such as those used in some stack-type switches, provided their movement does not impair the correct operation of the switch.~~

~~*Compliance is checked by fastening and loosening 10 times a conductor having the maximum cross-sectional area specified in table 4, for screw-type terminals the torque applied being the torque specified in table 20.*~~

~~**11.1.1.1.3** Terminals shall be designed or placed so that a conductor cannot slip out while being connected or while the switch is being operated as intended.~~

~~*Compliance is checked by the following tests:*~~

~~*a) terminals are fitted with conductors of maximum cross-sectional areas according to table 4 and the clamping means is fully tightened with the torque according to table 20. The test is repeated with the terminal fitted with conductors of minimum cross-sectional area according to table 4;*~~

~~*b) for terminals intended for the connection of two or more conductors, the test is repeated with the terminal fitted with the declared numbers of conductors;*~~

~~*c) before insertion into the terminal, wires of rigid conductors are straightened and flexible conductors are twisted in one direction so that a uniform twist of one complete turn in a length of approximately 2 cm is obtained;*~~

~~*d) the conductor is inserted into the terminal over a length equal to the minimum distance prescribed or, if no distance is prescribed, until an end-stop is reached or until the conductor just projects from the far side of the terminal and in the position most likely to assist a strand to escape;*~~

~~*e) for flexible conductors the test is repeated using a new conductor which is twisted as prescribed above, but in the opposite direction.*~~

~~*After the test, the conductor shall not have escaped into or through the gap between the clamping means and retaining device.*~~

~~NOTE The maximum diameters of the conductors according to IEC 60228A are given for information in table 5.~~

~~**Table 5 – Maximum diameters of circular copper conductors**~~

	~~*Rigid conductors in cables for fixed installation*~~		~~*Flexible conductors*~~
~~*Cross-sectional area*~~ ~~*mm²*~~	~~*Solid Class 1* diameter*~~ ~~*mm*~~	~~*Stranded Class 2* diameter*~~ ~~*mm*~~	~~*Classes 5 and 6* diameter*~~ ~~*mm*~~
~~*0,5*~~	~~*0,9*~~	~~*1,1*~~	~~*1,1*~~
~~*0,75*~~	~~*1,0*~~	~~*1,2*~~	~~*1,3*~~
~~*1,0*~~	~~*1,2*~~	~~*1,4*~~	~~*1,5*~~
~~*1,5*~~	~~*1,5*~~	~~*1,7*~~	~~*1,8*~~
~~*2,5*~~	~~*1,9*~~	~~*2,2*~~	~~*2,6*~~
~~*4,0*~~	~~*2,4*~~	~~*2,7*~~	~~*3,2*~~
~~*6,0*~~	~~*2,9*~~	~~*3,3*~~	~~*3,9*~~
~~*10,0*~~	~~*3,7*~~	~~*4,2*~~	~~*5,1*~~
~~*16,0*~~	~~*4,6*~~	~~*5,3*~~	~~*6,3*~~
~~*25,0*~~	~~*5,7*~~	~~*6,6*~~	~~*7,8*~~
~~** According to IEC 60228.*~~			
~~*The different types of conductors are classified according to IEC 60228 as follows:*~~ ~~*Rigid solid conductors Class 1*~~ ~~*Rigid stranded conductors Class 2*~~ ~~*Flexible conductors Classes 5 and 6*~~			

~~**11.1.1.1.4** Terminals suitable for the connection of flexible conductors shall be located or shielded so that, if a wire of a flexible conductor escapes from a terminal when the conductors are fitted, there is no risk of contact between live parts and accessible metal parts, and, for switches for Class II appliances, between live parts and metal parts separated from accessible metal parts by supplementary insulation only.~~

~~Furthermore, there shall be no risk of short-circuiting those terminals which are electrically connected together by switch action.~~

~~*Compliance is checked by inspection and by the following test:*~~

~~*a) at the end of a flexible conductor having the minimum cross-sectional area specified in table 4, the insulation is removed for a length of 8 mm. One wire of the flexible conductor is left free and the remainder are fully inserted into the terminal and clamped;*~~

~~*b) the free wire is bent, without tearing the insulation back, in every possible direction, but without making sharp bends around barriers.*~~

~~*The free wire of the flexible conductor shall not touch the relevant parts mentioned above. Furthermore, the free wire of a flexible conductor connected to an earthing terminal shall not touch any live part.*~~

~~**11.1.1.1.5** Terminals shall be designed so that they clamp the conductor without undue damage to the conductor.~~

~~*Compliance is checked by inspection.*~~

~~NOTE A test is under consideration.~~

~~**11.1.1.1.6** Terminals shall be designed so that the insertion of the conductor is prevented by a stop if further insertion may reduce creepage distances and/or clearances or influence the mechanism of the switch.~~

~~*Compliance is checked by inspection and during the tests of 11.1.1.1.3 and 11.1.1.1.4.*~~

~~**11.1.1.2 Screw-type terminals for unprepared copper conductors**~~

~~**11.1.1.2.1** Screw-type terminals shall allow the connection of conductors having cross-sectional areas as specified in table 4.~~

~~NOTE Examples of screw-type terminals are given in figures 1, 2, 3, 4 and 5.~~

~~*Compliance is checked by inspection, by measurement and by insertion of flexible and rigid conductors of cross-sectional areas according to table 4.*~~

~~*The conductors shall be able to enter into the terminal aperture without undue force to the designed depth of the terminal.*~~

~~**11.1.1.2.2** Screw-type terminals shall be designed so that they clamp the conductor reliably and between metal surfaces.~~

~~*Compliance is checked by inspection and by the following test.*~~

~~*a) The terminals are fitted with conductors of the smallest and largest cross-sectional areas specified in table 4, the terminal screws being tightened with a torque equal to two-thirds of that specified in the appropriate column of table 20.*~~

~~*b) If the screw has a hexagonal head with a slot, the torque applied is equal to two-thirds of that specified in column III of table 20.*~~

~~*c) Each conductor is subjected to a pull of the force as given in table 6, the pull being applied without jerks, for 1 min, in the direction of the axis of the conductor space.*~~

~~*d) If the terminal is declared as suitable for two or more conductors, the appropriate pull is applied consecutively to each conductor.*~~

~~*During the test, the conductor shall not move noticeably in the terminal.*~~

~~**11.1.1.2.3** Screws and nuts for clamping the conductors shall not serve to fix any other part, although they may hold the clamping part in place or prevent it from turning.~~

~~*Compliance is checked by inspection and during the tests of 19.2.*~~

~~**11.1.1.3 Screwless terminals for unprepared copper conductors**~~

~~**11.1.1.3.1** Screwless terminals shall allow, according to their classification, the proper connection of conductors having cross-sectional areas as specified in table 4 up to and including 2,5 mm² of cross-sectional area for flexible conductors, and up to and including 4 mm² for rigid conductors.~~

~~It shall be obvious how the insertion and disconnection of the conductors are intended to be effected.~~

~~NOTE Examples of screwless terminals are shown in figure 6.~~

~~The intended disconnection of a conductor shall require an operation, other than a pull at the conductor, such that it can be effected manually with or without the help of a tool in normal use.~~

~~Openings for the use of a tool intended to assist the insertion or disconnection shall be clearly distinguishable from the opening for the conductor.~~

~~*Compliance is checked by inspection, by measurement and by insertion of the appropriate flexible and/or rigid conductors of cross-sectional areas according to table 4.*~~

~~*The conductors shall be able to enter without undue force into the terminal aperture to the designed depth of the terminal.*~~

~~**11.1.1.3.2** Screwless terminals shall withstand the mechanical stress occurring in normal use.~~

~~The conductor shall be clamped reliably and between metal surfaces, except that, for terminals intended to be used in circuits carrying a current not exceeding 0,2 A, one of the surfaces may be non-metallic.~~

~~*Compliance is checked by the following test, which is carried out with uninsulated copper conductors, at first having the largest cross-sectional area, and then having the smallest cross-sectional area specified in table 4:*~~

- ~~*either rigid: five insertions and disconnections for solid conductors and one insertion and disconnection for stranded conductors;*~~
- ~~*or flexible: five insertions and disconnections;*~~
- ~~*or rigid and flexible: if the terminal can accept both types of conductors, the tests are carried out with rigid and flexible conductors for the number of times indicated above.*~~

~~*a) The conductors are inserted and disconnected for the number of times indicated above using new conductors each time, except for the last time, when the conductors used for the last but one insertion are clamped at the same place. For each insertion, the conductors are either pushed as far as possible into the terminal or shall be inserted so that adequate connection is obvious.*~~

~~*b) After each insertion, the conductor is twisted through 90° in an axial direction and then subjected to a pull of the force as specified in table 6; the pull is applied without jerks, for 1 min, in the direction of the axis of the conductor space.*~~

~~*c) If the terminal is declared as suitable for two or more conductors, the appropriate pull is applied consecutively to each conductor.*~~

~~*During the application of the pull, the conductor shall not come out of the terminal.*~~

~~*After these tests, neither the terminals nor the clamping means shall have worked loose.*~~

~~NOTE A bending test for rigid conductors is under consideration.~~

~~**11.1.1.3.3** Screwless terminals intended to be used for the interconnection of more than one conductor shall be designed so that~~

- ~~after the insertion, the operation of the clamping means of one of the conductors is independent of the operation of the clamping means of the other conductor;~~
- ~~during the disconnection, the conductors can be disconnected either simultaneously or separately.~~

~~*Compliance is checked by inspection and by tests with the appropriate conductors in any combination.*~~

~~**11.1.1.3.4** Screwless terminals shall withstand the thermal stress occurring in normal use.~~

~~*When the clamping means of the screwless terminal does not form part of the conductive path through the switch, compliance is checked during the tests of clause 17.*~~

~~*When the switch has a rated number of operating cycles below 10 000, or when the clamping means of the screwless terminal forms part of the conductive path through the switch, compliance is checked by the following thermal endurance test.*~~

~~*For the purpose of this test for switches classified according to 7.1.3.2 and 7.1.3.3, three separate new switches are mounted and connected as declared and are placed in a heating cabinet which is initially kept at a temperature of 25 °C ± 2 °C.*~~

~~Switches classified according to 7.1.3.3 are mounted as in normal use.~~

~~For switches classified according to 7.1.3.1, three separate new switches are kept at 25 °C ± 10 °C throughout this test and only submitted to the current cycles.~~

~~During the test, the maximum rated current is passed through the switches.~~

~~Then the switches are subjected to 192 test cycles, each cycle having a duration of approximately 1 h, as follows:~~

~~a) the temperature in the cabinet is raised in approximately 20 min to the maximum ambient temperature. It is maintained within ±5 °C of this value for approximately 10 min;~~

~~b) the switches are then allowed to cool down in approximately 20 min to a temperature of approximately 30 °C, forced air cooling being allowed. They are kept at this temperature for approximately 10 min. During the cooling-down period, no current is flowing through the specimens;~~

~~c) the temperature in the heating cabinet shall be measured at a distance of at least 50 mm from the specimen assemblies.~~

~~After the 192 test cycles, the temperature rise at the terminals shall not exceed 55 K when measured in accordance with 16.2.2 except that the temperature rise test at the terminals is carried out at rated current and in an ambient temperature of 25 °C ± 10 °C.~~

~~If one of the terminals does not comply with the test, the test is repeated using a second set of specimens all of which shall then comply.~~

~~11.1.1.4 Insulation piercing terminals for insulated unprepared copper conductors~~

~~NOTE Requirements and tests based on IEC 60998-2-3 are under consideration.~~

~~11.1.2 Terminals for prepared copper conductors and/or requiring the use of a special purpose tool~~

~~11.1.2.1 Common requirements~~

~~**11.1.2.1.1** Terminals shall be suitable for their purpose when the connection is made as declared.~~

~~Compliance is checked by inspection and during the tests of clauses 16 and 19.~~

~~**11.1.2.1.2** Terminals shall allow the connection of conductors having cross-sectional areas as declared.~~

~~Compliance is checked by inspection and by fitting conductors of the declared types and cross-sectional areas.~~

~~**11.1.2.1.3** Terminals shall be designed so that they make connection reliably between metal surfaces and without undue damage to the conductor.~~

~~Compliance is checked by inspection and during the tests of clauses 16 and 19. The results are only taken into account when the conductor is clamped directly in the terminal and/or when the precise method of special preparation is declared. In all other cases, the reliability is determined by the end-application.~~

~~**11.1.2.1.4** Terminals shall be designed so that the insertion of the conductor is limited by a stop, if further insertion may reduce creepage distances and/or clearances or influence the mechanism of the switch.~~

~~*Compliance is checked by inspection and during the tests of 11.1.2.1.2 and 11.1.2.1.3.*~~

~~11.1.2.2 Screw-type terminals for prepared copper conductors~~

~~No further specific requirements.~~

~~11.1.2.3 Screwless terminals for prepared copper conductors~~

~~**11.1.2.3.1** Screwless terminals shall clamp the conductor between metal surfaces, except that, for terminals intended to be used in circuits carrying a current not exceeding 0,2 A, one of the surfaces may be non-metallic.~~

~~*Compliance is checked by inspection.*~~

~~**11.1.2.3.2** Screwless terminals shall withstand the thermal stress occurring in normal use.~~

~~*Compliance is checked by the appropriate test according to 11.1.1.3.4.*~~

~~11.1.2.4 Tabs of flat quick-connect terminations~~

~~**11.1.2.4.1** Tabs forming part of a switch shall comply with the dimensions according to figure 7.~~

~~*Compliance is checked by measurement.*~~

~~Tabs with dimensions other than those shown in figure 7 are allowed only if the dimensions and shapes are so different as to prevent any mating with the female connector shown in figure 8 and prescribed in IEC 60760.~~

~~**11.1.2.4.2** Tabs may have an optional detent for latching. Round dimple detents, rectangular dimple detents and hole detents shall be located in the area "EF" along the centre line of the tab as indicated in figure 7.~~

~~**11.1.2.4.3** Provisions for non-reversible connections may be located in the area "EF" along the centre line of the tab, as indicated in figure 7.~~

~~**11.1.2.4.4** The material and plating of tabs shall be appropriate to the maximum temperature of the tab as specified in table 7.~~

~~Table 7 – Material and plating for tabs~~

~~**Material and plating of tabs**~~	~~**Maximum temperature of the tab**~~ ~~**°C**~~
~~Bare copper~~	~~155~~
~~Bare brass~~	~~210~~
~~Tin plated copper and copper alloys~~	~~160~~
~~Nickel plated copper and copper alloys~~	~~185~~
~~Silver plated copper and copper alloys~~	~~205~~
~~Nickel plated steel~~	~~400~~
~~Stainless steel~~	~~400~~
~~NOTE Materials or platings other than those specified may be used, provided their electrical and mechanical characteristics are no less reliable, particularly with regard to resistance to corrosion and mechanical strength.~~	

~~**11.1.2.4.5** Tabs shall allow the application and withdrawal of female connectors without damage to the switch such as to impair compliance with this standard.~~

~~*Compliance is checked by applying axial forces without jerks equal to those specified in table 8. No significant displacement or damage shall occur.*~~

~~Table 8 – Push and pull forces for tabs~~

~~*Tab size* 3)~~	~~*Push* 1) *N*~~	~~*Pull* 1) *N*~~
~~*2,8*~~	~~*64*~~	~~*58*~~
~~*4,8*~~	~~*80*~~	~~*98* 2)~~
~~*6,3*~~	~~*96*~~	~~*88*~~
~~*9,5*~~	~~*120*~~	~~*110*~~

~~1) The forces are the maximum allowed for a single tab.~~

~~2) The value is higher than that of the next largest size of tab according to the actual design of female connectors of IEC 60760.~~

~~3) See figure 7 for tab sizes.~~

~~**11.1.2.4.6** Tabs shall be adequately spaced to allow the connection of the appropriate uninsulated female connectors.~~

~~*Compliance is checked by applying an appropriate female connector to each tab in the most onerous orientation; during this operation, no strain or distortion shall occur to any of the tabs or to their adjacent parts, nor shall the creepage distances or clearances be reduced to values less than those specified in clause 20.*~~

~~NOTE 1 For tabs complying with figure 7, an appropriate female connector is that shown in figure 8.~~

~~NOTE 2 Requirements for insulated female connectors are under consideration.~~

~~11.1.2.5 Insulation piercing terminals for prepared insulated copper conductors~~

~~NOTE Requirements and tests are under consideration.~~

~~11.1.2.6 Solder terminals~~

~~**11.1.2.6.1** Solder terminals shall have sufficient solderability.~~

~~*Compliance is checked by applying the relevant tests according to IEC 60068-2-20.*~~

~~*For the purpose of test Ta, the conditions of table 9 apply.*~~

~~*Compliance with 11.1.2.6.2 for solder terminals with normal resistance to soldering heat shall be checked immediately after this test.*~~

~~Table 9 – Test conditions for Ta~~

~~*Clause of IEC 60068-2-20*~~	~~*Condition*~~
~~*4.3.2 / 4.8.3*~~	~~*No degreasing is required*~~
~~*4.4*~~	~~*No initial measurements*~~
~~*4.5*~~	~~*No ageing*~~
~~*4.6 / 4.7*~~	~~*Test method 1: Solder bath at 235 °C, or test method 2: Soldering iron at 350 °C, is applied, depending on the classification of terminals as specified in 7.2.10 and 7.2.11*~~
~~*4.6.2 /4.8.2.3*~~	~~*Non-activated flux*~~
~~*4.6.3 /4.9.2*~~	~~*Immersion time: 2 s to 3 s*~~

~~*4.6.3*~~	~~*No thermal screen used*~~
~~*4.7.3*~~	~~*Soldering iron size "B"*~~
~~*4.7.3*~~	~~*No thermal heat sink used*~~
~~*4.7.3*~~	~~*Application time of soldering iron: 2 s to 3 s*~~
~~*4.8.4*~~	~~*Soldering time: 2 s max.*~~
~~*4.9*~~	~~*No de-wetting*~~
~~*4.10*~~	~~*Final measurement: temperature rise according to clause 16*~~

~~*The dipped surface shall be covered with a smooth and bright solder coating with no more than small amounts of scattered imperfections such as pin-holes or unwetted or de-wetted areas. These imperfections shall not be concentrated in one area.*~~

~~**11.1.2.6.2** Solder terminals shall have sufficient resistance to soldering heat.~~

~~*For solder terminals with resistance to soldering heat type 1 (classified according to 7.2.14.1), compliance is checked during the tests of 11.1.2.6.1.*~~

~~*After the tests, the solder terminals shall not have worked loose, or have been displaced in a manner impairing their further use, and they shall still comply with the requirements of clause 20.*~~

~~*For solder terminals with resistance to soldering heat type 2 (classified according to 7.2.14.2), compliance is checked by applying the relevant tests according to IEC 60068-2-20.*~~

~~*For the purpose of test Tb, the conditions of table 10 apply.*~~

~~**Table 10 – Test conditions for Tb**~~

~~*Clause of IEC 60068-2-20*~~	~~*Condition*~~
~~*5.3*~~	~~*No initial measurements*~~
~~*5.4 / 5.5*~~	~~*Test method 1A: Solder bath at 260 °C, or test method 2: Soldering iron at 350 °C, is applied, depending on the declared type of solder terminal*~~
~~*5.4.3*~~	~~*Immersion time: 5 s ± 1 s*~~
~~*5.4.3*~~	~~*No thermal screen used*~~
~~*5.6.1*~~	~~*Soldering iron size "B"*~~
~~*5.6.3*~~	~~*No thermal heat sink used*~~
~~*5.6.3*~~	~~*Application time of soldering iron: 5 s ± 1 s*~~

~~*After the tests, the solder terminals shall not have worked loose, or have been displaced in a manner impairing their further use, and they shall still comply with the requirements of clause 20.*~~

~~**11.1.2.6.3** Solder terminals classified according to 7.2.12 shall be provided with means for mechanically securing the conductor in position independently of the solder.~~

~~Such means may be provided by~~

- ~~a hole suitable for hooking-in the conductor;~~
- ~~by shaping the edges of the terminal to allow the conductor to be wrapped around the terminal before soldering;~~
- ~~a clamping means adjacent to the solder connection.~~

~~**11.1.3 Additional requirements for terminals for supply connection and connection of external cords**~~

~~**11.1.3.1** Each terminal shall be located near to its corresponding terminal of different polarity, and to the earthing terminal, if any, unless there is a sound technical reason for the contrary.~~

~~NOTE According to IEC 60335-1, power supply cords are assembled with the appliance by one of the following methods of attachment:~~

- ~~type X attachment;~~
- ~~type Y attachment;~~
- ~~type Z attachment.~~

11.1 Common requirements to terminals

11.1.1 General

Terminals shall enable a safe and reliable connection for the conductors declared under the conditions of the intended use. The evaluation and tests are done considering the wire sizes given in Table 4 with respect to the resistive currents declared if no other wire sizes are declared by the manufacturer.

Table 4 – Resistive current carried by the terminal and related cross-sectional areas of terminals for unprepared conductors

Resistive current carried by the terminal		**Flexible conductors**			
		Cross-sectional areas			**Terminal size**
A		mm²			
Over	Up to and including	Minimum	Medium	Maximum	
-	3	-	0,5	0,75	0
3	6	0,5	0,75	1,0	0
6	10	0,75	1,0	1,5	1
10	16	1,0	1,5	2,5	2
16	25	1,5	2,5	4,0	~~4~~ 3
25	32	2,5	4,0	6,0	~~5~~ 4
32	40	4,0	6,0	10,0	~~6~~ 5
40	63	6,0	10,0	16,0	~~7~~ 6
Resistive current carried by the terminal		**Rigid conductors**			
		Cross-sectional areas			**Terminal size**
A		mm²			
Over	Up to and including	Minimum	Medium	Maximum	
-	3	0,5	0,75	1,0	0
3	6	0,75	1,0	1,5	1
6	10	1,0	1,5	2,5	2
10	16	1,5	2,5	4,0	3
16	25	2,5	4,0	6,0	4
25	32	4,0	6,0	10,0	5
32	40	6,0	10,0	16,0	6
40	63	10,0	16,0	25,0	7

~~*The different types of conductors are classified according to IEC 60228 as follows:*~~

~~*Rigid solid conductors Class 1*~~
~~*Rigid stranded conductors Class 2*~~
~~*Flexible conductors Classes 5 and 6*~~

Screws and nuts for clamping the conductors shall not serve to fix any other part, although they may hold the clamping part in place or prevent it from turning.

Clamping shall be between metal surfaces except that, for terminals intended to be used in circuits carrying a current not exceeding 0,2 A, one of the surfaces may be non-metallic.

Compliance is checked by inspection.

11.1.2 Design of terminals

Terminals shall be designed so that a suitable conductor may be inserted into the aperture to the designed depth without undue force and undue damage to the conductor and terminal.

Compliance is checked by inspection.

11.1.3 Insulation

Terminals shall be designed so, that there is no reduction of the insulation strength when the conductor is attached to the terminal as declared by the manufacturer.

Compliance is checked according to Clause 20 with the conductors connected as declared.

NOTE This can be done having the end of a conductor introduced into the hole visible or that the insertion of the conductor is prevented by a stop if further insertion may reduce creepage distances and/or clearances or influence the mechanism of the switch.

11.1.4 Connection

A terminal shall be designed so that a conductor cannot slip out while being connected or while the switch is being operated as intended.

Compliance is checked by TT1.

11.2 Fixing of terminals

11.2.1 Terminals shall be fixed so, that they will not work loose when the conductor is connected or disconnected. For example this can require that the clamping means are tightened or loosened.

The intended removal of a conductor shall require an action other than a pull at the conductor.

This requirement does not preclude floating terminals or terminals mounted on floating elements, such as those used in some stack-type switches. For terminals declared 7.20.14 (flat quick-connect termination) the tabs shall allow the application and withdrawal of female connectors without damage to the switch such as to impair compliance with this standard.

Compliance is checked by TT2.

11.2.2 For terminals declared 7.20.13 (push in) in combination with conductors declared unprepared (7.20.1):

Compliance is checked by inspection and 11.8.4.

11.3 Location and shielding of terminals

11.3.1 Terminals shall be located or shielded so that when wires are connected there is no reduction of the insulation strength of the terminals, live parts or to accessible metal parts.

11.3.2 Terminals suitable for the connection of flexible conductors (7.20.3) shall be located or shielded so that there is no risk of contact between live parts and accessible metal parts.

11.3.3 For switches for class II appliances there shall be no risk of contact between live parts and metal parts separated from accessible metal parts by supplementary insulation only.

Compliance is checked by inspection and for stranded wires by TT3 (strand escape test).

11.4 Terminals for interconnection of more than one conductors

Terminals intended to be used for the interconnection of more than one conductor (7.20.9) shall be designed so that the combination of the most onerous sizes connected simultaneously, does not result in a hazard.

Compliance is checked by inspection and TT4.

11.5 Thermal stress

Terminals shall withstand thermal stress occurring in normal use. Terminals rated for less than 20 mA are not subjected to this test.

Compliance is checked according to TE2 in Clause 17 of IEC 61058-1-1:2016 or IEC 61058-1-2:2016.

11.6 Test sequences

Depending on terminals allowing the connection of prepared or unprepared conductors, the tests are conducted according Table 5 in the sequence with increasing TT-number.

Table 5 – Terminal test sequence

Reconnection	Conductor	TT1	TT2	TT3	TT4	Examples of terminals (not exhaustive)
possible (7.20.11)	unprepared (7.20.1).	X	X	X	X	Screw 7.20.12, Piercing 7.20.18, Push in 7.20.13
possible (7.20.11)	prepared (7.20.2)	X	X	–	–	Screw 7.20.12, Piercing 7.20.18, Push in 7.20.13, Quick connect
not possible (7.20.10)	unprepared (7.20.1).	X	–	–	–	Solder 7.20.15 Welding 7.20.16
not possible (7.20.10)	prepared (7.20.2)	–	–	–	–	Fixed wires (7.20.17) and terminations in general

NOTE1 "X" indicates the test is required.

NOTE 2 Column descriptions and test codes:

TT1 Conductor escape test.

TT2 Terminal displacement test.

TT3 Strand escape test

TT4 Multiple conductors

11.7 Conductor escape test (TT1)

Conductors to be fitted are selected as declared by the manufacturer or of maximum cross-sectional areas according to Table 4.

The conductor is inserted into the terminal over a length equal to the minimum distance prescribed or, if no distance is prescribed, until an end-stop is reached or until the conductor just projects from the far side of the terminal and in the position most likely to assist a strand to escape.

The test is repeated with the terminal fitted with conductors as declared or of minimum cross-sectional area according to Table 4.

For terminals declared suitable for prepared conductors (7.20.2) the declared type shall be used.

For terminals declared suitable for rigid conductors (7.20.5), before insertion into the terminal, the wires are straightened.

For terminals declared suitable for stranded conductors (7.20.3 or 7.20.4), these are twisted in one direction, so that a uniform twist of one complete turn in a length of approximately 2 cm is obtained.

For terminals declared screw type terminals (7.20.12) these are tightened with the torque according to Table 10.

For terminals declared suitable for the connection of two or more conductors (7.20.9), the test is repeated with the terminal fitted with the declared numbers of conductors;

For terminals declared for solder or welding terminals (7.20.15 or 7.20.16) or if the connection is designed so that a slip out is prevented by design, no test is necessary.

Compliance of test:

After the test, the conductor shall not have escaped into or through the gap between the clamping means and retaining device.

11.8 Terminal displacement test (TT2)

11.8.1 Connection test

A conductor shall be connected and disconnected 10 times using the parameters of TT1, if no test according to 11.8.2 is required.

For terminals declared for only one time connection (7.20.10) this test is not required.

Compliance of test:

After the test, the terminal shall not have displaced from its intended position.

11.8.2 Screw-type terminal

For terminals declared 7.20.12 "screw" additionally the following test is conducted on the same samples:

a) The screw-type terminal is fitted with a conductor of the smallest or declared cross-sectional area specified in Table 4, the terminal screw being tightened with a torque equal to that specified in the appropriate column of Table 10.
b) If the screw has a hexagonal head with a slot, the torque applied is equal to that specified in column III of Table 10.
c) The conductor is subjected to a pull of the force as given in Table 6, the pull being applied without jerks, for 1 min, in the direction of the axis of the conductor space.
d) repeat a) to c) with the largest wire size.

   For terminals declared suitable for the connection of two or more conductors (7.20.9), the test is repeated with the terminal fitted with the declared number of conductors.

   For terminals declared suitable for two or more conductors (7.20.9), the appropriate pull is applied consecutively to each conductor.

During the test, the conductor shall not move noticeably in the terminal.

11.8.3 Flat quick-connect termination

For terminals declared 7.20.14 (flat quick-connect termination) compliance is checked by applying the axial forces without jerks to the tab equal to those specified in IEC 61210:2010, Table 6 (retention force). No significant displacement or damage shall occur.

11.8.4 Push in terminals

For terminals declared 7.20.13 (push in) in combination with conductors declared unprepared (7.20.1), the test procedure is:

Conductors to be fitted are selected as declared by the manufacturer or of maximum cross-sectional areas according to Table 4.

Perform steps a) to f).

The test is repeated with the terminal fitted with conductors as declared or of minimum cross-sectional area according to Table 4.

Step a) – Insert the conductor into the terminal, either as far as possible or insert so that adequate connection is obvious.

Step b) – Twist it through 90° in an axial direction.

Step c) – Apply a pull force in opposite to direction of insertion as specified in Table 6; the pull is applied without jerks, for 1 min

Step d) – Disconnect the conductor, use the designed disconnect means other than a pull on the conductor only.

Step e) – Select a new conductor for each of the next 3 insertions indicated above.

Step f) – At the 5th insertion, the conductor used for the 4th insertion is reused (the intention is that the conductor be used twice and gripped at the same place on the conductor).

Compliance of the test:

During the application of the pull, the conductor shall not come out of the terminal. After these tests, neither the terminal nor the clamping means shall have worked loose.

Table 6 – Pulling forces for screw-type terminals

Terminal size	0	1	2	3	4	5	6	7
Pulling force (N)	35	40	50	60	80	90	100	135

11.9 Strand escape test (TT3)

The insulation from the end of a stranded conductor having the minimum or declared cross-sectional area specified in Table 4 is removed for a length of 8 mm. One strand of the flexible conductor is separated and left free and the remainder are fully inserted into the terminal and clamped.

For terminals declared suitable for unprepared stranded conductors 7.20.3 and 7.20.4 this test is required.

Compliance of the test:

The free strand shall be bent without tearing the insulation back and without making sharp bends in every possible direction.

The free strand of the flexible conductor shall not touch relevant parts mentioned in 11.3.

The free strand of a flexible conductor connected to an earthing terminal shall not touch any live part.

11.10 Multiple conductors (TT4)

Conductors to be fitted are selected as declared by the manufacturer or of maximum cross-sectional areas according to Table 4.

For conductors classified 7.20.13, perform steps a) to c) of TT2 Clause 11.8.4.

For conductors classified 7.20.12 perform steps a) to c) of TT2 Clause 11.8.2.

For terminals declared suitable for the connection of two or more conductors (7.20.9), the test is repeated with the terminal fitted with the declared number of conductors;

For terminals declared suitable for two or more conductors (7.20.9), the appropriate pull is applied consecutively to each conductor.

Compliance of the test:

During the application of the pull, the conductor shall not come out of the terminal. After these tests, neither the terminal nor the clamping means shall have worked loose.

12 Construction

12.1 Constructional requirements relating to protection against electric shock

12.1.1 When double insulation is ~~employed~~ used the design shall be such that the basic insulation and the supplementary insulation can be tested separately unless compliance with regard to the properties of both insulations is provided in another way.

Compliance is checked by inspection.

a) If the basic and the supplementary insulation cannot be tested separately, or if compliance with regard to the properties of both insulations cannot be obtained in another way, the insulation is considered to be reinforced insulation.

b) Specially prepared specimens, or specimens of the insulating parts, are considered to be ways of providing means of determining compliance.

12.1.2 Switches shall be designed so that creepage distances and clearances cannot be reduced, as a result of wear, below the values specified in Clause 20. They shall be constructed so that if any conductive part of the switch becomes loose and moves out of position, it cannot get so disposed in normal use that creepage distances or clearances across supplementary insulation or reinforced insulation are reduced.

Compliance is checked by inspection, by measurement and by manual test.

For the purpose of this test:

– *it is not to be expected that two independent fixings will become loose at the same time;*
– *parts fixed by means of screws or nuts provided with locking washers are regarded as not liable to become loose, provided that these screws or nuts are not required to be removed during user maintenance or servicing;*
– *springs and spring parts are not regarded as being liable to become loose or fall out of position if they do not do so during the tests of Clauses 18 and 19.*

12.1.3 Integrated conductors shall be rigid, fixed, or insulated so that in normal use creepage distances and clearances ~~cannot~~ shall not be reduced below the values specified in Clause 20.

~~Such~~ Insulation, if any, shall be such that it cannot be damaged during mounting or in normal use.

Compliance is checked by inspection and by the tests of Clause 20.

If the insulation of a conductor is not at least electrically equivalent to that of cables and cords complying with the appropriate IEC standard ~~and~~ or does not comply with the dielectric strength test made between the conductor and metal foil wrapped around the insulation under the conditions specified in Clause 15, the conductor is considered to be a bare conductor.

~~**12.1.4** For electronic switches with combinations of semiconductor switching devices and mechanical switching devices, the contacts connected in series with the semiconductor switching device shall be in compliance with the requirements for full disconnection or micro-disconnection.~~

~~**12.1.5** For mechanical switching devices connected in parallel to the semiconductor switching devices, no requirements concerning the type of disconnection are specified.~~

12.1.4 Full disconnection or micro-disconnection can only be achieved using a series mechanical contact (without a parallel path or a parallel path evaluated using the impulse withstand test).

12.1.5 Electronic disconnection is formed by any parallel components or path across a series contact, or when no mechanical contact is provided in the switch.

12.2 Constructional requirements relating to safety during mounting and normal operation of the switch

12.2.1 Covers, cover plates, removable actuators and the like providing safety shall be fixed in such a way that they cannot be displaced or removed except by use of a tool. The fixings for a cover or cover plate shall not serve to fix any other part except an actuating member.

It shall not be possible to mount removable parts, for example cover PLATES bearing indicators or knobs, such that indication of switch positions does not correspond with the actual switch position.

12.2.2 Fixing screws of covers or cover plates shall be captive.

The use of tight-fitting washers of cardboard or similar material is deemed to be adequate for this purpose.

12.2.3 A switch shall not be damaged when its actuating member is removed as intended.

Compliance with the requirements of 12.2.1, 12.2.2 and 12.2.3 is checked by inspection ~~and, for actuating members which do not require a tool for their removal, by the tests of 18.4~~ after removing the actuating member and, by the tests of 18.3 and 18.4.

12.2.4 A pull-cord shall be insulated from live parts and designed such that it shall be possible to fit or to replace it without removing parts causing live parts to become accessible.

Compliance is checked by inspection.

12.2.5 If an illuminated indicator is incorporated in a switch, it shall provide the correct indication as declared by the manufacturer.

Compliance is checked by connecting the switch to a voltage not deviating by more than ± 10 % of the marked voltage for the lamp circuit or rating of the switch, whichever is applicable.

12.3 Constructional requirements relating to the mounting of switches and to the attachment of cords

12.3.1 Switches shall be designed so that the methods of mounting in accordance with the manufacturer's declarations do not adversely affect compliance with this standard.

~~**12.3.1.1**~~ These methods of mounting shall be such that the switch cannot rotate, or be otherwise displaced, and cannot be removed from an appliance without the aid of a tool. If the removal of a part, such as a key, is necessary during the normal use of the switch, then the requirements of Clauses 9, 15 and 20 shall be satisfied before and after such removal.

Compliance is checked by inspection and by manual test.

a) *Switches fixed by a nut and a single bush concentric with the actuating means are deemed to comply with this requirement, provided that the tightening and/or loosening of the nut requires the use of a tool, and that the parts have adequate mechanical strength.*
b) *An incorporated switch mounted by screwless fixing is deemed to comply with this requirement if the use of a tool is required before the switch can be removed from the appliance.*

12.3.2 A conductor intended to be disconnected, shall indicate an obvious method for insertion and disconnection of the conductors. The intended disconnection of a conductor shall require an operation, other than a pull at the conductor.

12.3.3 Openings for the use of a tool intended to assist the insertion or disconnection shall be clearly distinguishable from the opening for the conductor.

13 Mechanism

~~For electronic switches, these requirements apply only to those electronic switches provided with mechanical switching devices.~~

~~**13.1** For d.c. switches, the speed of contact making and breaking shall be independent of the speed of actuation, except for those switches with either a rated voltage not exceeding 28 V or a rated current not exceeding 0,1 A.~~

~~**13.2** Switches shall be constructed so that the moving contacts can come to rest only in the "ON" and "OFF" positions. An intermediate position is permissible if it corresponds to an intermediate position of the actuating member providing that this does not give a misleading indication of a marked "OFF" position and that the separation of the contacts is then adequate.~~

~~A switch is deemed to be in the "ON" position as soon as the contact pressure is sufficient to ensure compliance with the requirements of clause 16.~~

~~A switch is deemed to be in the "OFF" position when the separation of the contacts is sufficient to ensure compliance with the requirements of clause 15.~~

~~The adequacy of the separation of the contacts in an intermediate position is determined by compliance with the requirements of clause 15 as specified for the adjacent "OFF" position.~~

Switches with series contacts shall comply with the following:

13.1 For DC switches with a voltage rating above 28 V dc in combination with a current rating above 0,1 A the speed of contact making and breaking shall be sufficiently independent of the speed of actuation.

Compliance is checked during the test TC10 according to Clause 17 of IEC 61058-1-1:2016 or IEC 61058-1-2:2016.

13.2 A switch with an intermediate position shall not create an unintended operation.

Compliance with the requirement is checked by the test in 15.3. With the actuator in the intermediate position, apply the withstand test voltage in Table 8 for declared type of disconnection in 7.14 between the adjacent terminals associated with the disconnection.

13.3 When the actuating member is released, it shall take up automatically or stay in the position corresponding to that of the moving contacts, except that, for switches which have only one rest position, the actuating member may take up its normal rest position.

Compliance with the requirements of ~~13.1, 13.2 and~~ 13.3 is checked by manual test, the switch being mounted according to the manufacturer's declarations and the actuating member being actuated as in normal use.

If necessary, the adequacy of the separation of the contacts in an intermediate position is determined by a dielectric strength test in accordance with 15.3, the test voltage being applied between the relevant terminals, without removing any cover.

13.4 A cord-operated switch (pull cord) shall be constructed so that, after actuating the switch and releasing the cord, the relevant parts of the mechanism are in a position from which they allow the immediate performance of the next movement in the cycle of actuation.

Compliance is checked by inspection and by the following test.

Cord-operated switches shall be actuated from any one position, to the next position, by the application and removal of a steady pull not exceeding 45 N vertically downwards, or 70 N at 45° to the vertical, with the switch mounted as declared.

13.5 Multi-pole switches shall make and break all related poles substantially together unless otherwise declared according to ~~6.2 of~~ Table 3 "Operating sequence". For switches with switched neutral, the neutral may make before and break after the others.

Compliance is checked by inspection and, if necessary, by test.

14 Protection against ingress of solid foreign objects, ingress of ~~dust,~~ water and humid conditions

14.1 Protection against ingress of solid foreign objects

Switches shall provide the declared degree of protection as in 13.3 of IEC 60529:1989, against solid foreign objects when mounted and used as declared.

Compliance is checked by the appropriate test specified in IEC 60529.

Detachable parts are removed. A switch which relies on mounting in, or on, an appliance for the declared degree of protection against solid foreign objects shall be suitably mounted in, or *on, a closed box to simulate the appliance, and the tests shall be performed using this simulated assembly.*

For numerals 5 and 6, the test is carried out according to category 2 with the specimen in the most unfavourable position considering the manufacturer's declarations continued for a period of 8 h. During the 8 h period, the specimen under test shall be alternatively loaded for 1 h with the maximum rated current and 1 h without current.

For the test for first characteristic numeral 5, the switch is deemed to comply if

– *all actions function as declared;*
– *the temperature rise at the terminals does not exceed 55 K when tested in accordance with Clause 16, with the exception that the temperature-rise test at the terminals is carried out at rated current and at an ambient temperature of 25 °C ± 10 °C;*
– *the dielectric strength requirement of 15.3 applies with the exception that the specimens are not subjected to the humidity treatment before the application of the test voltage. The test voltage shall be 75 % of the corresponding test voltage specified in 15.3;*
– *there is no evidence that transient fault between live parts and earth metal, accessible metal parts, or actuating members has occurred.*

For the test for first characteristic numeral 6, the protection is satisfactory if no deposit of dust is observable inside the switch at the end of the test.

~~**14.2 Protection against ingress of dust**~~

~~Switches shall provide *the* declared degree of protection against ingress of dust when mounted and used as declared.~~

~~*Compliance is checked by the dust test according to IEC 60529, test for first characteristic numeral 5 or 6.*~~

~~*a) The test is carried out according to category 2 of IEC 60529.*~~

~~*b) The switches are placed in a position of normal use inside the test chamber. Detachable parts are removed. A switch which relies on mounting in, or on, an appliance for the declared degree of protection against ingress of dust shall be suitably mounted in, or on, a closed box to simulate the appliance, and the tests shall be performed using this simulated assembly.*~~

~~*c) The test shall be continued for a period of 8 h. During the 8 h period, the switch under test shall be alternatively loaded for 1 h with the maximum rated current and 1 h without current.*~~

~~*d) For the test for first characteristic numeral 5, the switch is deemed to comply if*~~

~~– *all actions function as declared;*~~
~~– *the temperature rise at the terminals does not exceed 55 K when tested in accordance with Clause 16, with the exception that the temperature-rise test at the terminals is carried out at rated current and at an ambient temperature of 25 °C ± 10 °C;*~~
~~– *the dielectric strength requirement of 15.3 applies with the exception that the specimens are not subjected to the humidity treatment before the application of the test voltage. The test voltage shall be 75 % of the corresponding test voltage specified in 15.3;*~~
~~– *there is no evidence that transient fault between live parts and earth metal, accessible metal parts, or actuating members has occurred.*~~

~~*e) For the test for first characteristic numeral 6, the protection is satisfactory if no deposit of dust is observable inside the switch at the end of the test.*~~

~~*f) The switch shall be tested in the most unfavourable position taking into consideration the manufacturer's declarations.*~~

14.2 Protection against ingress of water

Switches shall provide the declared degree of protection against ingress of water when mounted and used as declared.

Compliance is checked by the appropriate tests specified in IEC 60529 with the switch placed in any position of normal use. Switches are allowed to stand at 25 °C ± 10 °C for 24 h before being subjected to the following test.

The test is then carried out according to IEC 60529 as follows:

– IPX1 switches as described in 14.2.1 with the drain holes open;

– IPX2 switches as described in 14.2.2 with the drain holes open;

– IPX3 switches as described in 14.2.3 with the drain holes closed;

– IPX4 switches as described in 14.2.4 with the drain holes closed;

– IPX5 switches as described in 14.2.5 with the drain holes closed;

– IPX6 switches as described in 14.2.6 with the drain holes closed;

– IPX7 switches as described in 14.2.7 with the drain holes closed;

– IPX8 switches as described in 14.2.8 with the drain holes closed;

– IPX9 switches as described in 14.2.9 with the drain holes closed.

Immediately after the appropriate test, the switch shall withstand the dielectric strength test specified in 15.3, and inspection shall show that there is no trace of water on insulation which could result in a reduction of creepage and clearance below the values specified in Clause 20.

a) *The switch shall not be electrically loaded during these tests. The water temperature shall not differ from that of the switch by more than 5 K.*

b) *Detachable parts are removed.*

c) *Switches incorporating separate gaskets, screwed glands, membranes or other sealing means, manufactured from rubber or thermoplastic materials are aged in a heating cabinet with an atmosphere having the composition and pressure of the ambient air and ventilated by natural circulation.*

d) *Switches ~~without T-rating~~ declared 7.3.1 are kept in the cabinet at a temperature of 70 °C ± 2 °C, and switches ~~with T-rating~~ declared 7.3.2 and 7.3.3 are kept in the cabinet at a temperature of T + 30 °C for 240 h. If the switch is declared according to 7.3.3, the "T" equals the lower of the two values following the letter T in 8.4.2. Switches with glands or membranes are fitted and connected with conductors as specified in Clause 11. Glands are tightened with a torque as specified in Table 11. Fixing screws for enclosures are tightened with a torque as specified in Table 10.*

e) *Immediately after ageing, the parts are taken out of the cabinet and left at 25 °C ± 10 °C, avoiding direct daylight, for at least 16 h.*

f) *A switch which relies on mounting in, or on, an appliance for the declared degree of protection against harmful ingress of water shall be suitably mounted in, or on, a closed box to simulate the appliance, and the tests shall be performed using this simulated assembly.*

g) *For the tests of second characteristic numerals 3 and 4, preferably the hand-held spray nozzle specified in IEC 60529 shall be used.*

14.3 Protection against humid conditions

All switches shall be ~~proof~~ protected against humid conditions which may occur in normal use.

Compliance is checked by the humidity treatment described in this subclause, followed immediately by the tests of 15.2 and 15.3. Cable inlet openings, if any, and drain-holes are left open. If a drain-hole is provided for a water-tight switch, it is opened.

a) *Before being placed in the humidity cabinet, the specimens are brought to a temperature between t and t + 4 °C (where t is the steady state temperature of the humidity chamber).*

b) *Detachable parts are removed and subjected, if necessary, to the humidity treatment with the main part.*

c) *The humidity treatment is carried out in a humidity cabinet containing air maintained within ~~± 1~~ 5 °C of any convenient value (t) between 20 °C and 30 °C, with a relative humidity ~~between~~ above 91 % ~~and 95%~~. The specimens are kept in the cabinet for a minimum of 96 h.*

d) *~~Immediately after this treatment, the tests of 15.2 and 15.3 are made either in the humidity cabinet, or in the room in which the specimens were brought to the prescribed temperature after the reassembly of any detached parts.~~ After removing the specimens from the cabinet, the testing of 15.2 and 15.3 shall be completed within 2 h under ambient conditions.*

The switch shall not show any damage such as to impair compliance with this standard.

~~NOTE 1~~ In most cases, the specimens may be brought to the specified temperature by keeping them at this temperature for at least 4 h before the humidity treatment.

~~NOTE 2~~ In order to achieve the specified conditions within the cabinet, it is necessary to ensure constant circulation of the air and, in general, to use a cabinet which is thermally insulated.

15 Insulation resistance and dielectric strength

15.1 General requirements

The insulation resistance and the dielectric strength of switches shall be adequate.

Compliance is checked by the tests of 15.2 and 15.3, these tests being made immediately after the test of 14.3.

The test voltage according to Table 8 is applied in the case of:

– *~~operational~~ Functional insulation: between the different poles of a switch. For the purpose of the test, all the parts of each pole are connected together;*

– *Basic insulation: between all live parts connected together and a metal foil covering the outer accessible surface of the basic insulation and accessible metal parts in contact with the basic insulation;*

– *double insulation: between all live parts connected together and a metal foil covering the outer, normally not accessible surface of basic insulation and non-accessible metal parts; and following this: between two metal foils covering separately the inner, normally not accessible surface of supplementary insulation and connected to non-accessible metal parts, and the outer, accessible surface of supplementary insulation and connected to accessible metal parts;*

– *reinforced insulation: between all live parts connected together and a metal foil covering the outer accessible surface of reinforced insulation and accessible metal parts.*

– *contacts: between the open contacts of each pole of a switch.*

The foils are not pressed into openings but are pushed into corners and the like by means of the ~~standard~~ jointed test finger (test probe B according to IEC 61032).

In cases where basic insulation and supplementary insulation cannot be tested separately, the insulation provided is subjected to the test voltages specified for reinforced insulation.

~~For electronic switches, the test is carried out across full disconnection and micro-disconnection only on electronic switches with mechanical switching devices connected in series with the semiconductor switching device.~~

~~*For electronic switches,*~~ *The tests are not carried out across protective impedances and poles interconnected by components.*

15.2 Measurement of insulation resistance

The insulation resistance is measured with a DC voltage of approximately 500 V applied, the measurement being made 60 s after application of the voltage.

The insulation resistance shall not be less than specified in Table 7.

NOTE Materials such as ceramic or porcelain are considered to have adequate insulation resistance and are not subjected to the insulation resistance tests.

Table 7 – Minimum insulation resistance

Insulation to be tested	Insulation resistance MΩ
Functional	2
Basic	2
Supplementary	5
Reinforced	7

15.3 Insulation test voltage

The insulation is subjected to a voltage of substantially sine-wave form, having a frequency of 50 Hz or 60 Hz. The test voltage shall be raised uniformly from ~~0 V~~ a value not greater than the rated voltage to the value specified in Table 8 within not more than 5 s and held at that value for ~~5~~ 60 s.

No flashover or breakdown shall occur. Glow discharges without drop in voltage are neglected.

Table 8 – Dielectric strength

Insulation or disconnection to be tested[2)]	Test voltage (r.m.s.)[1)]			
	rated voltage up to and including 50 V	rated voltage above 50 V up to and including 130 V	rated voltage above 130 V up to and including 250 V	rated voltage above 250 V up to and including ~~440~~ 480 V
	V	V	V	V
Functional insulation[3)]	500	1 300	1 500	1 500
Basic insulation[4)]	500	1 300	1 500	1 500
Supplementary insulation[4)]	–	1 300	1 500	1 500
Reinforced insulation[4) 5)]	500	2 600	3 000	3 000
Across electronic disconnection	100	400	500	700
Across micro- disconnection	100	400	500	700
Across full disconnection	500	1 300	1 500	1 500

NOTE 1 Up to 50 V: Not intended to be connected direct to the mains and not expected to be subjected to temporary overvoltagesas defined in IEC ~~60364-4-442~~ 61140.

NOTE 2 Over 50 V: The values are based on IEC ~~60364-4-442~~ 61140.

– For functional, basic and supplementary insulation, and for full disconnection, the values are calculated with the formula: U_N + 1 200 V and rounded.

– For micro and electronic disconnection, the values are calculated with the formula: U_N + 250 V and rounded.

~~NOTE 3 In this standard, the maximum voltage considered between line and neutral is UN = 300 V.~~

~~1) The high-voltage transformer used for the test shall be designed so that, when the output terminals are short-circuited after the output voltage has been adjusted to the test voltage, the output current is at least 200 mA.~~

1) The overcurrent relay shall not trip when the output current is less than 100 mA. Care is taken that the r.m.s. value of the test voltage is measured within ±3 %.

2) Special components which might render the test impractical such as discharge lamps, coils, windings, or capacitors are disconnected at one pole, or bridged, as appropriate to the insulation being tested. Where this is not practical on the specimens to be used for the test of Clauses 16 and 17 in IEC 61058-1-1:2016 or IEC 61058-1-2:2016, the test of 15.3 shall be carried out on additional specimens. These may be special specimens with the appropriate components omitted.

3) An example is the insulation between poles (see definition 3.1.4).

4) For the test of basic, SUPPLEMENTARY and REINFORCED INSULATION, all LIVE PARTS are connected together and care is taken to ensure that all moving parts are in the most onerous position.

5) For SWITCHES incorporating REINFORCED INSULATION as well as DOUBLE INSULATION, care is taken that the voltage applied to the REINFORCED INSULATION does not overstress the basic or the supplementary parts of the DOUBLE INSULATION.

16 Heating

16.1 General requirements

Switches shall be constructed so that they do not attain excessive temperatures in normal use. The materials used shall be such that the performance of the switches is not adversely affected by operation in normal use at the ~~maximum rated current or declared thermal current and~~ rated temperature of the switch.

The procedure to conduct the compliance test is described in 16.4.

16.2 Contacts and terminals

~~16.2.1~~ The material and design of the contacts and terminals shall be such that the operation and performance of the switch is not adversely affected by their oxidation or other deterioration.

~~16.2.2~~ *Compliance is checked by ~~inspection~~ Clause 17.*

~~*The tests are carried out as follows.*~~

~~*a) Switches with terminals for unprepared conductors are fitted with conductors of a minimum length of 1 m, unless the manufacturer declares a length below 1 m, and having the medium cross-sectional area specified in table 4.*~~

~~*b) Switches with terminals for prepared conductors are fitted with conductors of a length of 1 m or less, if so declared by the manufacturer, and having the appropriate cross-sectional area as declared by the manufacturer.*~~

~~*c) Terminal screws and/or nuts are tightened with a torque equal to two-thirds of that specified in the appropriate column of table 20.*~~

~~*d) Actuating members of biased switches are fixed in the declared "ON" position.*~~

~~*e) On switches fitted with screwless terminals, care should be taken to ensure that the conductors are correctly fitted to the terminals in accordance with clause 11.*~~

~~*f) The poles of switches which make simultaneously may be connected in series by means of conductors. The minimum length of the conductors between two poles shall be 1 m unless the manufacturer declares a length below 1 m.*~~

~~*g) The switches are placed or mounted as declared in a suitable heating or refrigerating cabinet without forced convection.*~~

~~NOTE 1 A cabinet with forced convection may be used, provided the test specimen(s) is (are) not effected by this forced convection.~~

~~NOTE 2 Electronic switches need not be placed in a heating or refrigerating cabinet.~~

~~*h) Switches with a T-rating up to and including 55 °C are tested at a temperature of 20 °C ± 2 °C without forced convection. Switches with T-rating above 55 °C are placed in a heating cabinet without forced convection and the temperature is raised to the T-rating of the switch. The temperature of the cabinet is maintained at T ± 5 °C or T ± 0,05 T, whichever is greater.*~~

~~*i) The temperature of the air in which the specimens are placed shall be measured as near as possible to the centre of the space occupied by the specimens and at a distance approximately 50 mm from the specimen.*~~

~~*j) The test circuit is shown in figure 18. The load is set with switch A closed.*~~

~~*The specimens are subjected to 20 operating cycles with no current flowing. The actuating member is left in the most unfavourable "ON" position and the switches are loaded with a current of 1,06 times the maximum rated current for resistive load. If there are more "ON" positions, then the verification shall be realized at the most unfavourable one. Any convenient a.c. or d.c. voltage may be used for the test circuit.*~~

~~*In case of doubt about the test results, the test shall be carried out at the rated voltage and rated resistive load current. For switches designed for a.c. voltage and switches rated for d.c. voltage where no polarity is given, the test performed with d.c. voltage shall be performed in both polarities and an average value calculated.*~~

~~*Multiway switches classified according to 7.1.13.4.1 to 7.1.13.4.5 are loaded as specified in 17.2.1.1 resulting in the maximum heating.*~~

~~*The division of the individual loads for switches for declared specific load shall follow the manufacturer's declaration.*~~

~~*k) Components (other than contacts and their associated current-carrying parts) which may produce heat or influence the temperature at the terminals are not energized during the test. These components should be disconnected, or the voltage for the test chosen to ensure the minimum heating effect.*~~

~~*l) The maximum rated current is maintained at least for 1 h or until a constant temperature at the terminals is attained. A temperature is considered to be constant when three successive readings taken at intervals of 5 min indicate no change greater than ±2 °C.*~~

~~NOTE Care should be taken to ensure that the test current remains stable during the duration of this test.~~

~~*m) Temperature at the terminals is determined by means of fine wire thermocouples which are positioned so that they have negligible effect on the temperature being determined, the measuring points are positioned on the terminals as close as possible to the body of the switch. If the thermocouples cannot be positioned directly on the terminals, the thermocouples may be fixed on the conductors as close as possible to the switch.*~~

~~*n) The temperature rise at the terminals shall not exceed 45 K.*~~

~~*o) For electronic switches, the following additional test conditions apply:*~~

- ~~*for the tests of electrical contacts connected in series with a semiconductor switching device, the semiconductor switching device is short-circuited;*~~
- ~~*cord switches shall be tested laying on a dull black painted plywood surface in the normal position;*~~
- ~~*if the switch has a mechanical contact which is connected in parallel to the semiconductor switching device, the temperature rise is measured immediately before the contacts close. Alternatively, the temperature rise of the switch may be measured on specially prepared specimens:*~~
  - ~~*switches classified according to 7.1.17.1, 7.1.17.2 and 7.1.17.4 are tested as prescribed in a) to n), using resistive load;*~~
  - ~~*switches for specific test conditions of end application (see 7.1.17.3) are tested in or together with the appliance(s).*~~

16.3 Other parts

~~**16.3.1** Other parts of switches shall not attain excessive temperatures such that the performance or operation of the switch is impaired or a hazard is presented to the user and/or the immediate surroundings of the switch in normal use.~~

~~**16.3.2** *For mechanical switches, compliance is checked by the following tests.*~~

~~*a) The switches shall be mounted as declared and fitted with conductors and loaded with a test current as prescribed in 16.2.2 with the additional requirement that the test on all switches is carried out at the maximum rated temperature.*~~

~~*b) For switches only partially suitable for a rated ambient temperature higher than 55 °C, those parts which are accessible when the switch is mounted as declared shall be exposed to a temperature not higher than 55 °C.*~~

~~*c) The temperature of metal mounting surfaces of the test equipment shall be between T and 20 °C.*~~

~~*d) If other heating sources are incorporated or integrated in the switch, these circuits shall be of the maximum power declared and are connected to a supply having a voltage between 0,94 and 1,06 times the rated voltage, whichever will produce the most heat.*~~

~~NOTE Examples of such heating sources are tungsten filament lamps or discharge lamp assemblies incorporating resistors.~~

~~*e) The temperature of the parts and/or surfaces of the switch indicated in table 13 shall be determined by means of fine wire thermocouples or other equivalent means, so chosen and positioned that they have the minimum effect on the temperature of the part under test.*~~

~~*f) Thermocouples used for determining the temperature of surfaces are attached to the back of blackened discs of copper or brass 5 mm in diameter and 0,8 mm thick.*~~

~~*As far as possible, the discs are positioned on that part of the surface likely to attain the highest temperature in normal use.*~~

~~*g) In determining the temperature of actuating members, consideration has to be given to all parts which are gripped in normal use and to non-metallic parts where they are in contact with hot metal.*~~

~~*h) During this test, the temperatures shall not exceed the values specified in table 13.*~~

~~NOTE The temperature limits of table 13 are based on the values specified in IEC 60335-1. Since these values are under consideration, it will be necessary to review them.~~

~~**16.3.3** *For electronic switches, compliance is checked by the following tests.*~~

~~*a) The electronic switch shall be mounted as declared and fitted with conductors in accordance with table 4. The tests are carried out at the maximum rated temperature.*~~

~~*The test circuit is shown in figure 18. The load is set at rated voltage with switch A closed.*~~

~~*During the test, the electronic switch shall be energized. The electronic switch is left in the most unfavourable ON position. If there are more than one ON positions, then the verification shall be realized at the most unfavourable one.*~~

~~*If the switch has a mechanical contact which is connected in parallel to the semiconductor switching device, the temperature is recorded in the position immediately before the contact closes.*~~

~~*During the test, the voltage shall be between 0,94 and 1,06 times the rated voltage, whichever produces the most heat.*~~

~~*During the test with thermal current, one or few reference points are selected, and the temperatures are recorded.*~~

~~NOTE 1 The temperature recordings may be used for comparative heating tests in the end application under maximum current and cooling conditions.~~

~~*The load conditions are as follows:*~~

~~*– for electronic switches for which no thermal current is declared, the tests are carried out with rated current and duty type;*~~

~~*– for electronic switches for which a thermal current is declared, the tests are carried out with the specified thermal current and duty type;*~~

~~*– for electronic switches for a specific end application, the tests are carried out in or together with the appliance.*~~

~~NOTE 2 The heating occurring at full load current of the end application with its rated duty-type, under the cooling conditions present at the end application, should not be higher than the values recorded during the test with thermal current.~~

~~NOTE 3 Information concerning the appropriate reference point(s) (for example, metal heat sink, insulating material related to the heat sink) may be given by the manufacturer.~~

~~*b) For electronic switches only partially suitable for a rated ambient temperature higher than 35 °C or 55 °C (classifications 7.1.3.4 or 7.1.3.1), those parts which are accessible when the electronic switch is mounted as declared shall be exposed to a temperature not higher than 35 °C or 55 °C.*~~

~~*c) The temperature of metal mounting surfaces of the test equipment shall be between T and the ambient temperature.*~~

~~*d) If heating sources other than the electronic components are incorporated or integrated in the electronic switch, these circuits shall be of the maximum power declared and are connected to a supply having a voltage between 0,94 and 1,06 times the rated voltage, whichever will produce the most heat.*~~

~~NOTE Examples of such heating sources are tungsten filament lamps or discharge lamp assemblies incorporating resistors.~~

~~*e) The temperature of the parts and/or surfaces of the switch indicated in table 13 shall be determined by means of fine wire thermocouples or other equivalent means, so chosen and positioned that they have the minimum effect on the temperature of the part under test.*~~

~~*The maximum temperatures of windings are determined by the resistance method by calculating the temperature rise t and adding this value to the ambient temperature.*~~

~~*The temperature rise of copper windings is calculated from the formula:*~~

$$\cancel{t = (R_2 - R_1)(234{,}5 + t_1) / R_1 - (t_2 - t_1)}$$

~~where~~

~~t is the temperature rise;~~

~~R_1 is the resistance at the beginning of the test;~~

~~R_2 is the resistance at the end of the test;~~

~~t_1 is the ambient temperature at the beginning of the test;~~

~~t_2 is the ambient temperature at the end of the test.~~

~~*At the beginning of the test, the windings shall be at ambient temperature.*~~

~~NOTE It is recommended that the resistance of windings at the end of the test be determined by taking resistance measurements as soon as possible after switching off, and then at short intervals so that a curve of resistance against time can be plotted for ascertaining the resistance at the instant of switching off.~~

~~*f) Thermocouples used for determining the temperature of surfaces are attached to the back of blackened discs of copper or brass 5 mm in diameter and 0,8 mm thick.*~~

~~*As far as possible, the discs are positioned on that part of the surface likely to attain the highest temperature in normal use.*~~

~~*g) In determining the temperature of actuating members, consideration has to be given to all parts which are gripped in use and to non-metallic parts where they are in contact with hot metal.*~~

~~*h) The setting, if any, is adjusted in such a way that the highest temperature rise will occur. During the test, the switch state shall not change, fuses and other protective devices shall not operate and the permissible maximum temperatures in table 13, first column, shall not be exceeded.*~~

~~NOTE 1 Small unintended variations of the switch state, for example reversible variation of phase angle, are disregarded.~~

~~NOTE 2 During the test, the temperatures necessary to perform the test of 21.1 and annex E are to be measured.~~

~~**Table 13 – Permissible maximum temperatures**~~

~~**Parts**~~	~~**Maximum temperature**~~	
	~~**Normal conditions Subclauses 16.3.2 and 16.3.3**~~ ~~°C~~	~~**Abnormal conditions Clause 23**~~ ~~°C~~
~~Rubber or polyvinyl chloride insulation of non-detachable cables and cords~~		
~~– without T-marking~~	~~75~~ [1]	~~135~~
~~– with T-marking~~	~~T~~ [2]	~~135~~
~~Cord sheaths used as supplementary insulation~~	~~60~~	~~120~~
~~Rubber other than synthetic, used for gaskets or other parts, the deterioration of which could affect safety:~~		
~~– when used as supplementary insulation or as reinforced insulation~~	~~65~~	~~125~~
~~– in other cases~~	~~75~~	~~135~~
~~Material used as insulation other than that specified for wires:~~		
~~– printed circuit boards~~	[3]	
~~Moulding of~~		
~~– thermosetting materials~~	[4] [9]	[4] [9]
~~– thermoplastic materials~~	[4]	[4]
~~All accessible surfaces except those of actuating members or handles~~	~~85~~	~~100~~
~~Accessible surfaces of actuating members or handles which are held for short periods only~~		
~~– of metal~~	~~60~~	~~100~~
~~– of porcelain or vitreous material~~	~~70~~	~~100~~
~~– of moulded material or rubber~~	~~85~~	~~100~~

~~**Table 13**~~ *~~(suite)~~*

~~**Parts**~~	~~**Maximum temperature**~~	
	~~**Normal conditions Subclauses 16.3.2 and 16.3.3**~~ ~~°C~~	~~**Abnormal conditions Clause 23**~~ ~~°C~~
~~Inside of enclosures of insulating material~~	~~[5]~~	~~[5]~~
~~Windings – Thermal classification [6]:~~		
~~– class A~~	~~100~~	~~135~~
~~– class E~~	~~115~~	~~150~~
~~– class B~~	~~120~~	~~155~~
~~– class F~~	~~145~~	~~180~~
~~– class H~~	~~165~~	~~200~~
~~– class 200~~	~~185~~	~~220~~
~~– class 220~~	~~205~~	~~240~~
~~– class 250~~	~~235~~	~~270~~
~~Terminals and terminations for unprepared conductors~~	~~80 [7]~~	~~125 [8]~~
~~Other terminals and terminations~~	~~[7]~~	~~125 [8]~~

~~[1] This limit applies to cables, cords and wires complying with the relevant IEC standards; for others, it may be different.~~

~~[2] This limit will become applicable as soon as there are IEC standards for high-temperature cables, cords and wires.~~

~~[3] The material must be according to IEC 60893-1. The maximum permissible temperature shall not exceed values which can be proved to be safe in service for the materials in question.~~

~~[4] There is no specific limit. The material shall withstand the test of clause 21, for which purpose the temperature shall be measured.~~

~~[5] The permissible temperature rises at the inside of enclosures of insulating material are those indicated for the relevant materials.~~

~~[6] The thermal classification is the thermal class according to IEC 60085 with the following deductions which take into consideration the conventional difference between the average temperature and the maximum temperature:~~

~~– Classes A and E .... 5 °C~~

~~– Classes B and F .... 10 °C~~

~~– Classes H to 250 .... 15 °C~~

~~[7] The temperature measured shall not exceed 80 °C, unless a higher value has been declared by the manufacturer.~~

~~[8] The temperature measured shall not exceed 125 °C, unless a higher value has been declared by the manufacturer.~~

~~[9] For mechanical switches, the maximum permissible temperature shall not exceed that which can be shown to be safe in service for these materials. The material shall withstand the test of clause 21, for which purpose the temperature shall be measured.~~

~~Table 14 – Temperatures for thermosetting materials used for electronic switches~~

~~Parts~~	~~Maximum temperature~~	
	~~Normal conditions Subclauses 16.3.2 and 16.3.3~~ ~~°C~~	~~Abnormal conditions Clause 23~~ ~~°C~~
~~Material used as insulation other than that specified for wires:~~		
~~– melamine-formaldehyde, phenol-formaldehyde or phenol-furfural resins~~	~~135 (225) 1)~~	~~145 (225) 1)~~
~~– urea-formaldehyde resin~~	~~115 (200) 1)~~	~~125 (200) 1)~~
~~Moulding of:~~		
~~– phenol-formaldehyde with cellulose fillers~~	~~110 (200) 1)~~	~~165 (200) 1)~~
~~– phenol-formaldehyde with mineral fillers~~	~~125 (225) 1)~~	~~185 (225) 1)~~
~~– melamine-formaldehyde~~	~~100 (175) 1)~~	~~175~~
~~– urea-formaldehyde~~	~~90 (175) 1)~~	~~175~~
~~– polyester with glass-fibre reinforcement~~	~~135~~	~~185~~
~~– silicone rubber~~	~~170~~	~~225~~
~~– polytetrafluorethylene~~	~~290~~	~~290~~
~~1) The values in parentheses apply if the material is in contact with hot metal parts, not submitted to electrical stress, however.~~		

16.3.1 Switch parts other than the contacts and terminals, in normal use, shall not attain temperatures which impair the performance or operation of the switch or create a hazard to the user.

Compliance is checked by Clauses 17 and 21.

16.3.2 Insulation for conductors provided with the switch shall be rated not less than the relevant maximum temperature rating of the switch.

Compliance is checked/verified on data provided by switch manufacturer.

16.4 Heating test

Unless declared otherwise, the test is carried out on 3 specimens mounted as declared by the manufacturer.

a) *Conductors of an approximate length of 1 m, are fitted to the terminals or leads. The cross-sectional area shall be as declared or specified in Table 4 "medium".*

NOTE In case of doubt, the cross-sectional area of the conductor is measured to verify that the marked value is the measured value declared or given in Table 4.

b) *Connected conductors when provided are joined to conductors in item a) per the manufacturer's instructions.*

c) *Screw terminals and/or nuts are tightened with a torque equal to two-thirds (2/3) of the appropriate column of Table 10 (see Figures 2 and 6).*

d) *Heating cabinets for testing switches shall be without forced convection or a draught free condition. A cabinet with forced convection may be used, provided the test specimens are not affected by the forced convection.*

e) *The temperature of the air in the heating cabinet is measured as near as possible to the center of the space occupied by the specimens and at a distance not closer than 50 mm to the specimen.*

f) Switches declared as 7.3.2 or 7.3.3, are placed in a heating cabinet and the temperature is raised to the maximum T-rating of the switch. The temperature of the cabinet is maintained at T ± 5 °C or T ± 5 % (T ± 0,05 T), whichever is greater.

g) Partially suitable rated switches declared as 7.3.3, with accessible parts (after the switch is mounted as declared) rated 0 to 55 °C, shall be exposed to a temperature not higher than 55 °C. The internal switch enclosure with a T rating is tested as described for "all parts".

h) The temperature of mounting surfaces of the test equipment shall be between T and 20 °C.

i) The specimens are subjected to 20 operating cycles with no current flowing. The actuating member is left in the most unfavourable "ON" position. If there are more "ON" positions, then the verification shall be realized at the most unfavourable one. Actuating members of biased switches are fixed in the declared "ON" position.

j) Multi-way switches are loaded as specified in 5.3 resulting in the maximum heating.

k) Switches designed for DC only or AC and DC voltage where no polarity is given, the test performed with DC voltage shall be performed in both polarities and an average value calculated.

l) During the test, the switch state shall not change. Fuses and other protective devices shall not operate. Small unintended variations of the switch state, for example reversible variation of phase angle, are disregarded.

m) Any convenient AC or DC voltage may be used for the test circuit as far as the result is not affected.

n) The load is adjusted to allow the maximum rated current. Resistive loads are used unless declared specifically.

o) If the switch is provided with components generating heat in addition to the heat generated by the contacts, these have to be operated in the most unfavourable mode (e.g. semiconducting devices)

p) The ON period is maintained with the test current until a constant temperature at the terminals is attained. A temperature is considered to be constant when three successive readings taken at intervals of 5 min indicate no change greater than ± 2 °C. For a cycling load, after 1 h, the maximum temperature of the cycle is measured.

q) Thermocouples shall measure the temperature of the surfaces of the switch indicated below. Temperatures shall be determined by means of fine wire thermocouples or other equivalent means, so chosen and positioned that they do have the minimum effect on the temperature of the part under test.

During the test, the temperatures necessary to perform the ball pressure test of 21.1 are to be measured. The non-metallic surfaces likely to attain the highest temperature are measured without disassembling the switch.

17 Endurance

~~17.1 General requirements~~

~~**17.1.1** Switches shall withstand without excessive wear or other harmful effect the electrical, thermal and mechanical stresses that occur in normal use.~~

~~*For all switches except electronic switches, compliance is checked as specified in 17.1.2.*~~

~~*For electronic switches, compliance is checked as specified in 17.1.3.*~~

~~*The different types of tests are specified in 17.2.4.*~~

~~**17.1.2** *The sequence of tests for all switches except electronic switches is as follows:*~~

- ~~*a test at high speed specified in 17.2.4.3; this test only applies to switches with more than one pole, and where the type of connection is of polarity reversal;*~~
- ~~*a test at slow speed specified in 17.2.4.2;*~~
- ~~*an increased-voltage test at accelerated speed as specified in 17.2.4.1; this test does not apply to switches classified according to 7.1.2.9;*~~
- ~~*a locked-rotor test as specified in 17.2.4.9 at accelerated speed; this test only applies to switches classified according to 7.1.2.9;*~~
- ~~*a test at accelerated speed as specified in 17.2.4.4;*~~
- ~~*a temperature-rise test in accordance with 16.2, with the exception that the temperature-rise test at the terminals is carried out at rated current and in an ambient temperature of 25 °C ± 10 °C;*~~
- ~~*a dielectric strength test in accordance with 15.3, with the exception that the specimens are not subjected to the humidity treatment before the application of the test voltage. The test voltage shall be 75 % of the corresponding test voltage specified in that subclause.*~~

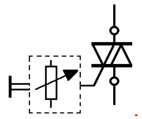
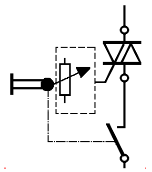
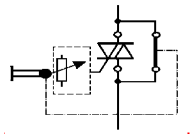
~~**17.1.3** *Electronic switches are tested as specified in table 15 and according to the following test conditions depending on their classification in 7.1.17:*~~

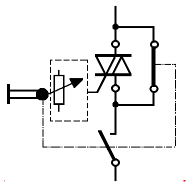
- ~~*under functional test conditions according to 7.1.17.1 with thermal current or with maximum rated resistive current, if no thermal current is declared, and without forced cooling;*~~
- ~~*under simulated test conditions according to 7.1.17.2 and with type of load according to 7.1.2 and under the cooling conditions classified in 7.1.15 and with test conditions as specified in tables 17 and 18;*~~
- ~~*under specific test conditions of end application according to 7.1.17.3, in or together with the appliance and under the cooling conditions of the appliance;*~~
- ~~*under test conditions according to duty type according to 7.1.17.4, the tests may be performed in combination with simulated test conditions or specific test conditions of the end application.*~~

  ~~NOTE Additional mechanical operating means (for example, actuating members such as speed-limit settings for electric tools) are ignored.~~

~~*The electrical, thermal and mechanical conditions of these tests shall be as specified in 17.2.1, 17.2.2 and 17.2.3.*~~

~~Table 15 – Electrical endurance tests for the different types of electronic switches with or without electrical contact(s)~~

~~Type of electronic switch~~[3)]		~~Test conditions~~					
		~~Functional test (7.1.17.1)~~		~~Simulated test (7.1.17.2) (Tables 17, 18)~~		~~Specific test condition of end application (7.1.17.3)~~	
		~~Complete switch~~	~~Contacts only~~	~~Complete switch~~	~~Contacts only~~	~~Complete switch~~	~~Contacts only~~
~~SSD~~ [1)] ~~without electrical contact(s)~~		~~TL1~~ ~~TC5, TC6, TC8~~ ~~TE1, TE3~~	~~—~~	~~TL3~~ ~~TC5, TC6, TC8~~ ~~TE1, TE3~~	~~—~~	~~TL4~~ ~~TC5, TC6, TC8~~ ~~TE1, TE3~~	~~—~~
~~SSD with serial contact(s)~~		~~TL1~~ ~~TC5, TC6, TC8~~ ~~TE1, TE3~~	~~Serial contact:~~ ~~TC1, TC4 with TL2~~ ~~TE1 to TE3~~ ~~(SSD short-circuited)~~ [2)]	~~a) TL1~~ ~~TC5, TC6, TC8~~ ~~TE1, TE3~~ ~~b) TL3~~ ~~TC5, TC6, TC8~~ ~~TE1, TE3~~	~~a) Serial contact:~~ ~~TL3, TC1, TC4~~ ~~TE1 to TE3~~ ~~(SSD short-circuited)~~ [2)] ~~b) Serial contact:~~ ~~TL3, TC1, TC7~~ ~~TE1 to TE3~~ ~~(SSD short-circuited)~~ [2)]	~~TL4~~ ~~TC5, TC8~~ ~~TE1, TE3~~	~~Serial contact:~~ ~~TC7 with TL4~~ ~~TE1 to TE3~~ ~~(SSD short-circuited)~~ [2)]
~~SSD with parallel contact(s)~~		~~TL1~~ ~~TC5, TC6, TC8~~ ~~TE1, TE3~~	~~Parallel contact:~~ ~~TC1, TC4 with TL2~~ ~~TE1 to TE3~~ ~~(SSD disconnected)~~	~~TL3~~ ~~TC5, TC6, TC8~~ ~~TE1, TE3~~	~~Parallel contact:~~ ~~TL3, TC1, TC4~~ ~~TE1 to TE3~~ ~~(SSD disconnected)~~	~~TL4~~ ~~TC5, TC8~~ ~~TE1, TE3~~	~~Parallel contact:~~ ~~TC7 with TL4~~ ~~TE1 to TE3~~ ~~(SSD disconnected)~~

~~SSD with serial and parallel contact(s)~~		~~TL1~~ ~~TC5, TC6, TC8~~ ~~TE1, TE3~~	~~Serial contact:~~ ~~TC1, TC4 with TL2~~ ~~TE1 to TE3~~ ~~(SSD short-circuited)~~ ~~2)~~	~~a) TL1~~ ~~TC5, TC6, TC8~~ ~~TE1, TE3~~ ~~b) TL3~~ ~~TC5, TC6, TC8~~ ~~TE1, TE3~~	~~a) Serial contact:~~ ~~TL3, TC1, TC4~~ ~~TE1 to TE3~~ ~~(SSD short-circuited)~~ ~~2)~~ ~~b) Serial contact:~~ ~~TL3, TC1, TC7~~ ~~TE1 to TE3~~ ~~(SSD short-circuited)~~ ~~2)~~	~~TL4~~ ~~TC5, TC8~~ ~~TE1, TE3~~	~~Serial contact:~~ ~~TC7 with TL4~~ ~~TE1 to TE3~~ ~~(SSD short-circuited)~~ ~~2)~~
			~~Parallel contact:~~ ~~TC1, TC4 with TL2~~ ~~TE1 to TE3~~ ~~(SSD disconnected)~~		~~a) and b) Parallel contact:~~ ~~TL3, TC1, TC7~~ ~~TE1 to TE3~~ ~~(SSD disconnected)~~		~~Parallel contact:~~ ~~TC7 with TL4~~ ~~TE1 to TE3~~ ~~(SSD disconnected)~~

~~**Table 15** *(continued)*~~

~~TL = type of test load:~~

~~TL1 = thermal current or maximum rated resistive current, if no thermal current is declared~~

~~TL2 = maximum rated resistive current~~

~~TL3 = rated load (7.1.2)~~

~~TL4 = declared specific load (7.1.2.5)~~

~~TC = type of test condition:~~

~~TC1 = increased-voltage test at accelerated speed (17.2.4.1)~~

~~TC2 = test at slow speed (17.2.4.2)~~

~~TC3 = test at high speed (17.2.4.3)~~

~~TC4 = test at accelerated speed (17.2.4.4)~~

~~TC5 = manual functional test: 20 times at maximum manual operating speed to perform the full function of the electronic switch (17.2.4.5)~~

~~TC6 = test at minimum load (17.2.4.6)~~

~~TC7 = test condition according to TC4, number of operating cycles: 1 000 or the declared number of cycles whichever is the lowest (17.2.4.7)~~

~~TC8 = full number of operating cycles at accelerated speed (17.2.4.8)~~

~~TE = type of evaluation test:~~

~~TE1 = functional compliance (17.2.5.1)~~

~~TE2 = thermal compliance (17.2.5.2)~~

~~TE3 = insulating compliance (17.2.5.3)~~

~~1) SSD = semiconductor switching device.~~

~~2) The short circuit shall be performed in a way to allow the terminals and contacts and other parts designed for the maximum rated current to be loaded with the maximum rated current.~~

~~3) For combinations of SSD and mechanical contacts, where the function of the SSD and the mechanical contacts are independent of each other, the requirements of this part of IEC 61058 apply for the mechanical contacts.~~

~~a/b) Testing shall be completed using either method "a" or method "b". The same method shall be used for both complete switch and the contacts only testing. Testing with series and parallel contacts, the parallel contact test is added to either method "a" or "b". Testing to both method "a" and method "b" is not required.~~

~~**17.1.4** After all the tests specified, the specimens shall meet the requirements of 17.2.5.~~

~~17.2 Electrical endurance tests~~

~~17.2.1 Electrical conditions~~

~~**17.2.1.1** *The switch shall be loaded as specified in table 17 and/or table 18 and connected in accordance with the circuit(s) as given in table 2 if applicable, following the declaration according to 7.1.13.*~~

~~*Switches of a declared specific type and/or connection are connected and loaded as specified by the manufacturer.*~~

~~*Circuits and contacts which are not intended for external loads are operated with the designated load.*~~

~~*Where, in table 2, an auxiliary switch (A) is symbolized in the test circuit, the tests for the two ON-positions of the specimen (S) are performed on two separate sets of test samples. The connection to the test load to be performed for the two tests is symbolized in table 2 by an auxiliary switch A.*~~

~~*Multiway switches classified according to 7.1.13.4.2 to 7.1.13.4.5 are loaded according to table 16.*~~

~~Table 16 – Test loads for multiway switches~~

~~Operating cycles~~	~~Switch position of~~	~~Type of switch Subclause~~	~~Load~~
~~First half~~	~~Highest load~~	~~7.1.13.4.2 to 7.1.13.4.5~~	~~I_R~~
	~~Next lower load~~	~~7.1.13.4.2 to 7.1.13.4.5~~	~~0,8 × I_R~~
	~~Further next lower load~~	~~7.1.13.4.5~~	~~0,533 × I_R~~
~~Second half~~	~~Highest load~~	~~7.1.13.4.2 to 7.1.13.4.5~~	~~I_R~~
	~~Next lower load~~	~~7.1.13.4.2 to 7.1.13.4.5~~	~~0,5 × I_R~~
	~~Further next lower load~~	~~7.1.13.4.5~~	~~0,333 × I_R~~

~~*The load for the other switch positions is that resulting from the loads necessary to achieve the conditions specified above.*~~

~~*For circuits according to 7.1.2.7 for specific lamp load, the connection and test load is as specified by the manufacturer using the maximum occurring inrush current at room temperature.*~~

~~*No electrical endurance tests are necessary for switches for 20 mA load as classified in 7.1.2.6.*~~

~~NOTE For a specific lamp load, it is recommended that the specimen be operated with loads that are used in the field rather than with synthetic loads. Forced cooling of the specific lamp load may be applied in order to ensure cold resistance for each operating cycle and shorten the test time.~~

~~*For electronic switches, the test circuit shall be as shown in figure 19. The declared load shall be set at rated voltage before the electronic switch is inserted into the circuit.*~~

~~**17.2.1.2** *When increased-voltage conditions are specified, the loads used are those specified for tests at rated voltage, the voltage then being increased to 1,15 the rated voltage.*~~

~~*For test circuits for capacitive load tests and simulated lamp load tests for a.c. circuits, the test voltage is the rated voltage and the test currents are increased to 1,15 rated currents.*~~

~~**Table 17 – Test loads for electrical endurance tests for a.c. circuits**~~

~~**Type of circuit as classified in 7.1.2**~~	~~**Operation of contacts**~~	~~**Test voltage**~~	~~**Test current r.m.s.**~~	~~**Power factor**~~ [3]
~~Substantially resistive (classified in 7.1.2.1)~~	~~Making and breaking~~	~~Rated voltage~~	~~*I-R*~~	~~≥0,9~~
~~Resistive and/or motor (classified in 7.1.2.2)~~	~~Making~~ [2]	~~Rated voltage~~	~~6 × *I-M* or *I-R*~~ [1]	~~0,60 (+0,05)~~ ~~≥0,9~~
	~~Breaking~~	~~Rated voltage~~	~~*I-R* or *I-M*~~ [1]	~~≥0,9~~ ~~≥0,9~~ [5]
~~Circuit for specific load of motor with a locked rotor and with a power factor not less than 0,6 (classified in 7.1.2.9)~~	~~Making~~	~~Rated voltage~~	~~6 × *I-M*~~	~~0,60 (+0,05)~~
	~~Breaking~~	~~Rated voltage~~	~~6 × *I-M*~~	~~0,60 (+0,05)~~
~~Circuit for an inductive load (classified in 7.1.2.8)~~	~~Making~~ [2]	~~Rated voltage~~	~~6 × *I-I*~~	~~0,60 (+0,05)~~
	~~Breaking~~	~~Rated voltage~~	~~*I-I*~~	~~0,60 (+0,05)~~
~~Resistive and capacitive (classified in 7.1.2.3)~~	~~Making and breaking~~	~~Tested in a circuit as shown in figure 9a~~		
~~Tungsten filament lamp load (classified in 7.1.2.4)~~	~~Making and breaking~~	~~Tested in a circuit as shown in figure 9a~~ [4] ~~– Rated voltage ≥ 110 V a.c., *X* = 16~~ ~~– Rated voltage < 110 V a.c., *X* = 10~~		
~~Circuit for specific lamp load (classified in 7.1.2.7)~~	~~Making and breaking~~	~~Rated voltage~~	~~As determined by load~~	
~~Specific declared (classified in 7.1.2.5)~~	~~Making and breaking~~	~~Rated voltage~~	~~As determined by load~~	

~~NOTE *I-I*: inductive load current~~

~~*I-M*: motor load current~~

~~*I-R*: resistive load current~~

~~1) Whichever is arithmetically greater or the most unfavourable value in case of equal values.~~

~~2) The specified making conditions are maintained for a period between 50 ms and 100 ms, and are then reduced by an auxiliary switch to the specified breaking conditions.~~

~~For all switches except electronic switches the test current may be reduced to *I-R* by introducing a resistor in the circuit. Short interruptions of the test current during the reduction to *I-R* not exceeding a period of 50 ms to 100 ms are permitted.~~

~~For electronic switches, the reduction to the break current should be achieved without any open circuiting of the simulated inductive loads circuit, to ensure that no abnormal voltage transients are generated.~~

~~A typical method of achieving this is shown in figure 19.~~

~~3) Resistors and inductors are not connected in parallel except that if any air-core inductor is used, a resistor taking approximately 1 % of the current through the inductor is connected in parallel with it. Iron-core inductors may be used provided that the current has a substantial sine-wave form. For three-phase tests, three-core inductors are used.~~

~~4) In the case where the tests are performed with tungsten filament lamp bulbs, the following test conditions apply:~~

~~– the ratio *X* = 16 or *X* = 10 shall be achieved;~~

~~– the cold resistance of the lamps shall be ensured for each operating cycle;~~

~~– the resistance of connections within the load circuit (for example lamp sockets) shall be constant;~~

~~– the proper function of the lamps performing the load set shall be ensured for each operating cycle.~~

~~5) The test circuit condition for testing electronic switches, according to figure 18, shall be substantially resistive.~~

~~Table 18 – Test loads for electrical endurance tests for d.c. circuits~~

~~Type of circuit as classified in 7.1.2~~	~~Operation of contacts~~	~~Test voltage~~	~~Test current~~	~~Time constant~~
~~Substantially resistive load~~	~~Making and breaking~~	~~Rated voltage~~	~~*I* R~~	~~*L*/*R* ≤ 1,15 ms~~
~~Tungsten filament lamp load (classified in 7.1.2.4)~~	~~Making and breaking~~	~~Tested in a circuit as shown in figure 9b – Rated voltage ≥ 110 V d.c., *X* = 16 – Rated voltage < 110 V d.c., *X* = 10 1)~~		
~~Resistive and capacitive load (classified in 7.1.2.3)~~	~~Making and breaking~~	~~Tested in a circuit as shown in figure 9b~~		
~~Circuit for specific lamp load (classified in 7.1.2.7)~~	~~Making and breaking~~	~~Rated voltage~~	~~As determined by load~~	
~~Declared specific load (classified in 7.1.2.5)~~	~~Making and breaking~~	~~Rated voltage~~	~~As determined by load~~	
~~NOTE *I* R: resistive load current~~				
~~1) In case where the tests are performed with tungsten filament lamp bulbs, the following test conditions apply: – the ratio *X*=16 or *X*=10 shall be achieved; – the cold resistance of the lamps shall be ensured for each operating cycle; – the resistance of connections within the load circuit (for example, lamp sockets) shall be constant; – the proper function of the lamps performing the load set shall be ensured for each operating cycle.~~				

~~17.2.2 Thermal conditions~~

~~**17.2.2.1** *For switches according to 7.1.3.2 and 7.1.3.4.2, the tests in 17.2.4.4 are carried out for the first half of the test period at maximum ambient air temperature °C and for the second half of the test period at 25 °C ± 10 °C or at the minimum ambient air temperature °C if T is less than 0 °C.*~~

~~**17.2.2.2** *For switches according to 7.1.3.3, during the tests in 17.2.4.4, those parts that are declared for use at 0 °C to 55 °C shall be exposed to a temperature within this range for the complete test period.*~~

~~*The ambient air temperature of the remainder of the switch shall, for the first half of the test period, be maintained at the maximum ambient air temperature °C.*~~

~~*For the second half of the test period the tests are carried out at 25 °C ± 10 °C or at the minimum ambient air temperature °C if T is less than 0 °C.*~~

~~17.2.3 Manual and mechanical conditions~~

~~**17.2.3.1** *The switches are operated by means of its actuating member either manually or by an appropriate apparatus which is arranged to simulate normal actuation.*~~

~~*The operating speed for the operating cycles shall be as follows:*~~

~~*For the tests of switches except electronic switches:*~~

~~*a) for slow speed:*~~

- ~~*approximately 9°/s for rotary actuations at an angle of operation ≤45°;*~~
- ~~*approximately 18°/s for rotary actuations at an angle of operation >45°;*~~
- ~~*approximately 20 mm/s for linear actuations.*~~

~~*b) for high speed, the actuating member shall be actuated by hand as fast as possible. If a switch is normally provided without an actuating member, then a suitable actuating member should be supplied by the manufacturer for the purpose of this test.*~~

~~*c) for accelerated speed:*~~

- ~~*approximately 45°/s for rotary actuations at an angle of operation ≤45°;*~~
- ~~*approximately 90°/s for rotary actuations at an angle of operation >45°;*~~
- ~~*approximately 80 mm/s for linear actuations.*~~

~~*For the tests of electronic switches:*~~

~~*d) for slow speed:*~~

- ~~*approximately 9°/s for rotary actions;*~~
- ~~*approximately 5 mm/s for linear actions;*~~

~~*e) for high speed, the actuation member shall be actuated by hand as fast as possible. If a switch is delivered without an actuating member, then a suitable actuating member should be supplied by the manufacturer for the purpose of this test;*~~

~~*f) for accelerated speed:*~~

- ~~*approximately 45°/s for rotary actions,*~~
- ~~*approximately 25 mm/s for linear actions.*~~

~~**17.2.3.2** *For biased switches, the actuating member shall be moved to the limit of travel of the opposite position.*~~

~~**17.2.3.3** *During the slow-speed test, care is taken that the test apparatus drives the actuating member positively, without significant backlash between the apparatus and the actuating member.*~~

~~**17.2.3.4** *During the accelerated speed test*~~

~~*a) care shall be taken to ensure that the test apparatus allows the actuating member to operate freely, so that there is no interference with the normal action of the mechanism;*~~

~~*b) for switches designed for a rotary actuation where the movement is not limited in either direction, three-quarters of the total number of operating cycles in each test shall be made in a clockwise direction, and one-quarter in an anti-clockwise direction;*~~

~~*c) for switches which are designed for rotary actuation in one direction only, the test shall be performed in the designed direction, provided that it is not possible to rotate the actuating member in the reverse direction using the torques necessary for actuation in the designed direction;*~~

~~*d) additional lubrication shall not be applied during these tests;*~~

~~*e) the forces applied to the end stops of the actuating members shall not exceed the declared values (if any) for rotary and linear actuation. The declared full travel of the actuating member (if any) shall be applied during these tests.*~~

~~**17.2.3.4.1** *So far as the design allows, except for locked rotor tests as specified in 17.2.4.9, capacitive and simulated lamp load tests according to figure 9a and figure 9b, the switches are operated at a rate of*~~

~~– 30 operations per minute, if the rated current does not exceed 10 A;~~

~~– 15 operations per minute, if the rated current exceeds 10 A, but is less than 25 A;~~

~~– 7,5 operations per minute, if the rated current is 25 A or more,~~

~~with the ON period being % and the OFF period being % of an operating cycle.~~

~~**17.2.3.4.2** For capacitive and simulated lamp load tests according to figure 9a and figure 9b, switches are operated at a rate of 2 s ON and 15 s OFF.~~

~~**17.2.3.4.3** For locked rotor tests, the switches are operated at a rate of 1 s ON and 30 s OFF.~~

~~**17.2.4 Type of test condition (TC)**~~

~~**17.2.4.1 Increased-voltage test at accelerated speed (TC1)**~~

~~The electrical conditions are those specified for increased-voltage in 17.2.1.~~

~~The method of operation is that specified for accelerated speed in 17.2.3.~~

~~The number of operating cycles is 100.~~

~~**17.2.4.2 Test at slow speed (TC2)**~~

~~The electrical conditions are those specified in 17.2.1.~~

~~The method of operation is that specified for slow speed in 17.2.3.~~

~~The number of operating cycles is 100.~~

~~**17.2.4.3 Test at high speed (TC3)**~~

~~This test applies only to switches which have more than one pole and when polarity reversal occurs.~~

~~The electrical conditions are those specified in 17.2.1.~~

~~The method of operation is that specified for high speed in 17.2.3.~~

~~The number of operating cycles is 100.~~

~~**17.2.4.4 Test at accelerated speed (TC4)**~~

~~For all switches except electronic switches, the electrical conditions are those specified in 17.2.1.~~

~~For electronic switches, the electrical conditions are those specified in table 15.~~

~~The thermal conditions are those specified in 17.2.2.~~

~~The number of operating cycles is the number declared according to 7.1.4 less the number actually made during the tests of 17.2.4.1, 17.2.4.2 and 17.2.4.3.~~

~~For switches classified according to 7.1.13.4.2 to 7.1.13.4.5, the total number of operations shall be not more than 200 000.~~

~~*The method of operation is that specified for accelerated speed in 17.2.3.*~~

~~17.2.4.5 Manual functional test (TC5)~~

~~*Semiconductor switching devices including their electronic control units incorporated in electronic switches are subjected to the following functional tests.*~~

~~*The electronic switch is loaded with thermal current or maximum rated resistive current, if no thermal current is declared, at rated voltage until steady-state temperatures are reached.*~~

~~*When tested with maximum rated resistive current, the voltage is then increased to 1,1 times rated voltage, and again allowed to stabilize.*~~

~~*The switch is operated 20 times at the fastest manual rate possible, over the whole range from minimum to maximum and back to minimum, by means of its actuating member.*~~

~~*During and after the test, the specimens shall operate correctly.*~~

~~17.2.4.6 Functional test at minimum load (TC6)~~

~~*For electronic switches for which a minimum load or minimum current is specified by the manufacturer, the characteristic is additionally tested with the specified minimum load or current at 0,9 times rated voltage.*~~

~~*The switch is operated 10 times over the whole range from minimum to maximum and back to minimum by means of its actuating member.*~~

~~*In addition, where appropriate, the switch is operated 10 times over the whole range from minimum to maximum and back to minimum by means of a remote control.*~~

~~*During and after the test, the specimens shall operate correctly.*~~

~~17.2.4.7 Test with limited number of operations (TC7)~~

~~*The electrical conditions are those specified in table 15.*~~

~~*The thermal conditions are those specified in 17.2.2.*~~

~~*The number of operating cycles is 1 000 or the declared number of cycles whichever is the lowest.*~~

~~*The method of operation is that specified in 17.2.3 for accelerated speed.*~~

~~17.2.4.8 Endurance test (TC8)~~

~~*Full number of operating cycles, the electrical conditions are those specified in table 15, at accelerated speed.*~~

~~17.2.4.9 Locked-rotor test (TC9)~~

~~*For switches according to 7.1.2.9, the test load condition for making operation for resistive and/or motor load with a rated current of 6 × I-M and with a power factor of 0,6 is used for the making and breaking operation.*~~

~~NOTE The test simulates the locked rotor condition of a motor.~~

~~*The method of operation is that specified in 17.2.3 for accelerated speed.*~~

~~*The number of operating cycles is 50.*~~

~~**17.2.5 Evaluation of compliance**~~

~~**17.2.5.1 Functional compliance (TE1)**~~

~~*After all the appropriate tests of 17.2.4, the switch is deemed to comply if*~~

- ~~*all actions function as declared;*~~
- ~~*no loosening of electrical or mechanical connections occur;*~~
- ~~*sealing compound shall not flow to such an extend that live parts are exposed.*~~

~~**17.2.5.2 Thermal compliance (TE2)**~~

~~*After all the appropriate tests of 17.2.4, the switch is deemed to comply if the temperature rise at the terminals does not exceed 55 K, when tested in accordance with 16.2, with the exception that the temperature-rise test at the terminals is carried out at rated current and in an ambient temperature of 25 °C ± 10 °C.*~~

~~**17.2.5.3 Insulating compliance (TE3)**~~

~~*After all the appropriate tests of 17.2.4, the switch is deemed to comply if*~~

- ~~*the dielectric strength requirement of 15.3 applies with the exception that the specimens are not subjected to the humidity treatment before the application of the test voltage. The test voltage shall be 75 % of the corresponding test voltage specified in that subclause;*~~
- ~~*there is no evidence that any transient fault between live parts and earth metal, accessible metal parts, or actuating members has occurred.*~~

Reference IEC 61058-1-1 for mechanical switch testing.

Reference IEC 61058-1-2 for electronic switch testing.

NOTE Refer to Figure 16.

18 Mechanical strength

18.1 General requirements

~~Switches shall have adequate mechanical strength and be constructed so as to withstand such rough handling as may be expected in normal use.~~

~~**18.1.1**~~ Accessible parts ~~of actuating members of switches for Class I and Class II appliances~~ shall ~~either~~ have adequate mechanical strength ~~or be such that adequate protection against electric shock is maintained if the actuating member is broken~~ to withstand a minimum level of force during normal use.

~~*Compliance is checked by the tests of 18.2, 18.3 and 18.4, as appropriate, carried out sequentially.*~~

The specimen may be used for more than 1 test, if cumulative stress as a result of sequential testing is avoided. When a specimen is damaged a new specimen shall be used for the next test.

18.2 Impact

~~*Switches are checked by applying blows to the specimen by means of the spring-operated impact test apparatus of IEC 60068-2-75.*~~

~~**18.2.1** *The actuating member and all surfaces which are accessible when the switch is mounted as in normal use are tested with the impact test apparatus.*~~

~~*Incorporated switches are mounted in a test device as shown in figure 11.*~~

~~*Switches where only the actuating member is accessible when mounted as declared are fixed to the metal plate shown in figure 11, so that they are between it and the sheet of plywood.*~~

~~*Blows are applied to all accessible surfaces, including actuating members, in a direction perpendicular to the surface of the point to be tested, the test apparatus being calibrated to deliver an energy of 0,5 Nm ± 0,04 Nm. Foot-actuated switches shall be subject to the same test, but using a test apparatus calibrated to deliver an energy of 1,0 Nm ± 0,05 Nm.*~~

~~*For all such surfaces, three blows are applied to every point that is likely to be weak.*~~

~~*Care shall be taken that the results from one series of three blows do not influence subsequent series. If there is doubt whether a defect has been caused by the application of preceding blows, this defect is neglected and the group of three blows which led to the defect is applied to the same place on a new specimen, which shall then withstand the test.*~~

~~*Foot-operated switches are, in addition, subjected to a force applied by means of a circular steel pressure plate with a diameter of 50 mm. The force is increased continuously from an initial value of about 250 N up to 750 N within 1 min, after which it is maintained at this value for 1 min. The switches are mounted as in normal use in a horizontal panel, with the operating means protruding, and the force is applied once.*~~

~~*After these tests, the switch shall still comply with the requirements of clauses 9, 13, 15 and 20. Insulating linings, barriers and the like shall not have worked loose. It shall still be possible to remove and to replace detachable and other external parts such as cover plates without these parts or their insulating linings being broken.*~~

~~*It shall still be possible to actuate the actuating member to provide the appropriate disconnection.*~~

~~*In case of doubt, supplementary insulation or reinforced insulation is subjected to a dielectric strength test as specified in 15.3.*~~

~~*Damage to the finish, small dents which do not reduce creepage distances or clearances below the values specified in clause 20, and small chips which do not adversely affect the protection against electric shock or moisture, are neglected. Cracks not visible to the unaided eye, and surface cracks in fibre reinforced mouldings and the like, are ignored. If a decorative cover is backed by an inner cover, fracture of the decorative cover is neglected if the inner cover withstands the test after removal of the decorative cover.*~~

Switches rated equal to or above 0 °C are tested at 25 °C± 10 °C.

Switches rated below 0 °C are cooled to the minimum rated temperature T + 0/-5 °C for 2 h prior to testing.

The impact is delivered using the spring hammer test apparatus of IEC 60068-2-75. The impact is equal to 0,5 Nm ± 0,04 Nm, for foot operated switches the impact is equal to 1,0 Nm ± 0,05 Nm.

One specimen is mounted in the test plate of Figure 11. Remove the mounting device and specimen from the cold cabinet, when required. Immediately apply 3 blows, in a direction perpendicular to the switch.

Compliance is checked by inspection and in case of doubt by Clause 9.

18.3 Pull

18.3.1 Cord-operated switches are submitted to an additional pull test as follows.

The switch is mounted as declared by the manufacturer, and the pull-cord is subjected to a force, applied without jerks, first for 60 s in the normal direction, and then for 60 s in a direction 45° maximum from the normal direction. The minimum values of the pull force shall be as specified in Table 9 or three times the values of the normal operating force if that is greater.

Table 9 – Minimum values of pull force

RATED CURRENT A	Force N Normal direction	Force N 45° from normal direction
Up to and including 4	50	25
Over 4	100	50

~~*After this test, the switch shall show no damage to impair compliance with this standard.*~~

~~*Switches supplied or intended to be fitted, with actuating members shall be tested as follows.*~~

~~*First, a pull shall be applied for 1 min to try to pull off the actuating member.*~~

The sample shall not be damaged in a way that reduces the electrical safety.

Compliance is checked by inspection.

18.3.2 Pull (switches other than cord operated switches).

One specimen is used for testing, only parts accessible after mounting are tested. Testing is completed at 25 °C ± 10 °C.

A pull force shall be applied for 60 s to try to pull off the actuating member.

The pull to be applied is ~~normally~~ 15 N, but if the actuating member is intended to be pulled in normal use, the force is increased to 30 N.

~~*Secondly, a push of 30 N for 1 min is then applied to all actuating members.*~~

~~*During these tests, a movement of the actuating member on the actuating means is acceptable provided this does not result in an incorrect indication of the switch position.*~~

~~*After both of these tests, the specimen shall show no damage to impair compliance with this standard.*~~

~~*If a switch is intended to have an actuating member but is submitted for approval without, then a pull and a push of 30 N are applied to the actuating means.*~~

~~*Adhesives, except of the self-hardening type, are not deemed to be adequate to prevent loosening of the actuating member.*~~

The sample shall not be damaged in a way that reduces the electrical safety.

Compliance is checked by inspection.

18.4 Push

A push force of 30 N, using a switch not subjected to the pull force, shall be applied for 60 s to try to push the actuating members in.

The sample shall not be damaged in a way that reduces the electrical safety.

Compliance is checked by inspection.

19 Screws, current-carrying parts and connections

19.1 General requirements for electrical connections

Electrical connections shall be designed so that contact pressure is not transmitted through insulating material other than ceramic, pure mica or other material with characteristics no less suitable, unless there is visual evidence of sufficient resiliency in the metallic parts to compensate for any possible shrinkage or distortion of the insulating material.

The suitability of the material is considered in respect to the stability of the dimensions within the temperature range applicable to the switch.

This requirement is not applicable to connections internal to a switch where the connection is used for lamps for indicating purposes and where the current in this circuit is equal or below 20 mA.

Compliance is checked by inspection.

19.2 Screwed connections

19.2.1 Screwed connections, not tested in Clause 11, electrical or other, shall withstand the mechanical stresses occurring in normal use.

19.2.2 Screws transmitting contact pressure shall be in engagement with a metal thread. Such screws shall not be of metal which is soft or liable to creep, such as zinc or aluminium.

19.2.3 Mechanical connections to be used during installation of switches may be made using thread-forming tapping screws or thread-cutting tapping screws, only if the screws are supplied together with the piece in which they are intended to be inserted. In addition, thread-cutting tapping screws intended to be used during installation shall be captive with the relevant part of the switch.

19.2.4 Thread-forming (metal sheet) screws shall not be used for the connection of current-carrying parts, unless they clamp these parts directly in contact with each other and are provided with a suitable means of locking. Thread-cutting (self-tapping) screws shall not be used for the electrical connection of current-carrying parts, unless they generate a full metric ISO thread or a thread of equivalent effectiveness. Such screws shall not, however, be used if they are likely to be operated by the user or installer, unless the thread is formed by a swaging action.

~~Provisionally, SI, BA and Unified threads are deemed to be of equivalent effectiveness to a metric ISO thread.~~

Compliance is checked by inspection.

For screws and nuts which are likely to be operated while the switches are being mounted and connected, compliance is checked by the following test.

The screws or nuts are tightened and loosened:

- *10 times for screws in engagement with a thread of insulating material;*
- *5 times in all other cases.*

Nuts concentric with the button or ~~dolly~~ lever are tightened and loosened five times. If either thread is of insulating material, the torque is 0,8 Nm. If the threads are of metal, the torque is 1,8 Nm.

~~*Screws in engagement with a thread of insulating material are completely removed and reinserted each time. When testing terminal screws and nuts, conductors having the cross-sectional areas specified in clause 11 are placed in the terminal. The conductor is solid for terminals not intended for the connection of supply cables or cords or if the nominal cross-sectional area does not exceed 6 mm²; in other cases, the conductor is stranded.*~~

~~*For terminals for the connection of supply cables or cords, the conductor shall have the largest cross-sectional area specified.*~~

Screws and nuts are tightened and loosened by means of a suitable test screwdriver or spanner. The torque applied when tightening being equal to that specified in the appropriate column of Table 10, if not otherwise specified.

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

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

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

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

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

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

Where a screw has a hexagonal head with a slot and the values in columns III and IV are different, the test is made twice, first applying to the hexagonal head the torque specified in column IV, and then, on another set of specimens, applying the torque specified in column III by means of a screwdriver. If the values in columns III and IV are the same, only the test with the screwdriver is made.

During the test, terminals shall not work loose and there shall be no damage, such as breakage of screws or damage to the head slots, threads, washers or stirrups that could impair the further use of the screwed connection.

For mantle terminals, the specified nominal diameter is that of the slotted stud (see Figure 5).

The shape of the blade of the test screwdriver ~~must~~ shall suit the head of the screw to be tested. The screws and nuts shall not be tightened in jerks.

NOTE Screws or nuts which are likely to be operated while the switches are being mounted and connected include terminal screws or nuts, screws for fixing covers, etc.

Table 10 – Torque values

Nominal diameter of thread		Torque				
mm		Nm				
Over	**Up to and including**	**I**	**II**	**III**	**IV**	**V**
~~–~~	~~1,7~~	~~0,1~~	~~–~~	~~0,2~~	~~0,2~~	~~–~~
~~1,7~~	~~2,2~~	~~0,15~~	~~–~~	~~0,3~~	~~0,3~~	~~–~~
–	1,6	0,05	–	0,1	0,1	–
1,6	2,0	0,10	–	0,2	0,2	–
~~2,2~~ 2,0	2,8	0,2	–	0,4	0,4	–
2,8	3,0	0,25	–	0,5	0,5	–
3,0	3,2	0,3	–	0,6	0,6	–
3,2	3,6	0,4		0,8	0,8	–
3,6	4,1	0,7	1,2	1,2	1,2	1,2
4,1	4,7	0,8	1,2	1,8	1,8	1,8
4,7	5,3	0,8	1,4	2,0	2,0	2,0
5,3	6	–	1,8	2,5	3,0	3,0
6	8	–	2,5	3,5	6,0	4,0
8	10	–	3,5	4,0	10,0	6,0
10	12	–	4,0	–	–	8,0
12	15	–	5,0	–	–	10,0

19.2.5 Switches having screwed glands are submitted to the following test.

Screwed glands are fitted with a cylindrical metal rod having a diameter equal to the nearest ~~whole number below~~ integer value less than the internal diameter of the packing, in millimetres. The glands are then tightened by means of a suitable spanner, the torque specified in Table 11 being applied to the spanner for 60 s.

Table 11 – Torque values for screwed glands

Diameter of the test rod		Torque	
mm		Nm	
Over	**Up to and including**	**Metal glands**	**Glands of insulating material**
–	14	6,25	3,75
14	20	7,5	5,0
20	–	10,0	7,5

After the test neither the glands nor the enclosure of the specimen shall show any damage within the meaning of this standard.

19.2.6 Correct introduction of the screws which are operated during mounting or connection of the switch into the screw holes or nuts shall be ensured.

The requirement of correct introduction is met if introduction of the screw in a slanting manner is prevented, for example, by guiding the screw by the part to be fixed, by a recess in the female thread or by the use of a screw with the leading thread removed.

Compliance is checked by inspection and by manual test.

19.2.7 Screws which make a mechanical connection between different parts of the switch shall be locked against loosening if the connection carries current. Rivets used for current-carrying connections shall be secured against loosening if these connections are subject to torsion in normal use.

Compliance is checked by inspection and by manual test.

Spring washers may provide ~~satisfactory~~ adequate locking. For rivets, a non-circular shank or an appropriate notch may be sufficient.

Sealing compound which softens in heat provides ~~satisfactory~~ adequate locking only for screw connections not being subject to torsion in normal use.

19.2.8 Screws and nuts for clamping the conductors shall have a metric ISO standard thread or a thread comparable in pitch and mechanical strength.

Compliance is checked by inspection and by the tests of 19.2.

~~Provisionally, SI, BA and UN threads are considered to be comparable in pitch and mechanical strength to metric ISO thread.~~

19.3 Current-carrying parts

Current-carrying parts and parts in an earthing path shall ~~be of a metal having, under conditions occurring in the switch~~ have adequate mechanical strength and resistance to corrosion.

~~Springs, resilient parts, clamping screws and the like of terminals are not considered as parts mainly intended for carrying current.~~

~~Examples of metals resistant to corrosion when used within the permissible temperature range and under normal conditions of chemical pollution, are~~

- ~~copper;~~
- ~~an alloy containing at least 58 % copper for parts that are worked cold or at least 50 % copper for other parts;~~
- ~~stainless steel containing at least 13 % chromium and not more than 0,09 % carbon;~~
- ~~steel provided with an electroplated coating of zinc according to ISO 2081, the coating having a thickness of at least~~
  - ~~5 µm ISO service condition No. 1, for non-protected switches;~~
  - ~~12 µm ISO service condition No. 2, for switches with degree of protection IPX1 through IPX4;~~
  - ~~25 µm ISO service condition No. 3, for switches with degree of protection IPX5 through IPX7;~~
- ~~steel provided with an electroplated coating of nickel and chromium according to ISO 1456, the coating having a thickness of at least~~
  - ~~20 µm ISO service condition No. 2, for non-protected switches;~~

- ~~30 µm ISO service condition No. 3, for switches with degree of protection IPX1 through IPX4;~~
- ~~40 µm ISO service condition No. 4, for switches with degree of protection IPX5 through IPX7;~~

~~– steel provided with an electroplated coating of tin according to ISO 2093, the coating having a thickness of at least~~

- ~~12 µm ISO service condition No. 2, for non-protected switches;~~
- ~~20 µm ISO service condition No. 3, for switches with degree of protection IPX1 through IPX4;~~
- ~~30 µm ISO service condition No. 4, for switches with degree of protection IPX5 through IPX7.~~

~~Parts which might be subjected to arcs and mechanical wear shall not be made of steel provided with an electroplated coating.~~

~~*Compliance is checked by inspection and if necessary by chemical analysis.*~~

~~NOTE 1 This requirement does not apply to switching and sliding contacts.~~

~~NOTE 2 This requirement does not apply to current-carrying parts which carry a current equal to or less than 20 mA.~~

Compliance is checked by inspection, in case of doubt, compliance is checked by the testing of Clause 22.

20 Clearances, creepage distances, solid insulation and coatings of rigid printed board assemblies

20.1 General requirements

Switches shall be constructed so that the clearances, creepage distances, solid insulation and coatings of rigid printed board assemblies are adequate to withstand the electrical, mechanical and thermal stresses taking into account the environmental influences that may occur during the anticipated life of the switch. Creepage distances and clearances are measured as shown in Annex A.

Clearances, creepage distances, solid insulation and coatings of rigid printed board assemblies shall comply with the relevant subclauses 20.2 to 20.6.

NOTE The requirements and tests are based on IEC 60664-1 and IEC 60664-3.

Compliance is checked with detachable parts removed and movable parts which can be assembled in different orientations placed in the most unfavourable position.

Distances through slots or openings in surfaces of insulating material are measured to a metal foil in contact with the surface. The foil is pushed into comers and the like by means of the jointed test finger of IEC 61032 Probe B (IEC 60529:1989, Figure 1), but is not pressed into openings.

A force is applied to bare conductors and accessible surfaces in order to attempt to reduce clearances and creepage when making the measurement.

The force is:

– *2 N for bare conductors;*

– *30 N for accessible surfaces.*

The force is applied by means of a straight unjointed test finger Probe 11 of IEC 61032 the same dimensions as the jointed test finger Probe B of IEC 61032 (Figure 1 of IEC 60529:1989).

When applied to openings as specified in 9.1, the distance through insulation between live parts and the metal foil shall not be reduced below the values specified.

NOTE 1 Movable parts are for example hexagonal nuts, the position of which cannot be controlled throughout an assembly.

NOTE 2 A flow chart for the dimensioning of clearances is given in Annex B.

NOTE 3 A creepage distance cannot be less than the associated clearance.

20.2 Clearances

20.2.1 General

The clearances shall be dimensioned to withstand the rated impulse voltage declared by the manufacturer according to 7.12 considering the rated voltage and the overvoltage category as given in annex E and the applicable pollution degree declared by the manufacturer according to 7.8 and 7.9.

~~*For the measurements:*~~

- ~~*Detachable parts are removed and movable parts which can be assembled in different orientations placed in the most unfavourable position.*~~

~~NOTE 1 Movable parts are for example hexagonal nuts, the position of which cannot be controlled throughout an assembly.~~

- ~~*Distances through slots or openings in surfaces of insulating material are measured to a metal foil in contact with the surface. The foil is pushed into corners and the like by means of the standard test finger of IEC 60529, but is not pressed into openings.*~~
- ~~*A force is applied to bare conductors and accessible surfaces in order to attempt to reduce clearances when making the measurement.*~~

~~*The force is:*~~

- ~~*2 N for bare conductors;*~~
- ~~*30 N for accessible surfaces.*~~

~~*The force is applied by means of a straight unjointed test finger of the same dimensions as the jointed test finger shown in figure 1 of IEC 60529.*~~

~~*When applied to openings as specified in 9.1, the distance through insulation between live parts and the metal foil shall not be reduced below the values specified.*~~

~~NOTE 2 For the measurement of clearances and creepage distances, see annex A.~~

~~NOTE 3 A flow chart for the dimensioning of clearances is given in annex B.~~

20.2.2 Clearances for basic insulation

The clearances for basic insulation shall not be less than the values given in Table 12.

However, smaller clearances, except those values marked in Table 12 with note 5, may be used if the switch meets the impulse withstand voltage test of Annex G but only if the parts are rigid or located by mouldings, or if the construction is such that there is no likelihood of the distances being reduced by distortion, or by movement of the parts during mounting, connection and normal use.

Compliance is checked by measurement and, if necessary, by the test of Annex G. For production where Annex G was used to show compliance, routine testing shall be conducted in accordance with Annex K.

20.2.3 Clearances for functional insulation

The clearances for functional insulation shall not be less than the values specified for basic insulation in 20.2.2.

Compliance is checked by measurement and, if necessary, by the ~~test~~ requirements of Annex G. For production where Annex G was used to show compliance, routine testing shall be conducted in accordance with Annex K.

20.2.4 Clearances for supplementary insulation

The clearances for supplementary insulation shall not be less than the values given in Table 12.

Compliance is checked by measurement.

Table 12 – Minimum clearances for basic insulation

Rated impulse withstand voltage[2)]	Minimum clearances in air in millimetres up to 2 000 m above sea-level[1) 7) 3)]		
kV	Pollution degree 1	Pollution degree 2	Pollution degree 3
0,33	0,01	0,2[4) 5)]	0,8[5)]
0,50	0,04	0,2[4) 5)]	0,8[5)]
0,80	0,10	0,2[4) 5)]	0,8[5)]
1,5	0,5	0,5	0,8[5)]
2,5	1,5	1,5	1,5
4,0	3	3	3
6[6)]	5,5	5,5	5,5

1) Clearances for altitudes above 2 000 m sea-level shall be multiplied by the altitude correction factor specified in Annex H.

2) This voltage is:

– for functional insulation: the maximum impulse voltage expected to occur across the clearance;

– for basic insulation directly exposed to or significantly influenced by transient overvoltage from the low-voltage mains: the rated impulse withstand voltage of the switch

– for other basic insulation: the highest impulse voltage that can occur in the circuit.

3) Details for pollution degree are given in Annex F.

4) For printed wiring material, the values for pollution degree 1 apply, except that the value shall not be less than 0,04 mm.

5) Minimum clearance values based on experience rather than on fundamental data.

6) This voltage is only applicable when determining reinforced insulation for a ~~rated~~ impulse withstand voltage of 4,0 kV.

7) The values for clearances on rigid printed boards do not apply under the provision that the requirements of Clause 23 are fulfilled and that the overcurrent protection provides full disconnection.

NOTE The values given in Table 12 are equal to IEC 60664-1 and are not increased because only minimal reduction of clearances, for example, due to mechanical abrasion during the lifetime of the switch, is expected and because of the, in general, small overall dimension of switches for appliances.

20.2.5 Clearances for reinforced insulation

The clearances for reinforced insulation shall be not less than the values specified for basic insulation in 20.2.2 but using the next higher step for the rated impulse withstand voltage in Table 12. Smaller clearances than those specified in Table 12 are not allowed.

Compliance is checked by measurement.

20.3 Clearances for disconnection

20.3.1 Electronic disconnection

No clearances are specified for electronic disconnection.

20.3.2 Micro-disconnection

Clearances between terminals and terminations shall fulfil the requirement for functional insulation according to 20.2.3.

No clearances are specified for the distance across the contacts.

For switches with a rated impulse withstand voltage less than 1,5 kV, clearances between other current-carrying parts which are separated by the action of the switch shall be equal to or greater than the actual value of the distance between the relevant contacts. ~~They shall, however, be at least 0,5 mm for switches with a rated impulse withstand voltage of ≥1,5 kV.~~ Switches with a rated impulse withstand voltage of 1,5 kV the clearance of the other current carrying parts which are separated by action of the switch shall be at least 0,5 mm.

NOTE The values for clearances on rigid printed boards do not apply under the provision that the requirements of Clause 23 are fulfilled and that the overcurrent protection provides full disconnection.

20.3.3 Full disconnection

The clearances for full disconnection shall not be less than the values for basic insulation specified in 20.2.2, except that smaller values than those given in Table 12 are not allowed.

In switches where clearances in any one pole between parts separated by the action of the switch is provided by two or more breaks in series, the separation is considered to be the sum of the distances of the breaks. Each break shall be not less than one-third of the prescribed distance.

20.4 Creepage distances

20.4.1 General

The creepage distances shall be dimensioned for the voltage which is expected to occur in normal use taking into account the pollution degree as declared by the manufacturer according to 7.8 and 7.9 and the material group.

~~*For the measurements:*~~

– ~~*Detachable parts are removed and movable parts and parts which can be assembled in different orientations placed in the most unfavourable position.*~~

  ~~NOTE 1 Movable parts are, for example, hexagonal nuts, the position of which cannot be controlled throughout an assembly.~~

– ~~*Distances through slots or openings in surfaces of insulating material are measured to a metal foil in contact with the surface. The foil is pushed into corners and the like by means of the standard test finger of IEC 60529, but is not pressed into openings.*~~

– ~~*A force is applied to bare conductors and accessible surfaces in order to attempt to reduce creepage distances when making the measurement.*~~

  ~~*The force is*~~

  - ~~*2 N for bare conductors;*~~
  - ~~*30 N for accessible surfaces.*~~

  ~~*The force is applied by means of a straight unjointed test finger of the same dimensions as the jointed test finger shown in figure 1 of IEC 60529.*~~

~~NOTE 2 For the measurements of creepage distances, see annex A.~~

~~NOTE 3 A flow chart for the dimensioning of creepage distances is given in annex B.~~

~~NOTE 4 A creepage distance cannot be less than the associated clearance.~~

The relationship between material group and Proof Tracking Index (PTI) values is as follows:

Material group I	*600 ≤ PTI*
Material group II	*400 ≤ PTI < 600*
Material group IIIa	*175 ≤ PTI < 400*
Material group IIIb	*100 ≤ PTI < 175*

These PTI values are obtained in accordance with the proof tracking test of Annex C.

NOTE 1 Attention is drawn to the fact that certain IEC 60335-2 parts require a minimum PTI or CTI value of 250.

NOTE 2 For glass, ceramics and other inorganic materials which do not track, creepage distances need not be greater than their associated CLEARANCE.

CTI (Comparative tracking index) may be substituted for PTI in Clause 20. If a CTI of 175 or greater is needed, and the data is not available, the material group can be established with a test for proof tracking index (PTI) as detailed in IEC 60112.

20.4.2 Creepage distances for basic insulation

The creepage distances for basic insulation shall not be less than the values given in Table 13

Compliance is checked by measurement.

Table 13 – Minimum creepage distances for basic insulation

Rated voltage r.m.s. [a] V	Creepage distance in millimetres [b] ~~[4)]~~						
	Pollution degree 1	Pollution degree 2			Pollution degree 3		
		Material group			Material group		
		I	II	IIIa/IIIb	I	II	IIIa/IIIb
50[c]	0,2	0,6	0,9	1,2	1,5	1,7	1,9
125	0,3	0,8	1,1	1,5	1,9	2,1	2,4
250	0,6	1,3	1,8	2,5	3,2	3,6	4,0
320	0,75	1,6	2,2	3,2	4	4,5	5
400	1,0	2,0	2,8	4,0	5,0	5,6	6,3
500	1,3	2,5	3,6	5,0	6,3	7,1	8,0

[a] This voltage is the voltage rationalized through Table 3a and Table 3b of IEC 60664-1 based on the rated voltage.

[b] Details for pollution degrees are given in Annex F.

[c] Concerning SELV, the last paragraph of 9.1 should be considered.

~~4) The values for creepage distances on rigid printed boards do not apply under the provision that the requirements of clause 23 are fulfilled and that the overcurrent protection provides full disconnection.~~

20.4.3 Creepage distances for functional insulation

The creepage distances for functional insulation shall not be less than the values given in Table 14.

Compliance is checked by measurement.

Table 14 – Minimum creepage distances for functional insulation

Working voltage r.m.s. [1]	Printed board assemblies		Pollution degree [2] [6]						
	Pollution degree								
	1[3]	2[4]	1[3]	2			3		
				Material group			Material group		
				I	II	III[5]	I	II	III[5]
V	mm	mm	mm	mm	mm	mm	mm	mm	mm
10	0,025	0,04	0,08	0,4	0,4	0,4	0,95	0,95	0,95
12,5	0,025	0,04	0,09	0,42	0,42	0,42	1,0	1,0	1,0
16	0,025	0,04	0,1	0,45	0,45	0,45	1,05	1,05	1,05
20	0,025	0,04	0,11	0,48	0,48	0,48	1,1	1,1	1,1
25	0,025	0,04	0,125	0,5	0,5	0,5	1,2	1,2	1,2
32	0,025	0,04	0,14	0,53	0,53	0,53	1,25	1,25	1,25
40	0,025	0,04	0,16	0,56	0,8	1,1	1,3	1,3	1,3
50	0,025	0,04	0,18	0,6	0,85	1,2	1,4	1,6	1,8
63	0,04	0,063	0,2	0,63	0,9	1,25	1,5	1,7	1,9
80	0,063	0,1	0,22	0,67	0,95	1,3	1,6	1,8	2,0
100	0,1	0,16	0,25	0,74	1	1,4	1,7	1,9	2,1
125	0,16	0,25	0,28	0,75	1,05	1,5	1,8	2,0	2,2
160	0,25	0,4	0,32	0,8	1,1	1,6	1,9	2,1	2,4
200	0,4	0,63	0,42	1	1,4	2	2,0	2,2	2,5
250	0,56	1	0,56	1,25	1,8	2,5	2,5	2,8	3,2
320	0,75	1,6	0,75	1,6	2,2	3,2	3,2	3,6	4,0
400	1	2	1	2	2,8	4	4,0	4,5	5,0
500	1,3	2,5	1,3	2,5	3,6	5	5,0	5,6	6,3
630	1,8	3,2	1,8	3,2	4,5	6,3	6,3	7,1	8
800	2,4	4	2,4	4	5,6	8	8	9	10
1 000	3,2	5	3,2	5	7,1	10	10	11	12,5

1) Interpolation for intermediate values is allowed.

2) Details for pollution degrees are given in annex F.

3) Material groups I, II, IIIa and IIIb.

4) Material group I, II, IIIa.

5) Material groups III includes IIIa, and IIIb.

6) The values for creepage distances on rigid printed boards do not apply under the provision that the requirements of Clause 23 are fulfilled and that the overcurrent protection provides full disconnection.

20.4.4 Creepage distances for supplementary insulation

The creepage distances for supplementary insulation shall not be less than the values specified for basic insulation in 20.4.2.

Compliance is checked by measurement.

20.4.5 Creepage distances for reinforced insulation

The creepage distances for reinforced insulation shall not be less than double the values specified for basic insulation in 20.4.2.

Compliance is checked by measurement.

20.4.6 Creepage distances for disconnection

The creepage distances for disconnection shall not be less than the values specified for functional insulation in 20.4.3.

Compliance is checked by measurement.

NOTE 1 For conductive pollution, see Annex F, last paragraph.

NOTE 2 The values for creepage distances on rigid PRINTED BOARDS do not apply under the provision that the requirements of Clause 23 are fulfilled and that the overcurrent protection provides full disconnection

20.5 Solid insulation

Solid insulation shall be capable of durably withstanding electrical and mechanical stresses as well as thermal and environmental influences which may occur during the anticipated life of the switch.

Compliance is checked during the tests of Clauses 14, 15, 16 and 17 in IEC 61058-1-1:2016 or IEC 61058-1-2:2016.

The distance through accessible supplementary solid insulation shall have a minimum value of 0,8 mm.

The distances through accessible reinforced solid insulation shall have the following minimum values:

– for rated impulse withstand voltage equal to or less 1 500 V: 0,8 mm;
– for rated impulse withstand voltage equal to or larger 2 500 V: 1,5 mm.

NOTE 1 The values take into consideration the possibility of cracks as a single fault occurring in the solid insulation. The values corresponding to basic insulation are taken from Table 12, considering pollution degree 3.

NOTE 2 No minimum thickness is specified for functional, basic, inaccessible supplementary and inaccessible reinforced insulation.

Compliance is checked by inspection and by measurement.

NOTE 3 An abrasion test for accessible insulation is under consideration.

20.6 Coatings of rigid printed board assemblies

20.6.1 General

Coatings of rigid printed board assemblies shall provide protection against pollution and/or insulation depending on the type 1 or type 2 coating used.

NOTE Explanations for type 1 and type 2 coating are given in Annex I.

20.6.2 Type 1 coating

The insulation distances of a rigid printed board assembly with type 1 coating, as declared by the manufacturer, shall comply with the highest value for pollution degree 1 of the clearances given in Table 12 and of the creepage distances given in Table 14. Details for the measuring of the insulation DISTANCE of a coated printed board are given in Annex J.

Compliance is checked by measurement and for the type 1 coating by the relevant tests of Clause 6 of IEC 60664-3:2003 with the test levels or conditions as given in Table 15.

~~NOTE Details for the measuring of the insulation distance of a coated printed board are given in annex Q.~~

Test specimens can be

– standard test specimens as specified in 5.1 and 5.2 of IEC 60664-3:2003, or
– any representative rigid printed board assemblies as specified in 5.3 of IEC 60664-3:2003

Table 15 – Test levels and conditions

IEC 60664-3:2003 subclause	Test levels and conditions
6.6.1 Cold storage	–25 °C
6.6.3 Rapid change of temperature	Degree of severity 2 (–25 °C to 125 °C)
6.7 Electromigration	Not applicable
6.8.6 Partial discharge	Not applicable

20.6.3 Type 2 coating

A rigid printed board assembly with type 2 coating as declared by the manufacturer shall comply with the requirements for solid insulation as specified in 20.5. No clearances and creepage distances are specified between conductors on printed boards under the coating.

Compliance for the type 2 coating is checked by the relevant test of Clause 6 of IEC 60664-3:2003 with the test levels or conditions as given in Table 15 and the test specimens as specified in 20.6.2.

~~21 Resistance to heat and fire~~

~~21.1 Resistance to heat and fire~~

~~NOTE Annex J may be used as a guideline to select the sequences and tests of this clause.~~

~~Parts of non-metallic material (except parts unlikely to be ignited or to propagate flames originating from the switch, for which no test is required) shall be resistant to heat and fire.~~

~~*Compliance is checked by the tests of 21.1.1, 21.1.2, 21.1.3 and 21.1.4.*~~

~~**21.1.1** *For parts which are accessible when the switch is mounted as declared, and the deterioration of which may result in the switch becoming unsafe:*~~

~~– *the ball-pressure test 1 of annex E followed by the glow-wire test of annex C carried out at the 650 °C level.*~~

~~**21.1.2** *For parts which are in contact with or support current-carrying parts other than those defined in 21.1.3:*~~

~~– *the ball-pressure test 2 of annex E followed by the glow-wire test of annex C carried out at the 650 °C level.*~~

~~**21.1.3** *For parts which are in contact with, maintain, or retain in position electrical connections including those parts which maintain an electrical connection under spring force, for example a connection within the switch maintained in position by a spring in association with a non-metallic part, the deterioration of which could cause overheating:*~~

– ~~*the ball-pressure test 2 of annex E followed by the glow-wire test of annex C carried out at the declared level which shall be selected from the following.*~~

– ~~*Level 1 – the glow-wire test carried out at 650 °C.*~~

– ~~*Level 2 – the glow-wire test carried out at 750 °C.*~~

– ~~*Level 3 – the glow-wire test carried out at 850 °C.*~~

~~NOTE When selecting the declared level, consideration should be given to the requirements of the relevant appliance or equipment standard. Where an appliance standard gives no indication of the level, reference can be made to IEC 60335-1 for guidance.~~

~~**21.1.4** *For parts which are in contact with or support heat-sources (for example, heat sinks):*~~

– ~~*the ball-pressure test 2 of annex E followed by the glow-wire test of annex C carried out at the 650 °C level.*~~

~~**21.1.5** *For all other parts (except parts unlikely to be ignited or to propagate flames originating from the switch, for which no test is required):*~~

– ~~*the glow-wire test of annex C carried out at the 650 °C level.*~~

21 Fire hazard

21.1 Resistance to heat

21.1.1 Parts of non-metallic material shall be resistant to heat.

This requirement applies to the following:

– Actuators integral with the actuating means.
– Critical parts when deteriorated by heat, will result in a reduction of the declared degree of protection against electrical shock.

The resistant to heat requirement does not apply to the following:

– small parts (when not critical),
– decorative trims, and
– actuators which are not integral with the actuating means

NOTE The definition for small parts is given in IEC 60695-4.

21.1.2 *Compliance is checked with new samples using the ball pressure test according to IEC 60695-10-2 at the temperatures using either the (A) heating test results or (B) calculated temperatures.*

The heating test results method can be used only when stable steady state temperatures can be achieved. Switches that do not achieve a stable steady state temperature shall use the calculated temperature method.

21.1.3 Heating test results A

a) *The test temperature is 20 °C ± 2° C plus the value of the maximum temperature measured during the heating test of Clause 16 or as declared, or at 75 °C ± 2 °C whichever is the highest:*

   1) *for parts which are accessible when the switch is mounted as declared, and the deterioration of which may result in the switch becoming unsafe (e.g. reduction in the declared degree of protection, or reduction of creepage and clearances below those values required according to Clause 20).*

b) The test temperature is T plus 20° C ± 2 °C with a minimum value of 125 °C or the maximum temperature recorded during the heating test of Clause 16 if this would lead to a higher temperature:

1) for parts which are in contact with, maintain or retain in position electrical connections including those parts which maintain an electrical connection under spring force, for example a connection within the switch maintained in position by a spring in association with a non-metallic part, the deterioration of which could cause overheating;

2) for parts which are in contact with or support heat-sources (for example, heat sinks); where "T" is the rated maximum temperature of the switch.

21.1.4 Calculated temperatures B

a) T or 75 °C whichever is the highest.

1) for parts which are accessible when the switch is mounted as declared, and the deterioration of which may result in the switch becoming unsafe (e.g. reduction in the declared degree of protection, or reduction of creepage and clearances below those values required according to Clause 20).

b) T + 70 °C or 125 °C whichever is the highest.

1) for parts which are in contact with, maintain or retain in position electrical connections including those parts which maintain an electrical connection under spring force, for example a connection within the switch maintained in position by a spring in association with a non-metallic part, the deterioration of which could cause overheating;

2) for parts which are in contact with or support heat-sources (for example, heat sinks); where "T" is the rated maximum temperature of the switch.

Insulation external to the switch (such as non-detachable conductors) shall be minimum the T value of the switch.

Coil windings shall be minimum the T value of the switch.

The switch conductive materials are evaluated during testing according to Clause 17.

21.2 Resistance to abnormal heat

Parts of non-metallic material shall be resistant to abnormal heat.

This resistance to abnormal heat requirement does not apply to the following:

– small parts where no reduction of the declared degree of protection against electric shock will result from deterioration by abnormal heat;
– decorative trims;
– actuators which are not integral with the actuating means.

NOTE The definition for small parts is given in IEC 60695-4 .

In cases where it is neither practical nor possible to carry out the tests on a complete switch, e.g. when the switch is of an inconvenient shape, then the test is carried out using a specimen of the material from which the relevant part is manufactured. The size of the specimen shall be a minimum of 25 mm × 25 mm and having a thickness equal to the minimum thickness as measured for the relevant part.

Compliance is checked with one new sample using the glow wire test of IEC 60695-2-11 at the declared glow wire temperature:

a) *the declared glow wire temperature for parts which are in contact with, maintain or retain in position electrical connections including those parts which maintain an electrical connection under spring force, for example a connection within the switch maintained in position by a spring in association with a non-metallic part, the deterioration of which could cause overheating at the declared glow wire temperature;*

b) *650 °C for all other parts.*

The test specimen is considered to have passed the glow-wire test if flames or glowing of the test specimen extinguish within 30 s after removal of the glow wire and there is no ignition of the layer of wrapping tissue.

If there is no flame or ignition, this shall be reported.

22 Resistance to rusting

Ferrous parts, the rusting of which might impair safety, 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 an appropriate cleaning 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 25 °C ± 10 °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 25 °C ± 10 °C with a relative humidity above 91 %. After the parts have been dried for 10 min in a heating cabinet at a temperature of 100 °C ± 5 °C, their surfaces shall show no signs of rust.

Traces of rust on sharp edges and any yellowish film removable by rubbing are ignored. For small helical springs and the like, and for inaccessible parts exposed to abrasion, a layer of grease may provide sufficient protection against rusting. Such parts are only subjected to the test if there is doubt about the effectiveness of the grease film, and the test is then made without previous removal of the grease.

23 Abnormal operation and fault conditions for ~~electronic~~ switches

~~Switches shall be constructed so that the risk of fire, mechanical damage impairing safety or protection against electric shock as a result of abnormal condition is prevented.~~

~~*Compliance is checked by the following tests:*~~

- ~~temperature under abnormal conditions according to 23.1;~~
- ~~protection against electric shock in case of abnormal conditions according to 23.2;~~
- ~~protection against short circuit according to 23.3;~~
- ~~protection against failing of cooling according to 23.4.~~

~~*It is acceptable to carry out all tests on the same specimen provided that, with the replacement of an incorporated fuse, the switch is still capable of operation according to the specified rating(s). Otherwise new specimens shall be used.*~~

~~**23.1** When switches are operated under abnormal conditions, no part shall reach such a temperature that there is danger of fire to the surroundings of the switches.~~

~~*Compliance is checked by subjecting the switches to a heating test under fault conditions, as described in 23.1.1.*~~

~~*During the test, the temperature shall not exceed the values given in tables 13 and 14, second column.*~~

~~**23.1.1** *Unless otherwise specified, the tests are made on switches while they are mounted, connected and loaded as specified in 16.3.3.*~~

~~*Each of the abnormal conditions indicated in 23.1.1.1 and 23.1.1.2 is applied in turn.*~~

~~NOTE Other faults may occur during the test, which are a direct consequence.~~

~~*The abnormal conditions are applied in the order which is the most convenient for testing.*~~

~~**23.1.1.1** *The following abnormal conditions shall be simulated:*~~

- ~~*short circuits across creepage distances and clearances, other than those complying with the requirements in clause 20 if they are less than the values given in tables 22 to 24;*~~
- ~~*short circuits across insulating coating consisting, for example, of lacquer or enamel.*~~

~~*Such coatings are ignored in assessing the creepage distances and clearances.*~~

~~*If enamel forms the insulation of a wire, it is considered as contributing 1 mm to those creepage distances and clearances;*~~

~~NOTE 1 A test for enamelled insulation is under consideration.~~

~~NOTE 2 The term "coating" does not apply to encapsulation ("potting").~~

- ~~*short circuit or interruption of semiconductor devices;*~~
- ~~*short circuit or interruption of capacitors or resistors which do not comply with the requirements of 24.2 or 24.3;*~~
- ~~*short circuit of the terminals on the load side of cord switches and independently mounted switches.*~~

~~*Cumulative stress as a result of sequential testing shall be avoided; it will therefore be necessary to use additional specimens. The number of additional specimens should, however, be kept to a minimum by an evaluation of the relevant circuits.*~~

~~*The abnormal conditions are applied one at a time and damages shall be repaired before applying the next abnormal condition.*~~

~~*If an abnormal condition simulated during the test influences other abnormal conditions, all these abnormal conditions are applied simultaneously.*~~

~~*If the temperature of the switch is limited by the operation of automatic protective devices (including fuses), the temperature is measured 2 min after the operation of the device.*~~

~~*If no temperature-limiting device operates, the temperature of switches for continuous duty, duty type S1, is measured after steady state has been reached, or after 4 h, whichever is the shorter time.*~~

~~*For switches for short-time duty, duty type S2, the temperature is measured 2 min after the operation of the switch.*~~

~~*For switches for intermittent periodic duty, duty type S3, the temperature is measured after steady state has been reached, or after 4 h, whichever is the shorter time.*~~

~~*If the temperature is limited by a fuse, the following additional test is carried out:*~~

- ~~*the fuse is short-circuited and the current under the relevant fault conditions is measured;*~~
- ~~*the switch is then switched on for a duration corresponding to the maximum fusing time of the type of fuse as specified by IEC 60127, corresponding to the current measured above. The temperature is measured 2 min after the end of the period.*~~

~~**23.1.1.2** *Switches designed to be incorporated or integrated in an appliance shall be tested both as:*~~

- ~~*switches without automatic protective devices according to 23.1.1.2.1;*~~
- ~~*switches with automatic protective devices according to 23.1.1.2.2.*~~

~~*Electronic cord switches and electronic independently mounted switches*~~

- ~~*without incorporated temperature-limiting devices or without incorporated fuses are tested according to 23.1.1.2.1;*~~
- ~~*protected by automatic protective devices (including other fuses than fuses according to IEC 60127) are tested according to 23.1.1.2.2;*~~
- ~~*protected by incorporated fuses complying with IEC 60127 are tested according to 23.1.1.2.3;*~~
- ~~*protected both by incorporated fuses and by automatic protective devices are tested according to 23.1.1.2.4.*~~

~~*The switch is left in the most unfavourable "ON" position.*~~

~~**23.1.1.2.1** *Switches for continuous duty, duty type S1, are loaded for 1 h with the conventional fusing current for the fuse which in the installation will protect the switch.*~~

~~*For switches for short-time duty, duty type S2, the temperature is measured 2 min after the operation of the switch.*~~

~~*For switches for intermittent periodic duty, duty type S3, the temperature is measured after steady state has been reached, or after 4 h, whichever is the shorter time.*~~

~~*The conventional fusing currents to be used for these tests are specified in table 26:*~~

~~**Table 26 – Conventional fusing current versus rated current**~~

~~Device~~	~~Rated current~~ ~~A~~	~~Conventional fusing current~~ [1)] ~~A~~
~~Cord switches~~	~~Up to and including 16~~	~~26~~
~~Independently mounted switches~~	~~Up to and including 16~~	~~26~~
	~~Over 16 up to and including 32~~	~~51~~
	~~Over 32 up to and including 63~~	~~101~~
~~1) The values specified originate from IEC 60269-1.~~		

~~**23.1.1.2.2** *Switches for continuous duty, duty type S1, are loaded in such a way that the current through the switch measures 0,95 times the current with which the protecting device releases after 1 h.*~~

~~*For switches for short-time duty, duty type S2, the temperature is measured 2 min after the operation of the switch.*~~

~~*For switches for intermittent periodic duty, duty type S3, the temperature is measured after steady state has been reached, or after 4 h, whichever is the shorter time.*~~

~~**23.1.1.2.3** *The fuses are replaced by links of negligible impedance and shall be loaded in such a manner that the current through the links shall be 2,1 times the rated current of the fuse.*~~

~~*For switches for continuous duty, duty type S1, the temperature is measured after steady state has been reached or after 30 min, whichever is the shorter time.*~~

~~*For switches for short-time duty, duty type S2, the temperature is measured 2 min after the operation of the switch.*~~

~~*For switches for intermittent periodic duty, duty type S3, the temperature is measured after steady state has been reached, or after 4 h, whichever is the shorter time.*~~

~~**23.1.1.2.4** *The electronic cord switches and electronic independently mounted switches are loaded either as described in 23.1.1.2.3 with incorporated fuse or as described in 23.1.1.2.2 with another automatic protective device, choosing the test requiring the lowest load.*~~

~~**23.2** Protection against electric shock is required, even though a switch is being used or has been used during fault conditions.~~

~~*Compliance is checked by carrying out the tests described in 23.1.*~~

~~*Having been subjected to the test, the switch shall comply with the requirements of clause 9.*~~

~~**23.3** Electronic cord switches and electronic independently mounted switches shall, without endangering their surroundings, withstand the short circuits they may be subjected to.~~

~~*Compliance is checked by the following test.*~~

~~*The switch is tested in a substantially non-inductive circuit in series with a load impedance and a device for limiting the let-through* I^2t.~~

~~*The prospective short-circuit of the supply shall be 1 500 A r.m.s. at a voltage equal to the rated voltage of the switch under test.*~~

~~*The prospective let-through* I^2t *value shall be 15 000* A^2s.~~

~~NOTE 1 The prospective current is a current that would flow in the circuit if the switch, the limitation device and the load impedance are replaced by links of negligible impedance without any other change in the circuit.~~

~~NOTE 2 The prospective I^2t value is a value that would be let through by the limitation device if the switch and the load impedance are replaced by links of negligible impedance. The I^2t value may be limited by using an open wire fuse, an ignitron or other suitable devices.~~

~~NOTE 3 The I^2t value of 15 000 A^2s corresponds to an unfavourable let-through I^2t value of 16 A miniature circuit-breakers measured at 1 500 A prospective short-circuit current.~~

~~*The diagram of the circuit in which the switch is tested is shown in figure 17.*~~

~~*The impedance* Z_1 *(short-circuit impedance) shall be adjustable to satisfy the specified prospective short-circuit current.*~~

~~*The impedance* Z_2 *(load impedance) shall be so adjusted that the switch is loaded with its minimum load or with approximately 10 % of the rated load, whichever is the higher.*~~

~~NOTE 4 A load is necessary for the switch to be in the on-state.~~

~~*The circuit is calibrated with the following tolerances: current +5 %/0 %, voltage +10 %/0 %, frequency +5 %/0 %, I^2t value ±10 %.*~~

~~*The incorporated fuse, if any, recommended by the manufacturer, is inserted into the switch which is loaded. The variable control, if any, is set at the position of maximum output with any by-pass in open position.*~~

~~*The short circuit is caused six times by the auxiliary switch A without any synchronizing with respect to the voltage wave.*~~

~~NOTE 5 Six tests are made in view of the need to avoid the complication on point-on-wave timing.~~

~~NOTE 6 Experience shows that at least one of these tests will result in near maximum total I^2t.~~

~~NOTE 7 Attention is drawn to the fact that solenoid operated pneumatic means may result in an unintentional synchronization.~~

~~*During the test, emission of flames or burning particles shall not occur.*~~

~~*Enclosed switches are wrapped in tissue paper.*~~

~~*No traces or burn-through shall occur.*~~

~~NOTE 8 Wrapping tissue as specified in 6.86 of ISO 4046: a soft and strong, lightweight wrapping paper of a grammage generally between 12 g/m² and 30 g/m². It is primarily intended for protective packaging of delicate articles and for gift wrapping.~~

~~*Unenclosed parts of a partially enclosed switch are tested with dry absorbent surgical cotton placed at a distance of 6 mm – 10 mm from the surface.*~~

~~*Ignition of the cotton shall not occur.*~~

~~*After the test, accessible metal parts shall not be live.*~~

~~*It is not necessary for the samples to remain in operating condition. However, the contacts of any incorporated automatic protective device shall not be welded, unless the switch is obviously useless.*~~

~~23.4 Protection against fire in case of failure of cooling~~

~~*For switches with declared thermal current intended to be used with forced cooling, the switch is mounted and connected as specified in 16.3.2, but without forced cooling during the test.*~~

~~*The switch is loaded with the rated current which is continued until steady state is achieved or the switch disconnects the load circuit.*~~

~~*During the test, emission of flames or burning particles shall not occur.*~~

~~*If it is declared by the manufacturer that the switch will open during this test condition, this function is verified.*~~

Reference IEC 61058-1-1 for mechanical switch testing.

Reference IEC 61058-1-2 for electronic switch testing.

24 Components for switches

24.1 General requirements

Components which, if they fail, may cause risk of electric shock or fire (for example, SELV transformers, protective impedances, fuses, capacitors which may cause a shock hazard, and capacitors for electromagnetic interference suppression) shall comply either with the requirements of this standard or with the relevant IEC component standard as far as they reasonably apply.

If components are marked with their operating characteristics, the conditions under which they are used in the ~~electronic~~ switch shall be in accordance with these markings, unless a specific exception is made in this standard.

The testing of components which have to comply with other standards is, in general, carried out separately, according to the relevant standard as follows.

If the component is marked and used in accordance with its marking, the number of samples is that required by the relevant standard.

Where no IEC standard exists or when the component has not been tested in accordance with a relevant IEC standard, or is used not in accordance with its specified ratings, the component is tested under the conditions occurring in the ~~electronic~~ switch.

Components incorporated in the ~~electronic~~ switch are subjected to all the tests of this standard as a component of the ~~electronic~~ switch.

NOTE Compliance with the IEC standard for the relevant component does not necessarily ensure compliance with the requirements of this standard.

24.2 Protective devices

24.2.1 General

Protective devices shall be in accordance with the relevant IEC publications and/or the additional requirements specified in the following subclauses:

– 24.2.2 fuses;

– 24.2.3 cut-outs;

– 24.2.7 protective devices which only decrease the current;

– 24.2.8 fusing resistors.

24.2.2 Fuses

Fuses, if any, shall comply with IEC 60127~~-2~~ or IEC 60269-3~~-1~~ and have a rated breaking capacity of at least 1 500 A unless any fault current through the fuse is limited to the breaking capacity of the fuse.

24.2.3 Cut-outs

Cut-outs shall have adequate making and breaking capacity, be selected for the appropriate number of operations and be in compliance with the requirements and test specifications in the following subclauses:

– 24.2.4 non-resettable cut-outs;

– 24.2.5 resettable, non-self-resetting cut-outs;

– 24.2.6 self-resetting cut-outs.

Compliance is checked by subjecting three specimens to the tests according to the following general test specification and the additional tests specified for the relevant type.

If the cut-out in the ~~electronic~~ switch is subjected to a reference temperature outside the range 0 °C to 35 °C or 55 °C (according to 7.3.2 or 7.3.3), the samples are tested at this reference temperature.

During the test, the other conditions shall be similar to those occurring in the ~~electronic~~ switch.

During the test, no sustained arcing shall occur.

After the test, the specimens shall show no damage impairing their further use or the safety of the ~~electronic~~ switch.

The switching frequency of the cut-out may be increased above the normal switching frequency inherent to the ~~electronic~~ switch, provided that no greater risk of failure of the cut-out is induced.

If it is not possible to test the cut-out separately, it will be necessary to submit additional specimens of the ~~electronic~~ switch in which the cut-out is used.

24.2.4 Non-resettable cut-outs

Non-resettable cut-outs shall be thermal links in accordance with IEC 60691 or bi-metallic single operation devices (SOD) according to IEC 60730-2-9.

Compliance is checked by the tests according to 24.2.3.

After the test, the supply shall be cut out and the temperature shall neither exceed the maximum temperatures specified by the manufacturer ~~or the values in table 13~~ for abnormal conditions.

24.2.5 Resettable, non-self-resetting cut-outs

Resettable, non-self-resetting cut-outs shall be in accordance with IEC 60730-1 and appropriate parts of IEC 60730-2.

Compliance is checked by the tests according to 24.2.3 and the following additional tests.

Resettable, non-self-resetting cut-outs in the load circuit of the ~~electronic~~ switch are tested at 1,1 times the rated voltage of the ~~electronic~~ switch and with loads as specified below.

The cut-outs are reset after each operation and thus caused to operate 10 times successively.

Cut-outs in ~~electronic~~ switches for incandescent lamps are tested in a non-inductive circuit and are loaded with the conventional fusing current of the protecting fuse;

Cut-outs in ~~electronic~~ switches for speed control circuits are subjected to two series of 10 operations.

In the first series, the cut-out under test closes a circuit through which a current of 9 In ($\cos \varphi$ = 0,8 ± 0,05) passes, this current being interrupted by means of an auxiliary switch 50 ms to 100 ms after each closure.

In the second series, the circuit through which a current of 6 In (cos ~~ω~~ φ = 0,6 ± 0,05) passes is closed by an auxiliary switch and opened by the cut-out under test.

Cut-outs for other types of load are tested with the opening and closing current declared by the manufacturer.

NOTE 1 The values 6 I_n and 9 I_n are provisional.

NOTE 2 "I_n" is the rated current of the ~~electronic~~ switch. If the ~~electronic~~ switch has a rated load instead of a rated current, I_n is calculated under the assumption that cos ~~ω~~ φ of the motor load is 0,6.

24.2.6 Self-resetting cut-outs

Self-resetting cut-outs shall be in compliance with IEC 60730 series.

Compliance is checked by the tests according to 24.2.3 and the following additional tests.

Self-resetting cut-outs in the load circuit of the ~~electronic~~ switch are tested at 1,1 times the rated voltage of the ~~electronic~~ switch and with loads as specified below:

Cut-outs in ~~electronic~~ switches for incandescent lamps are operated automatically for 200 cycles in a non-inductive circuit and are loaded with the relevant conventional fusing current of the protecting fuse.

NOTE Cut-outs in ~~electronic~~ switches for other types of load are tested as declared by the manufacturer.

24.2.7 Protective devices which only decrease the current (for example PTC resistors)

Protective devices which only decrease the current shall be of a thermistor type according to Annex J in IEC 60730-1:2013 or PTC-S thermistors according to IEC 60738-1.

Compliance is checked by the tests according to 24.2.3 and the following additional tests.

For PTC-S thermistors, the power dissipation of which exceeds 15 W for the rated zero-power resistance at an ambient temperature of 25 °C, the encapsulation or tubing shall comply with the flammability category ~~FV1~~ V-1 or better according to IEC ~~60707~~ 60695-11-10 and IEC 60695-11-20.

Compliance with the flammability criteria is checked according to IEC ~~60707~~ 60695-11-10 and IEC 60695-11-20.

24.2.8 Fusing resistors

Fusing resistors shall have adequate breaking capacity and shall not cause emission of flames or burning particles during rupture under fault conditions.

In case of doubt, the test is repeated on a new sample of the same resistor. If again the resistor interrupts in the same way it is accepted as a fusing resistor for protection against the relevant fault condition.

24.3 Capacitors

Capacitors

– which may cause a shock or fire hazard or ~~and capacitors for electromagnetic interference,~~

~~– the short-circuiting or disconnection of which would cause an infringement of the requirements under fault conditions with regard to shock or fire hazard,~~

- ~~the short-circuiting of which would cause a current >0,5 A through the terminals of the capacitor~~
- which have a current > 0,5 A through their terminals

shall comply with the requirements of IEC 60384-14 ~~and shall be in accordance with table 27~~.

~~The duration of the damp-heat, steady-state test as specified in 4.12 of IEC 60384-14, shall be 21 days.~~

~~*When determining the current fuses are to be considered short-circuited. For other protective devices, the resistive element is to be replaced by an equivalent impedance.*~~

When determining the current through the terminals of the capacitor a user replaceable fuses shall be short-circuited. For other protective devices, the resistive element is to be replaced by an equivalent impedance, such as 2 Ω or equivalent.

The capacitor class shall comply with Table 16 or as declared (7.23). The voltage rating of the capacitor shall be at least equal to the rating of the switch.

Table 16 – Minimum requirements for capacitors

Application of capacitors	Types of capacitors (according to IEC 60384-14)		
	$U_n \leq$ ~~125~~ 130V	~~125 V < $U_n \leq$ 250 V~~ 130 V < $U_n \leq$ 480 V	
		Without overcurrent protection[1)]	With overcurrent protection[1)]
Between live conductor (L or N) and earth (PE)	Y4	Y2	Y2
Between live conductors (L and N or L1 and L2)			
- without impedance in series	X2	X2	X2
- with impedance in series which, by short-circuiting of the capacitor, limits the current to a value			
• of 0,5 A and higher	X3	X2	X3
• below 0,5 A	No special requirement	No special requirement	No special requirement
[1)] Fusing resistor (built-in or external).			

24.4 Resistors

~~Resistors, the short-circuiting or interrupting of which would, in case of a defect, cause an infringement of the requirements with regard to the protection against fire and electric shock, shall have an adequately constant value under overload conditions prevailing in the electronic switch.~~

Resistors for protective impedances according to 9.1.1 and resistors the short-circuiting or disconnecting of which would cause an infringement of the requirements for operation under fault conditions (see Clause 23) shall have an adequately stable resistance value under overload and shall comply with the requirements of 14.1 of IEC 60065:2014.

25 EMC requirements

25.1 General

Mechanical switches without electronic circuits are considered not to be affected by electromagnetic disturbances and therefore, no immunity tests are necessary.

Mechanical switches without electronic circuits are considered not to generate continuous electromagnetic disturbances and therefore no emissions tests are necessary.

Incorporated switches for appliances are not subjected to the tests of this Clause 25, as the result of these tests can be affected by the incorporation of the switch in the appliance.

Tests in Clause 25 may however, be carried out on such switches if requested by the manufacturer.

Electronic switches for appliances shall fulfil the requirements for immunity and emission when used in accordance with the manufacturer's specification.

Electronic switches intended to be built in or incorporated in an appliance ~~shall~~ when applicable comply with the requirements for immunity and emission ~~of~~ as evaluated in the end product.

Compliance is checked with the electronic switch incorporated or integrated in the appliance.

~~NOTE Electronic switches intended to be built in or incorporated in an appliance are only tested if requested by the manufacturer.~~

~~Electronic cord switches and independently mounted switches shall fulfil the requirements for immunity and emission when used in accordance with the manufacturer's declaration.~~

~~*Compliance is checked by 25.1 and 25.2 with the electronic cord switch or independently mounted switch tested as a separate device or together with the relevant appliance.*~~

25.2 Immunity

~~Mechanical switches within the scope of this standard are not affected by electromagnetic disturbances, and, therefore, no immunity tests are necessary.~~

25.2.1 General

Electronic switches shall be designed so that the switch state (on or off) and/or setting value is protected against electromagnetic interference.

For the following tests the electronic switch is mounted as in normal use and is loaded as specified in Clause 17 so that at the rated voltage the rated load will be obtained.

Each electronic switch is tested, if applicable, in the following states:

– in the ON state, highest setting;
– in the ON state, lowest setting;
– in the OFF state, highest setting;
– in the OFF state, lowest setting.

25.2.2 Voltage dips and short interruptions

The electronic switch shall be tested ~~with~~ as described in 25.2.1 in accordance with Table 17 using the test equipment specified in IEC 61000-4-11 ~~as specified in 25.1 in accordance with table 28~~ with a sequence of three dips/interruptions with intervals of 10 s minimum (between each test event).

Abrupt changes in supply voltage shall occur at zero crossings. ~~The output impedance of the test voltage generator shall be low, even during the transition.~~

The change between the test voltage U_T and the changed voltage is abrupt.

~~NOTE~~ Note *100 % U_T is equal to the rated voltage.*

A test level of 0 % corresponds to a total supply voltage interruption.

During the test, the electronic switch state and/or setting may alter.

Occasional flickering of luminaires and irregular running of motors during the test are neglected.

After the test, the electronic switch shall be in the original state and the setting shall be unchanged.

~~**25.1.2 Withstand to 1,2/50 wave impulses**~~

~~NOTE If the electronic switch is intended to be used with different kinds of load, the most severe load(s) should be chosen for these tests.~~

Table 17 – Test levels and duration for voltage dips and short interruptions

Test level % U_T	Voltage dip/interruptions % U_T	Duration number of cycles at rated frequency Cycles
0	100	10
40	60	10
70	30	10

25.2.3 Surge immunity test

The tests are carried out according to IEC 61000-4-5 with an open-circuit test voltage of 1 kV (level 2).

During the tests, the switch state and/or setting shall not alter.

Occasional flickering of luminaires and irregular running of motors during the test are neglected.

After the tests the electronic switch shall be in the original state and the setting shall be unchanged.

25.2.4 Electrical fast transient test

The electronic switch shall be subjected to repetitive fast transients (bursts) on supply and control terminals/terminations.

The test is carried out according to IEC 61000-4-4 with the following specification.

The level of the repetitive fast transients consisting of bursts coupled into supply and control terminals/terminations of the electronic switch is in accordance with Table 18.

Both polarities of the test voltage are mandatory.

The duration of the test shall be not less than 1 min.

During the test, the electronic switch state and/or setting may alter.

Occasional flickering of luminaires and irregular running of motors during the test are neglected.

After the test, the switch shall remain in its original state.

~~NOTE If any change of the setting occurs, it should be possible to restore the setting by operation of the control(s).~~

Table 18 – Fast transient bursts

Open circuit output test voltage ±10 %	
Supply terminals/terminations	**Control terminals/terminations**
1 kV (level 2)	0,5 kV (level 2)

25.2.5 Electrostatic discharge test

The electronic switch mounted as in normal use shall withstand electrostatic contact and air discharges.

The test is carried out according to IEC 61000-4-2 by applying one positive and one negative discharge, of both types (air/contact), if necessary, to each of the 10 preselected points designated by the manufacturer.

The following levels apply:

– test voltage of contact discharge: 4 kV;
– test voltage of air discharge: 8 kV.

During the test, the switch state and/or setting may alter.

Occasional flickering of luminaires and irregular running of motors during the test are neglected.

After the test, the electronic switch shall remain in its original state.

~~NOTE 1 If any change of the setting occurs, it should be possible to restore the setting by operation of the control(s).~~

~~NOTE 2 Certain~~ Electronic switches (for example, passive infrared switches – "PIR switches") with adjustable time delay devices should be adjusted in such a way that the delay time is higher than the testing time.

NOTE Measured values within the test limits are acceptable for the results until the situation on uncertainty measurements has been clarified.

25.2.6 Radiated electromagnetic field test

The electronic switch subjected to electromagnetic fields such as those generated by portable radio transceivers or any other device that will generate continuous wave radiated electromagnetic energy shall be tested as follows.

The test is carried out according to IEC 61000-4-3, applying a field strength of 3 V/m.

~~NOTE It is under consideration to replace the tests according to IEC 61000-4-3 by tests according to IEC 61000-4-6.~~

After the test, the electronic switch shall be in the original state and the setting shall be unchanged.

During the test, the electronic switch state and/or setting may alter; other changes are not acceptable.

Occasional flickering of luminaires and irregular running of motors during the test are neglected.

~~For mechanical switching devices within the scope of this standard electromagnetic disturbances may only be generated during switching operations. Since this is not continuous, no emission tests are necessary.~~

25.2.7 Power-frequency magnetic field test

This test is applicable only to electronic switches containing devices susceptible to magnetic fields, for example, Hall elements, electro dynamic microphones, etc.

Electronic switches shall withstand the power frequency magnetic field test.

The test is carried out according to IEC 61000-4-8 by applying a magnetic field of 3 A/m, 50 Hz.

During the test, the state of the electronic switch shall not change.

Occasional flickering of lamps or irregular running of motors during the test is not allowed.

25.3 Emission

25.3.1 Low-frequency emission

Electronic switches intended to be connected to the public low-voltage supply systems shall be so designed that they do not cause excessive disturbances in this network.

Compliance is checked by carrying out tests according to IEC 61000-3-2 and IEC 61000-3-3 or IEC TS 61000-3-5.

~~*Requirements are deemed to be met if the electronic switch complies with the criterias specified in these standards, except that for harmonics of order 11, an overview of the spectrum is taken.*~~

The requirements of IEC 61000-3-2 and IEC 61000-3-3 or IEC TS 61000-3-5 apply, except that for harmonics of order 11 and above, an overview of the spectrum is taken.

If this overview shows an envelope of the spectrum with a monotonal decrease according to the increasing order of harmonics, measurements can be restricted to harmonics up to order 11.

25.3.2 Radio-frequency emission

~~Electronic switches shall be so designed that they do not cause excessive radio interference.~~

~~*Compliance tests are under consideration.*~~

Electronic cord switches and independently mounted switches shall be so designed that they do not cause excessive radio interference.

The electronic switch shall comply with the requirements of CISPR 14-1 or CISPR 15. For electronic switches used for electrical lighting application, CISPR 15 applies.

Subclauses 8.1.4.1 and 8.1.4.2 of CISPR 15:2013 are applicable with the following modifications.

Compliance is checked as follows:

a) *At the main terminals (8.1.4.1 of CISPR 15:2013).*

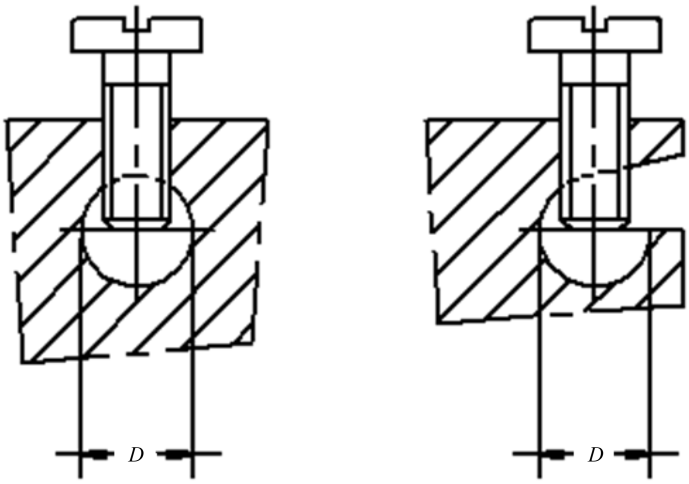
An initial survey or scan of the complete frequency range 9 kHz to 30 MHz shall be made in on-state at the highest setting. In addition, the following frequencies and at all frequencies at which there is a local maximum disturbances above the predetermined level of 6 dB below the limits given in CISPR 15, the control setting shall be varied for maximum disturbance while connected to the maximum load:

9 kHz, 50 kHz, 100 kHz, 150 kHz, 240 kHz, 550 kHz, 1 MHz, 1,4 MHz, 2 MHz, 3,5 MHz, 6 MHz, 10 MHz, 22 MHz and 30 MHz.

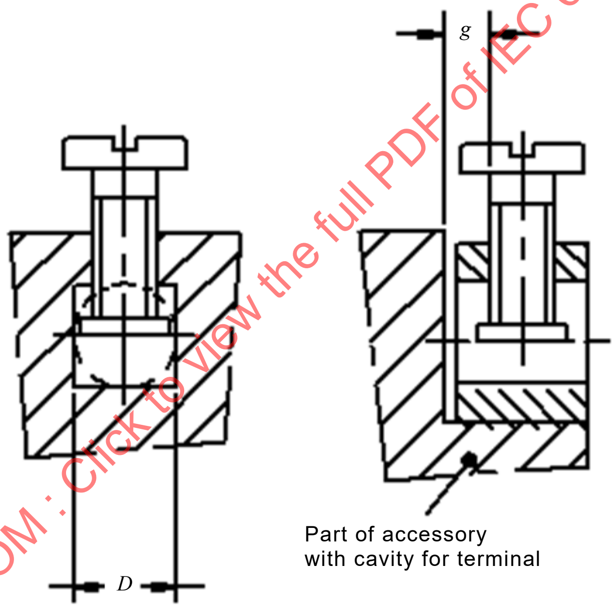
b) *At the load and/or control terminals (8.1.4.2 of CISPR 15:2013).*

An initial survey or scan of the complete frequency range 150 kHz to 30 MHz shall be made in on-state at the highest setting. In addition, the following frequencies and at all frequencies at which there is a local maximum disturbances above the predetermined level of 6 dB below the limits given in CISPR 15, the control setting shall be varied for maximum disturbance while connected to the maximum load:

150 kHz, 240 kHz, 550 kHz, 1 MHz, 1,4 MHz, 2 MHz, 3,5 MHz, 6 MHz, 10 MHz, 22 MHz and 30 MHz.



Terminals without pressure plates



Terminals with pressure plates

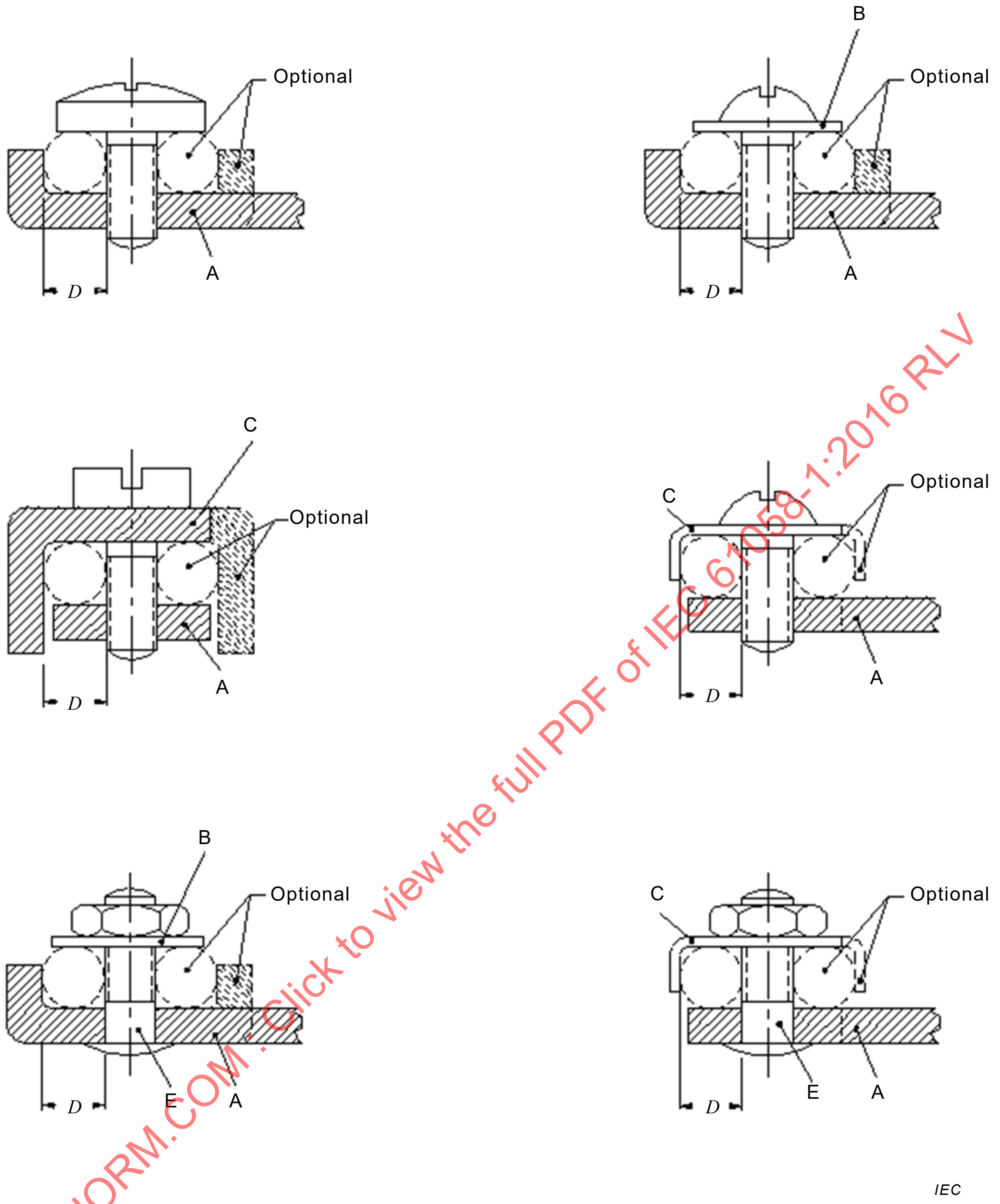
IEC

Key

D conductor space (not specified)

g distance between clamping screw and end-stop (not specified)

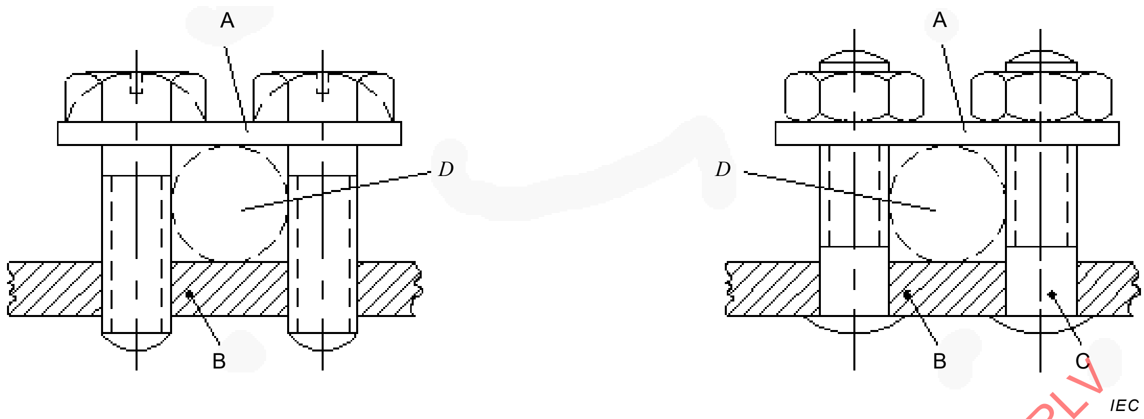
Figure 1 – Examples of pillar terminals



Key

A	fixed part	*D*	conductor space (not specified)
B	washer or clamping plate	E	stud
C	anti-spred device		

Figure 2 – Examples of screw terminals and stud terminals



Key

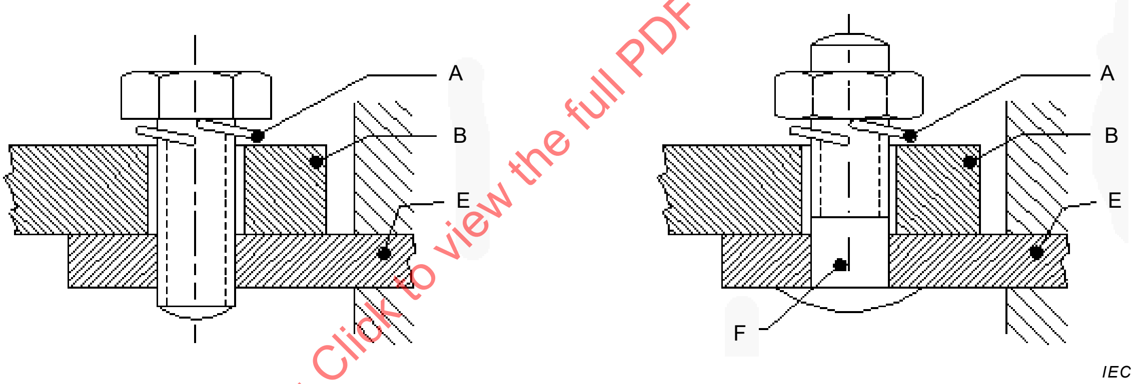
A saddle

B cable lug or bar

C stud

D conductor space (not specified)

Figure 3 – Examples of saddle terminals



Key

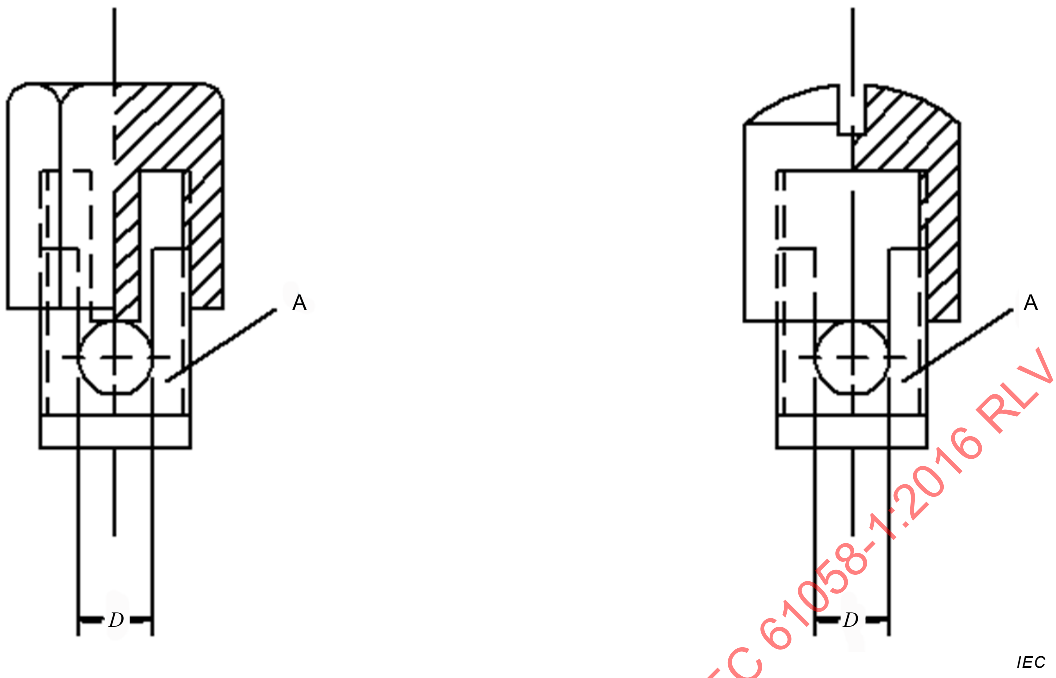
A locking means

B cable lug or bar

E fixed part

F stud

Figure 4 – Examples of lug terminals



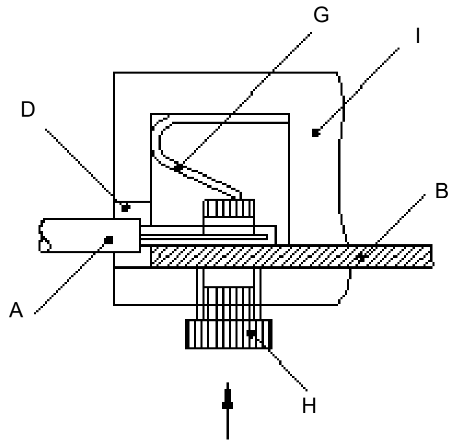
Key

A fixed part

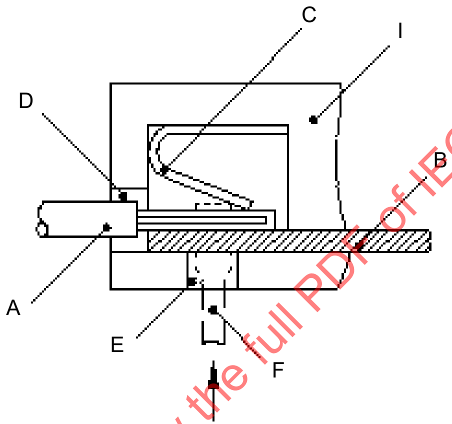
D conductor space (not specified)

The bottom of the conductor space shall be slightly rounded in order to obtain a reliable connection.

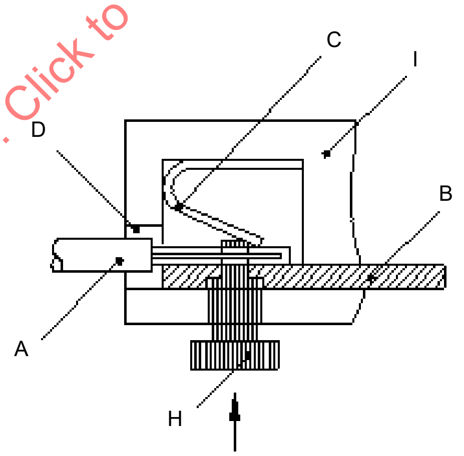
Figure 5 – Examples of mantle terminals



Screwless terminal with indirect pressure clamping means and loosening with an actuating element



Screwless terminal with direct pressure clamping means and loosening with a tool



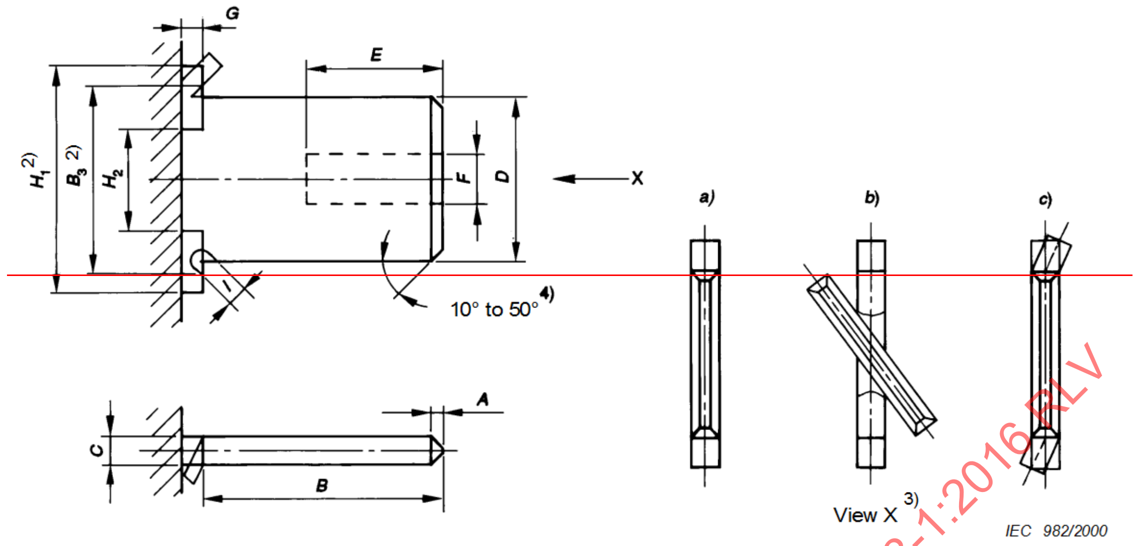
Screwless terminal with direct pressure clamping means and loosening with an actuating element

IEC

Key

A	conductor	D	conductor opening	G	pressure-spring
B	current-carrying part	E	tool opening	H	actuating element
C	clamping spring	F	tool (screwdriver)	I	part at the switch

Figure 6 – Examples of screwless terminals



~~Dimensions of tabs~~ ~~5)~~

~~*Dimensions in millimetres*~~

~~Nominal size~~	~~*A* (Mandatory) Max.~~	~~*B* (Mandatory) Min.~~	~~*C* (Mandatory) +0,04 −0,03~~	~~*D* (Mandatory) +0,1 −0,1~~	~~*E* (Optional) Max.~~	~~*F* (Optional) Max.~~	~~*G* (Mandatory) Min.~~	~~*H_2* (Mandatory) Min.~~	~~*I* (Optional) Diameter Max.~~
~~2,8 × 0,5~~	~~0,7~~	~~7,0~~	~~0,5~~	~~2,8~~	~~2,5~~	~~1,5~~	~~1,2~~	~~1,8~~	~~0,6~~
~~2,8 × 0,8~~	~~0,7~~	~~7,0~~	~~0,8~~	~~2,8~~	~~2,5~~	~~1,5~~	~~1,2~~	~~1,8~~	~~0,6~~
~~4,8 × 0,5 1)~~	~~1,2~~	~~6,2~~	~~0,5~~	~~4,7~~	~~4,2~~	~~1,6~~	~~1,2~~	~~3,0~~	~~1,0~~
~~4,8 × 0,8~~	~~1,2~~	~~6,2~~	~~0,8~~	~~4,7~~	~~4,2~~	~~1,6~~	~~1,2~~	~~3,0~~	~~1,0~~
~~6,3 × 0,8~~	~~1,3~~	~~7,8~~	~~0,8~~	~~6,3~~	~~5,7~~	~~2,0~~	~~1,2~~	~~4,0~~	~~1,3~~
~~9,5 × 1,2~~	~~1,3~~	~~12,0~~	~~1,2~~	~~9,5~~	~~6,5~~	~~2,0~~	~~1,2~~	~~6,2~~	~~1,8~~

~~1) Nominal size 4,8 × 0,5 is not recommended for new design.~~

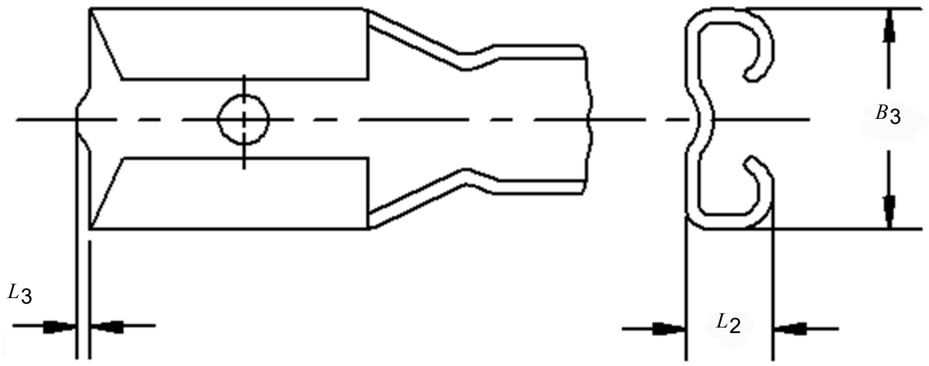
~~2) Dimensions "B_3" and "H_1" not specified.~~

~~3) View "X" shows examples a) to c) of different possible methods of fixation.~~

~~4) The end of the tab is shaped to facilitate the application of the female connector.~~

~~5) Tabs manufactured according to the dimensions of figure 7 will be compatible with female connectors manufactured according to IEC 60760. For push-on and pull-off forces, refer to annex H.~~

~~**Figure 7 – Tabs of flat quick-connect terminations**~~



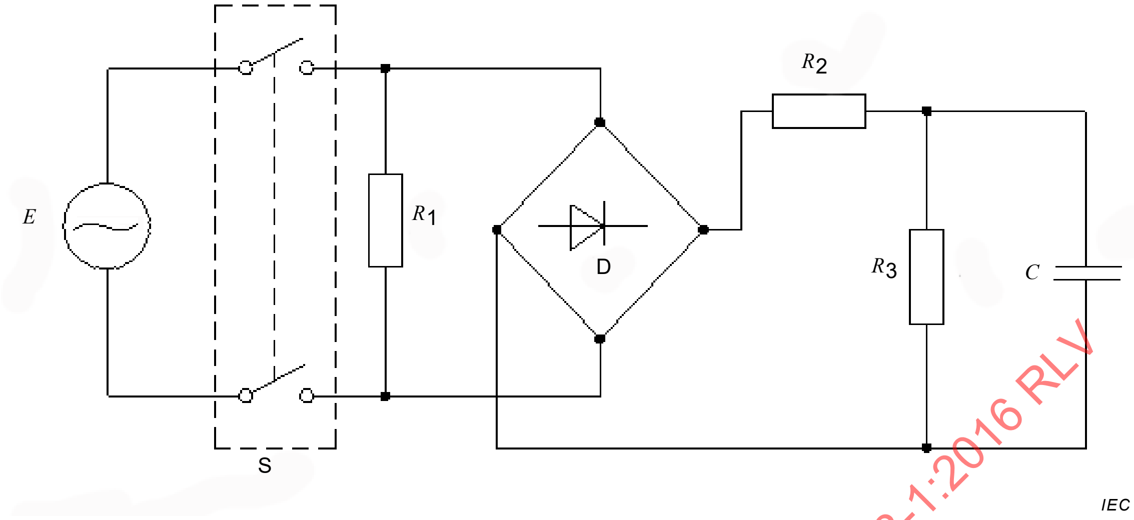
Dimensions of female connectors

Dimensions in millimeters

Connector for tab size	B_3 Max.	L_2 Max.	L_3 Max.
2,8 × 0,5	3,8	2,3	0,5
2,8 × 0,8	3,8	2,3	0,5
4,8 × 0,5[1)]	6,0	2,9	0,5
4,8 × 0,8	6,0	2,9	0,5
6,3 × 0,8	7,8	3,5	0,5
9,5 × 1,2	11,1	4,0	0,5

1) Nominal size 4,8 × 0,5 is not recommended for new design.

Figure 7 – Example of female (test) connector of flat quick-connect terminations



Key

$R_1 = E / I$ where E is the rated voltage and I is the rated resistive current or the rated current of the lamp;

$R_2 = R_1 \times 1{,}414 / (X - 1)$ where X is the ratio between the peak surge current and the rated resistive current, or the ratio of the peak inrush current of the cold lamp and the rated current of the lamp;

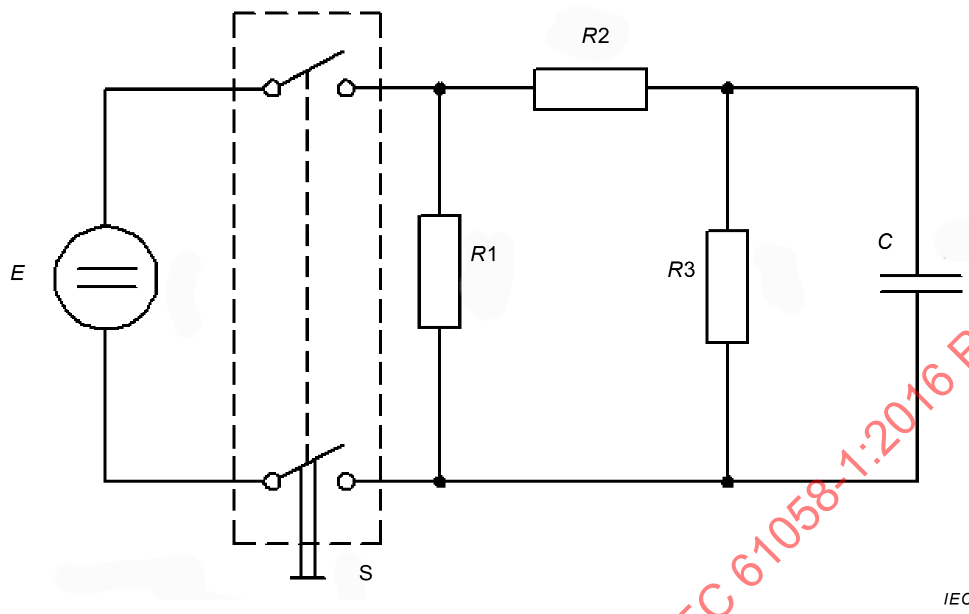
$R_3 = (800/X) \times R_1$

$C \times R_2 = 2\ 500\ \mu s$

D is a rectifier-bridge

The circuit elements and the source impedance are chosen so as to ensure a 10 % accuracy of the surge current, the peak inrush current of the cold lamp, the rated resistive current, or the rated current of the lamp.

Figure 8 – Circuit for capacitive load test and simulated tungsten filament lamp load test for AC circuits



Key

R_1 = E / I where E is the rated voltage and I is the rated resistive current or the rated current of the lamp;

R_2 = R_1 / (X – 1) where X is the ratio between the peak surge current and the rated resistive current, or the ratio of the peak inrush current of the cold lamp and the rated current of the lamp;

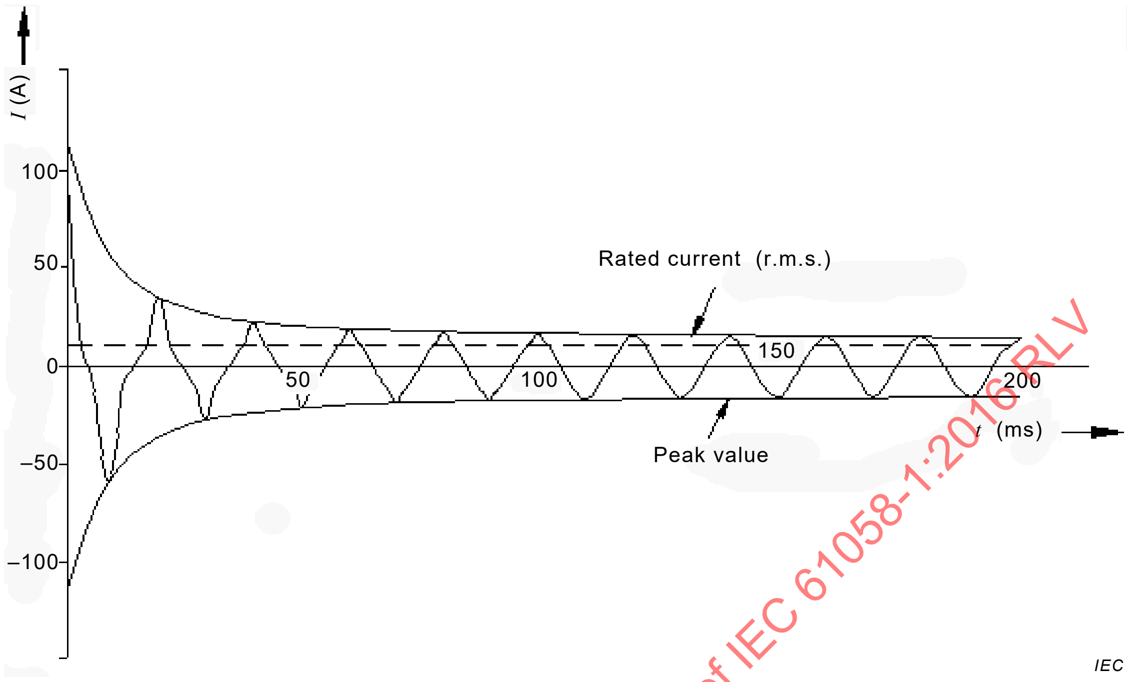
R_3 = (800/X) × R_1

C × R_2 = 2 500 µs

S = specimen

The circuit elements and the source impedance are chosen so as to ensure a 10 % accuracy of the surge current, the peak inrush current of the cold lamp, the rated resistive current, or the rated current of the lamp.

Figure 9 – Circuit for capacitive load test and simulated lamp load test for DC circuits



List of values

R_1 = 25 Ω

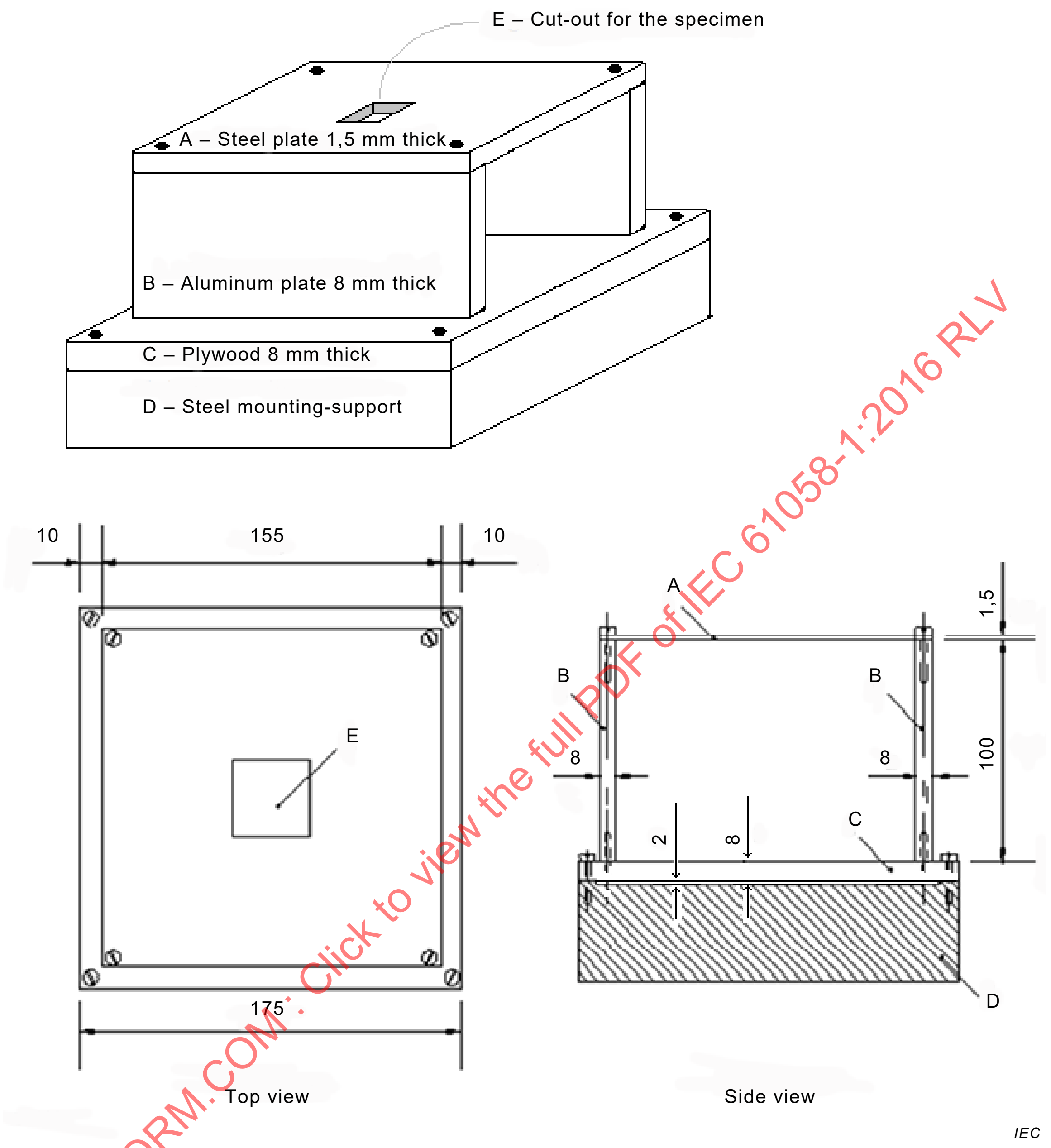
R_2 = 3,93 Ω

R_3 = 2 000 Ω

C = 636 μF

Figure 10 – Values of the capacitive load test circuit for test of switches rated 10/100 A 250 V~

Dimensions in millimeters



Key

A interchangeable steel plate with a thickness of 1,5 mm

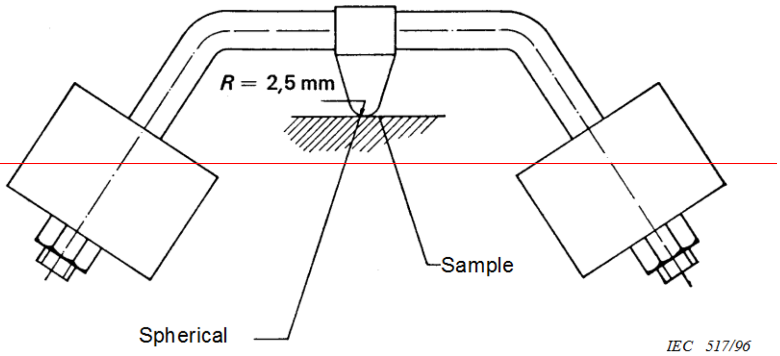
B aluminium plate with a thickness of 8 mm

C sheet of plywood with a thickness of 8 mm

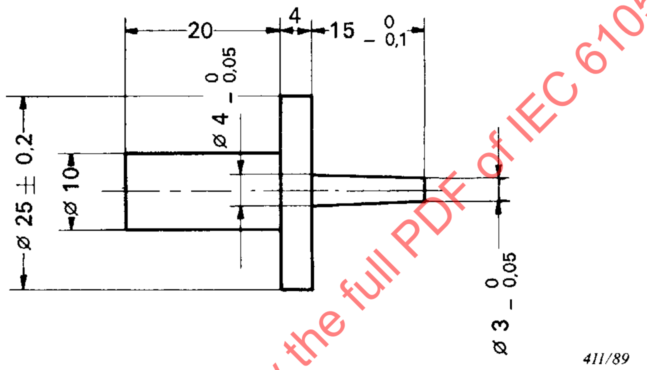
D mounting-support of steel with a minimum mass of 10 kg

E cut-out in the steel plate for the specimen

Figure 11 – Mounting device for the impact tests

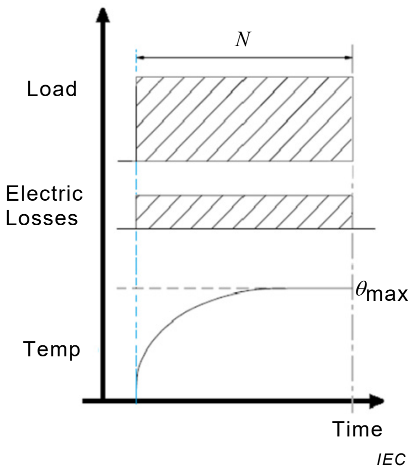


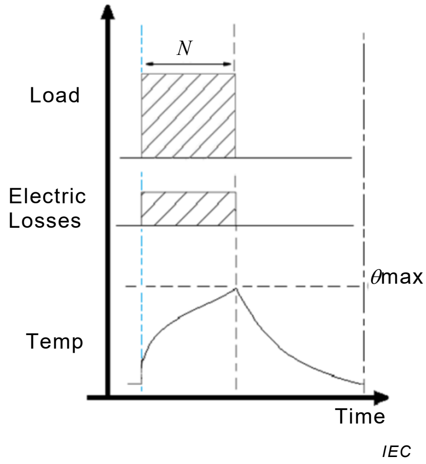
~~Figure 12 – Ball pressure apparatus~~

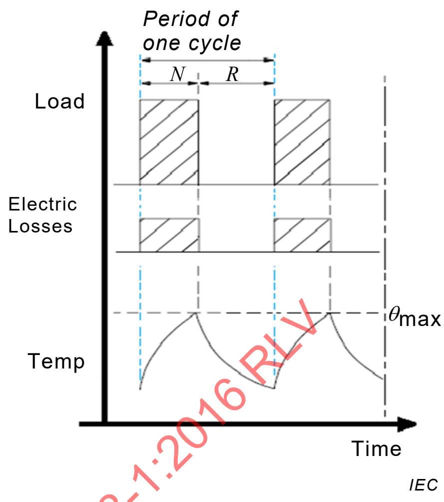


~~*Dimensions in millimetres*~~

~~Figure 13 – Test pin~~







Key

N Operation at constant load

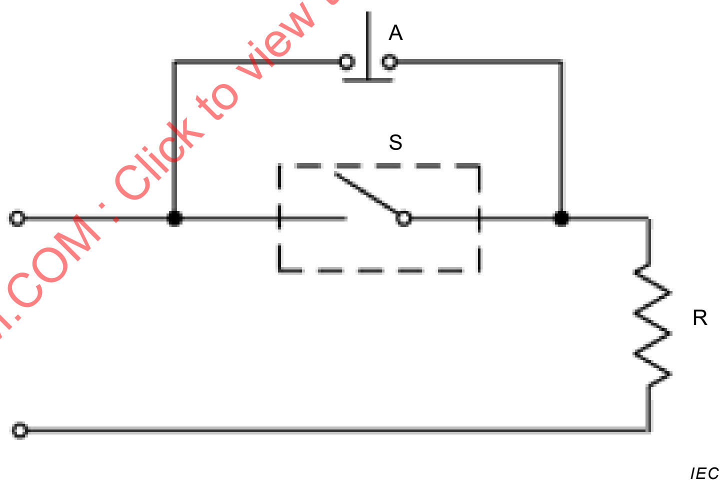
θmax Maximum temperature attained

R At rest and de-energized

Figure 12 – Continuous duty – Duty type S1 (see 7.18.1)

Figure 13 – Short-time duty – Duty type S2 (see 7.18.2)

Figure 14 – Intermittent periodic duty – Duty-type S3 (see 7.18.3)



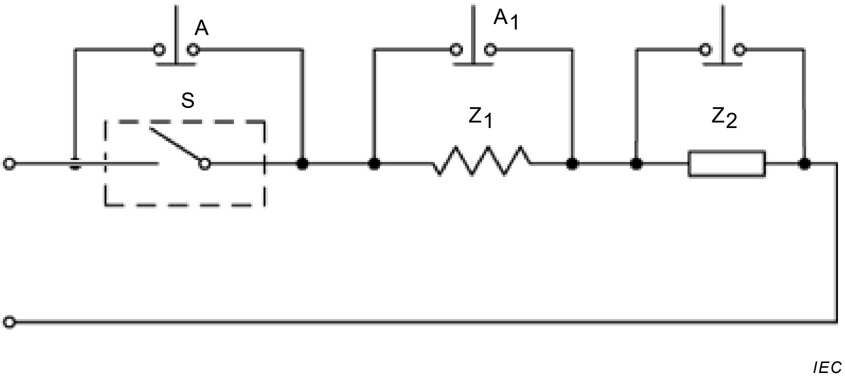
Key

A Auxiliary switch to set switch load

R Resistive load to attain current

S Test specimen

Figure 15 – Diagram for heating test



Components

A Auxiliary switch to set switch load

A_1 Auxiliary switch to attain "break" current

S Test specimen

Z_1 Resistive load to attain "break" current

Z_2 Load for "make" current

The "make" test load is set by closing the auxiliary switches A and A_1 and adjusting Z_2.

The "break" test load is set by closing the auxiliary switch A and adjusting Z_1 with the auxiliary switch A_1 open-circuited.

Throughout the electrical endurance test, the auxiliary switch A is open-circuited.

A_1 is initially closed and is open-circuited time-delayed after the test specimen closes, to reduce the "make" test load to the break load. After the test, the specimen S switches off, and the auxiliary switch A_1 is closed before the next operation of the test specimen.

For the test of electrical contacts, the delay time shall be 50 ms to 100 ms. For the test of electronic switches, where the phase angle of the switched load voltage varies with the movement of the actuating member, the delay time is chosen in such a way that, depending on the operating speed of the actuating mechanism of the test equipment, A_1 is open-circuited at maximum phase angle.

NOTE Some simulated loads, for example 12(2) A, will require auxiliary additional switches in order to set the correct break load.

Figure 16 – Diagram for endurance test

Annex A
(normative)

Measurement of clearances and creepage distances

The methods of measuring clearances and creepage distances which are specified in the following figures are used in interpreting the requirements of this standard.

In the following figures, the minimum values of X are given in Table A.1. Where the distance shown is less than X, the depth of the gap or groove is disregarded when measuring a creepage distance.

Table A.1 is valid only if the required minimum clearance is 3 mm or more. If the required minimum clearance is less than 3 mm, the value of X is the lesser of:

– the relevant value in Table A.1; or
– one third of the required minimum clearance.

Table A.1 – Minimum values for distances with specific pollution degrees

Pollution degree	Width X Minimum values mm
1	0,25
2	1,0
3	1,5

The width X specified in the following examples 1 to 11 in Annex A apply to all examples as a function of the pollution degree as follows:

~~If the associated clearance is less than 3 mm, the minimum width X may be reduced to one-third of this clearance.~~

~~The methods of measuring creepage distances and clearances are indicated in the following examples 1 to 11.~~

These cases do not differentiate between gaps and grooves or between types of insulation.

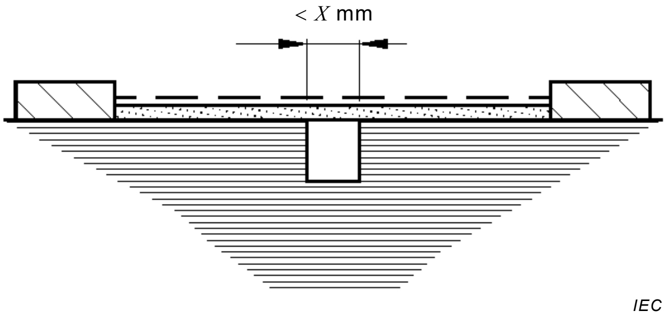
The following assumptions are made:

– any recess is assumed to be bridged with an insulating link having a length equal to the specified width X and being placed in the most unfavourable position (see example 3);
– where the distance across a groove is equal to or larger than the specified width X, the creepage distance is measured along the contours of the groove (see example 2);
– creepage distances and clearances measured between parts which can assume different positions in relation to each other, are measured when these parts are in their most unfavourable position.

Explanation for examples 1 to 11:

———— clearance

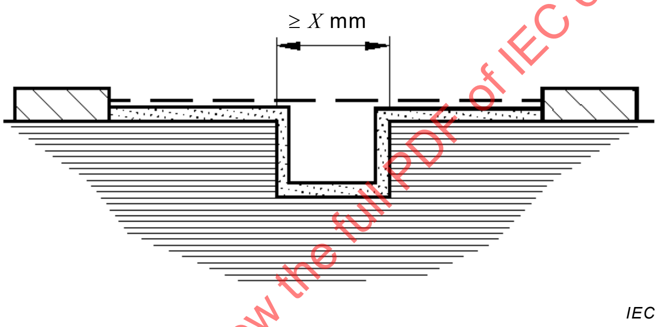
━━━━ creepage distance



Example 1

Condition: Path under consideration includes a parallel-sided or converging~~-sided~~ sides groove of any depth with a width less than X mm.

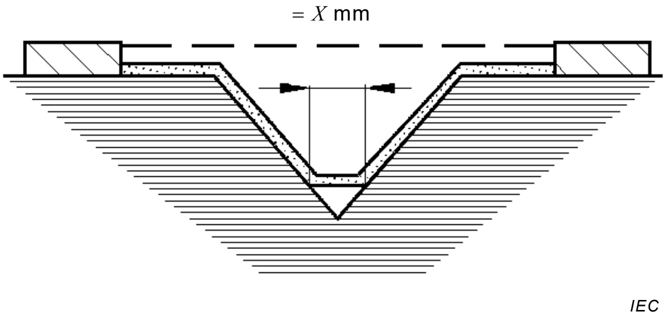
Rule: Creepage distance and clearances are measured directly across the groove as shown.



Example 2

Condition: Path under consideration includes a parallel-sided groove of any depth and with a width equal to or more than X mm.

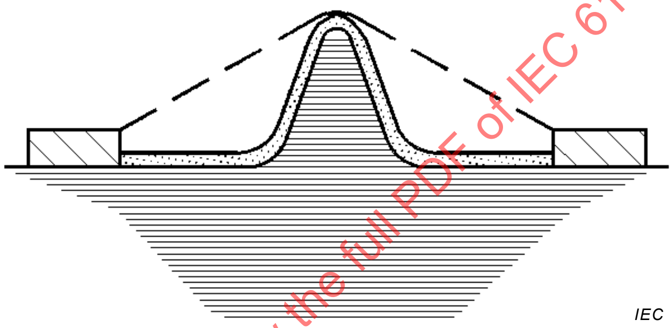
Rule: Clearance is the "line of sight" distance. Creepage path follows the contour of the groove.



Example 3

Condition: Path under consideration includes a V-shaped groove with a width greater than X mm.

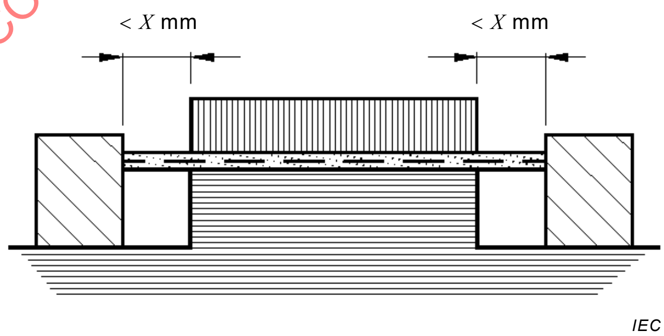
Rule: Clearance is the "line of sight" distance. Creepage path follows the contour of the groove but "short-circuits" the bottom of the groove by an X mm link.



Example 4

Condition: Path under consideration includes a rib.

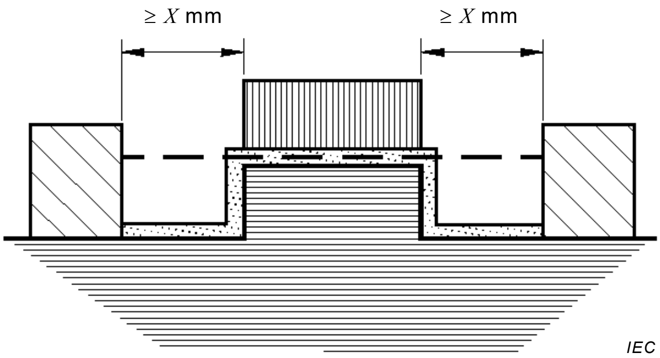
Rule: Clearance is the shortest direct air path over the top of the rib. Creepage path follows the contour of the rib.



Example 5

Condition: Path under consideration includes an uncemented joint with grooves less than X mm wide on each side.

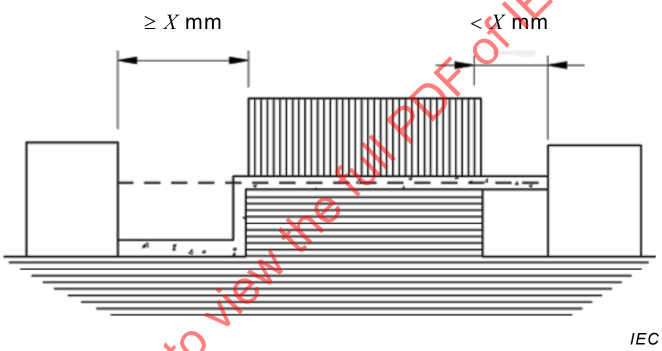
Rule: Creepage and clearance path is the "line of sight" distance shown.



Example 6

Condition: Path under consideration includes an uncemented joint with grooves equal to or more than X mm wide on each side.

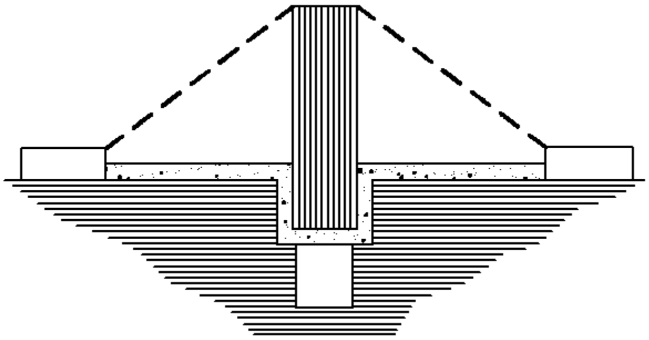
Rule: Clearance is the "line of sight" distance. Creepage path follows the contour of the grooves.



Example 7

Condition: Path under consideration includes an uncemented joint with a groove on one side less than X mm wide and the groove on the other side equal to or more than X mm wide.

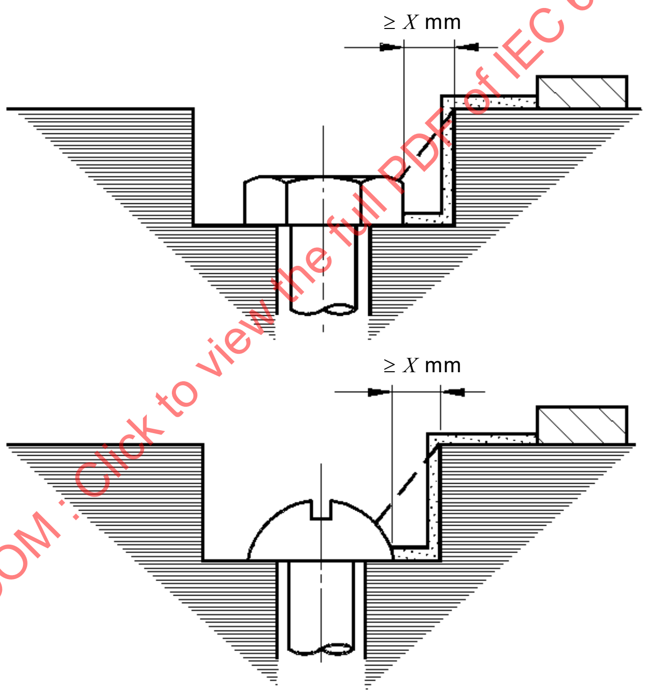
Rule: Clearance and creepage paths are as shown.



Example 8

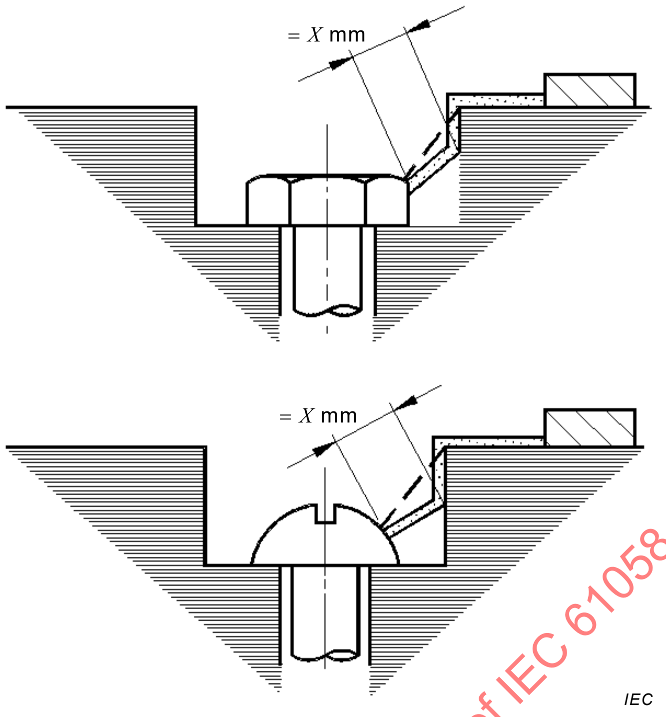
Condition: Creepage distance through an uncemented joint is less than creepage distance over a barrier.

Rule: Clearance is the shortest direct air path over the top of the barrier.



Example 9

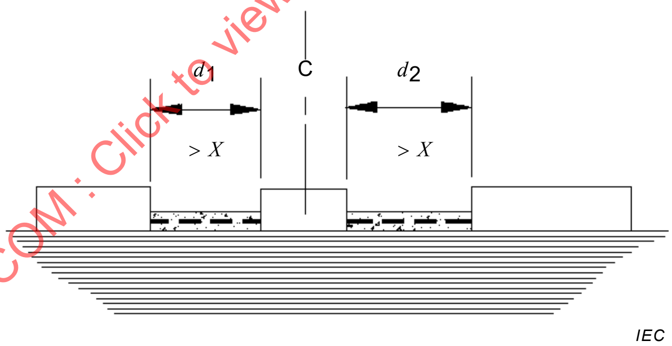
Gap between head of screw and wall of recess wide enough to be taken into account.



Example 10

Gap between head of screw and wall of recess too narrow to be taken into account.

Measurement of creepage distance is from screw to wall when the distance is equal to X mm.



Example 11

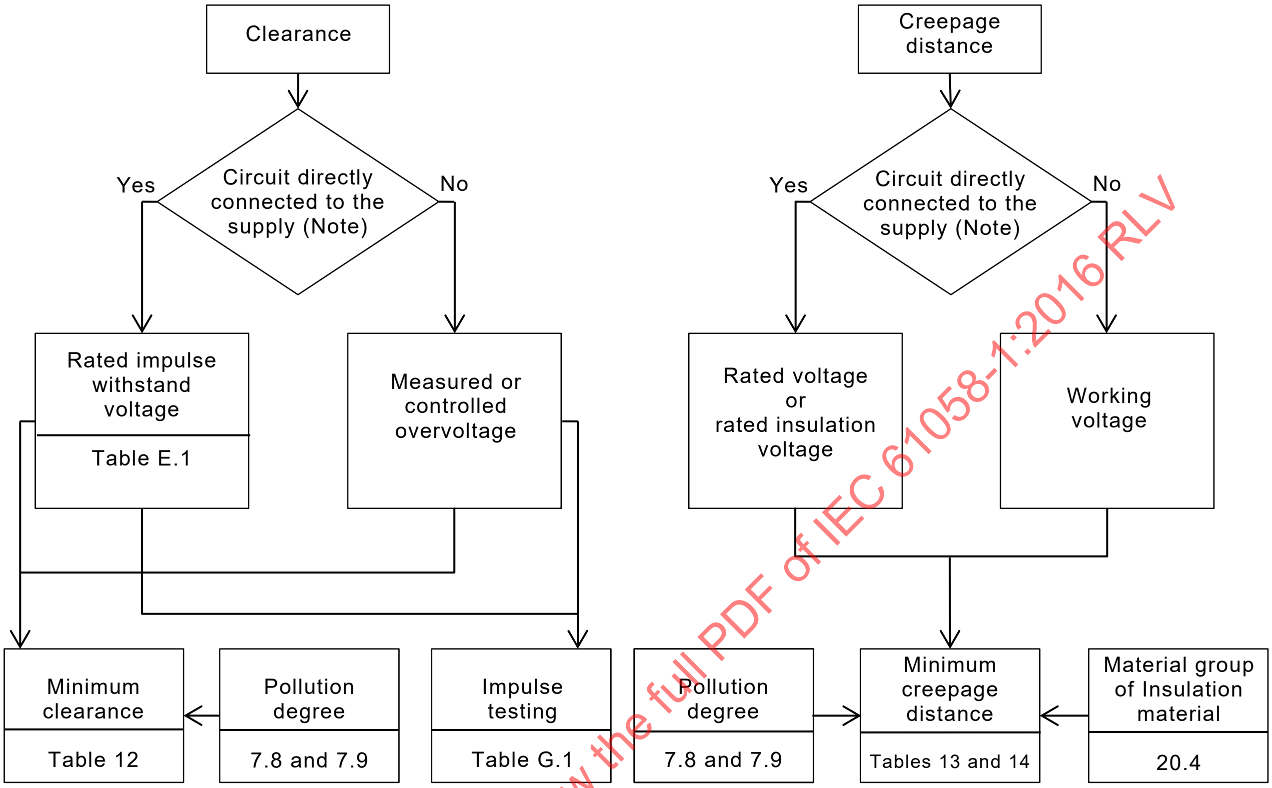
C floating part

Clearance is the distance $d_1 + d_2$.

Creepage distance is also $d_1 + d_2$.

Annex B
(informative)

Diagram for the dimensioning of clearances and creepage distances



Note Includes all circuits significantly affected by ~~external~~ transient overvoltages.

~~Annex C~~
~~(normative)~~

~~Glow-wire test~~

~~*The glow-wire test is made in accordance with IEC 60695-2-1.*~~

~~*For the purpose of this standard, the following applies.*~~

~~*a) In clause 4, description of test apparatus, the first paragraph on page 11 is replaced by*~~

~~*"In cases where burning or glowing particles might fall from the test specimen onto an external surface underneath, the test is carried out with a piece of white pine-wood board, approximately 10 mm thick and covered with a single layer of tissue paper, positioned at a distance of 200 mm ± 5 mm below the place where the tip of the glow-wire is applied to the specimen. When the specimen is a complete switch, the switch itself, in its normal position of use, is placed on, or mounted above, the pine-wood board covered with a single layer of tissue paper. Before starting the test, the board is conditioned as described in clause 7 for the specimen."*~~

~~*b) In clause 5, severities, the duration of application of the tip of the glow-wire to the specimen is 30 s ± 1 s.*~~

~~*c) In clause 10, observations and measurements, items b) and c) shall be recorded and reported.*~~

~~*In cases where it is neither practical nor possible to carry out the test on a complete switch due to metallic parts preventing full penetration of the glow-wire, the test is carried out after having removed the metal parts preventing the full penetration of the glow-wire.*~~

~~*When the switch is either too small or of an inconvenient shape to carry out the test, the test is carried out using a specimen of the material from which the component is manufactured. The specimen shall be of the smallest size possible, resembling the original in size and thickness, and, in any case, shall be not greater than 25 mm in diameter and 3 mm thick.*~~

~~*The test is not carried out on parts that are too small to contribute appreciably to a fire hazard.*~~

Annex C
(normative)

Proof tracking test

The proof tracking test (PTI) is carried out in accordance with IEC 60112.

For the purpose of this standard, the following details apply:

~~*a) In clause 3, test specimen, the last sentence of the first paragraph does not apply.*~~

~~*Moreover, notes 2 and 3 also apply to the proof tracking test of 6.3.*~~

~~NOTE If the surface 15 mm × 15 mm cannot be obtained, because of the small dimensions of the switches, special specimens made with the same manufacturing procedure may be used.~~

~~*b) The test solution "A" described in 5.4 shall be used.*~~

~~*c) If the test is carried out with electrodes of materials other than platinum, this shall be reported.*~~

~~*d) The tolerance on the interval between drops shall be ±1 s.*~~

~~*e) In clause 6, procedure, the voltage referred to in 6.1 is set to the value as determined from 20.2 of this standard dependent on the material group taken from table 23 or table 24 of this standard for the measured creepage distance considering the declared pollution degree and the voltage (rated voltage) expected to occur in normal use. Moreover, 6.2 does not apply and the proof tracking test of 6.3 shall be performed on five specimens.*~~

a) 60112:2003, 7.3 – Only the test solution "A" described in 7.3 shall be used.

b) 60112:2003, Clause 8, Basic test procedure

c) 60112:2003, 8.2 "Set the test voltage to the required value". The required test voltage value is the PTI voltage of the material group according to IEC 61058-1:2016, 20.2 (typically the minimum value of the range).

~~Annex E~~
~~(normative)~~

~~Ball-pressure test~~

~~E.1 Ball-pressure test 1~~

~~E.1.1 Test specimen~~

~~The surface of the part to be tested is placed in the horizontal position. The thickness of the specimen shall not be less than 2,5 mm; if necessary, two or more layers of the part subjected to the test shall be used.~~

~~E.1.2 Preconditioning~~

~~The parts to be tested are stored for 24 h in an atmosphere having a temperature between 15 °C and 35 °C and a relative humidity between 45 % and 75 %, before starting the test.~~

~~E.1.3 Test apparatus~~

~~The test apparatus is shown in figure 12.~~

~~E.1.4 Test procedure~~

~~The ball is applied to the surface of the part to be tested placed in a horizontal position.~~

~~The specimen is supported on a 3 mm thick steel plate.~~

~~A steel ball of 5 mm diameter is pressed against the surface of the specimen by a force of 20 N.~~

~~The test is made in a heating cabinet at a temperature of 20 °C ± 2 °C plus the value of the maximum temperature measured during the heating tests of 16.3, or as declared, or at 75 °C ± 2 °C, whichever is the highest.~~

~~The support and the ball shall be at the prescribed test temperature before the test is started.~~

~~After 1 h, the ball is removed from the specimen which is then cooled down to approximately room temperature by immersion for 10 s in cold water.~~

~~E.1.5 Observations and measurements~~

~~The diameter of the impression caused by the ball is measured and shall not exceed 2 mm.~~

~~NOTE The test is not made on parts of ceramic material.~~

~~E.2 Ball-pressure test 2~~

~~This test is equal to ball-pressure test 1 with the exception that the temperature of the heating cabinet shall be Tb ± 2 °C, where Tb is equal to T + 20 °C with a minimum value of 125 °C or 20 °C in excess of the maximum temperature recorded during the heating test of 16.3 if this would lead to a higher temperature.~~

Annex D
(informative)

Switch application guide

D.1 General

In actual applications switches control many different types of circuits throughout a broad range of currents. It is not economically feasible to test every switch on every application load. For the purpose of testing for certification, standard test circuit conditions have been established which are representative of typical circuits in the application. The electrical ratings of the switch are then verified using the standard circuit conditions. The following guidelines may be used for determining whether a particular switch rating is suitable for controlling the circuit in the actual application.

D.2 Resistive load current ratings

D.2.1 The resistive load current rating is established using a substantially resistive load with a power factor not less than ~~0,95~~ 0,9.

D.2.2 Switches with resistive load rating may be used to control a motor load provided

– the power factor is not less than 0,8 and the motor load current does not exceed 60 % of the resistive load current rating of the switch and the inrush current value does not exceed the resistive load value, or

– the power factor is not less than 0,6 and the motor load current does not exceed 16 % of the resistive load current rating of the switch.

D.2.3 Switches with resistive load rating may be used to control a tungsten filament lamp load, provided the steady-state current of the tungsten filament lamp load does not exceed 10 % of the resistive load current rating of the switch.

D.3 Resistive and/or motor load current ratings

D.3.1 The motor load current rating is established using a load with a power factor of 0,6 for making the circuit and a power factor of ~~0,95~~ 0,9 for breaking the circuit.

D.3.2 Switches having both resistive and motor load ratings are not suitable for switching a combined load of the full resistive load plus the full motor load. Such switches can be used for switching a combined resistive load plus a motor load, ~~providing~~ provided the vector sum of the resistive current and six times the steady-state motor current does not exceed either the resistive current rating or six times the motor current rating, whichever is greater, and depending upon the power factor of the combined load. The vector sum of the resistive current and the steady-state current of the motor shall not exceed the resistive current rating.

NOTE An example is a switch in which the same set of contacts is used to control a circuit in a fan heater which incorporates both a heating element and a motor.

D.3.3 Switches having both resistive and motor load ratings may be used for tungsten filament lamp loads and capacitive load, provided that the steady-state ~~lamp load~~ current does not exceed either 10 % of the resistive current rating or 60 % of the motor current rating, whichever is greater.

D.3.4 Switches with motor current ratings only may either be classified

– according to 7.2.2 by declaring the resistive load to be equal to the motor load, or

– according to 7.2.5 for a declared specific load.

D.4 Combination capacitive and resistive load ratings

NOTE An example is a circuit in a radio-receiving apparatus for sound and television.

D.5 Declared specific load ratings

NOTE 1 Examples are fluorescent lamp loads and inductive loads with a power factor less than 0,6.

NOTE 2 Switches submitted in an appliance may be tested using the circuit in the appliance and classified according to 7.2.5 as a declared specific load.

D.6 Current ratings not exceeding 20 mA

NOTE Examples are switches which control discharge lamp indicators and other signal lamps.

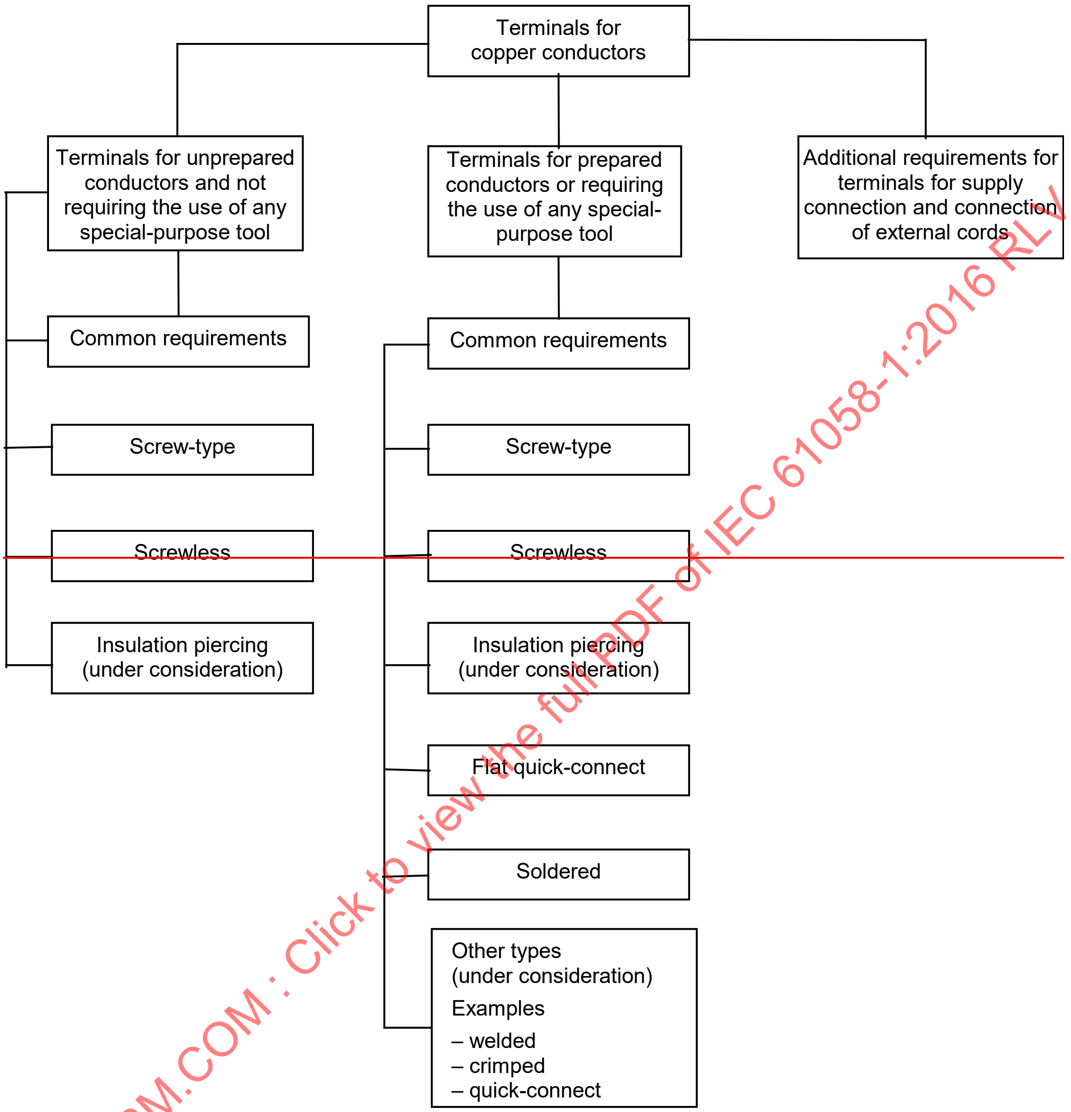
D.7 General purpose load

D.7.1 The general purpose load current rating is established using an inductive load with a power factor within 0,75 to 0,8.

D.7.2 It is for inductive or general use but not representing motor or lamp load.

~~Annex G~~
~~(informative)~~

~~Schematic diagram of families of terminals~~



IEC 993/2000

~~Annex H~~
~~(informative)~~

~~Flat quick-connect terminations, method for selection of female connectors~~

~~For the purpose of testing switches with tabs, approved female connectors with dimensions according to IEC 60760 shall be used.~~

~~In case of doubt, female connectors according to figure 8 are submitted to the following tests. If the tests are withstood, new specimens of the same production lot are used for the purpose of testing switches.~~

~~Six specimens of the female connectors are fitted with conductors of the medium cross-sectional area specified in table 4. For each female connector an unused tab is inserted and then withdrawn. The same tab is inserted and withdrawn five times more. The insertion force and the withdrawal force are applied axially and without jerks; they are measured for each insertion and each withdrawal.~~

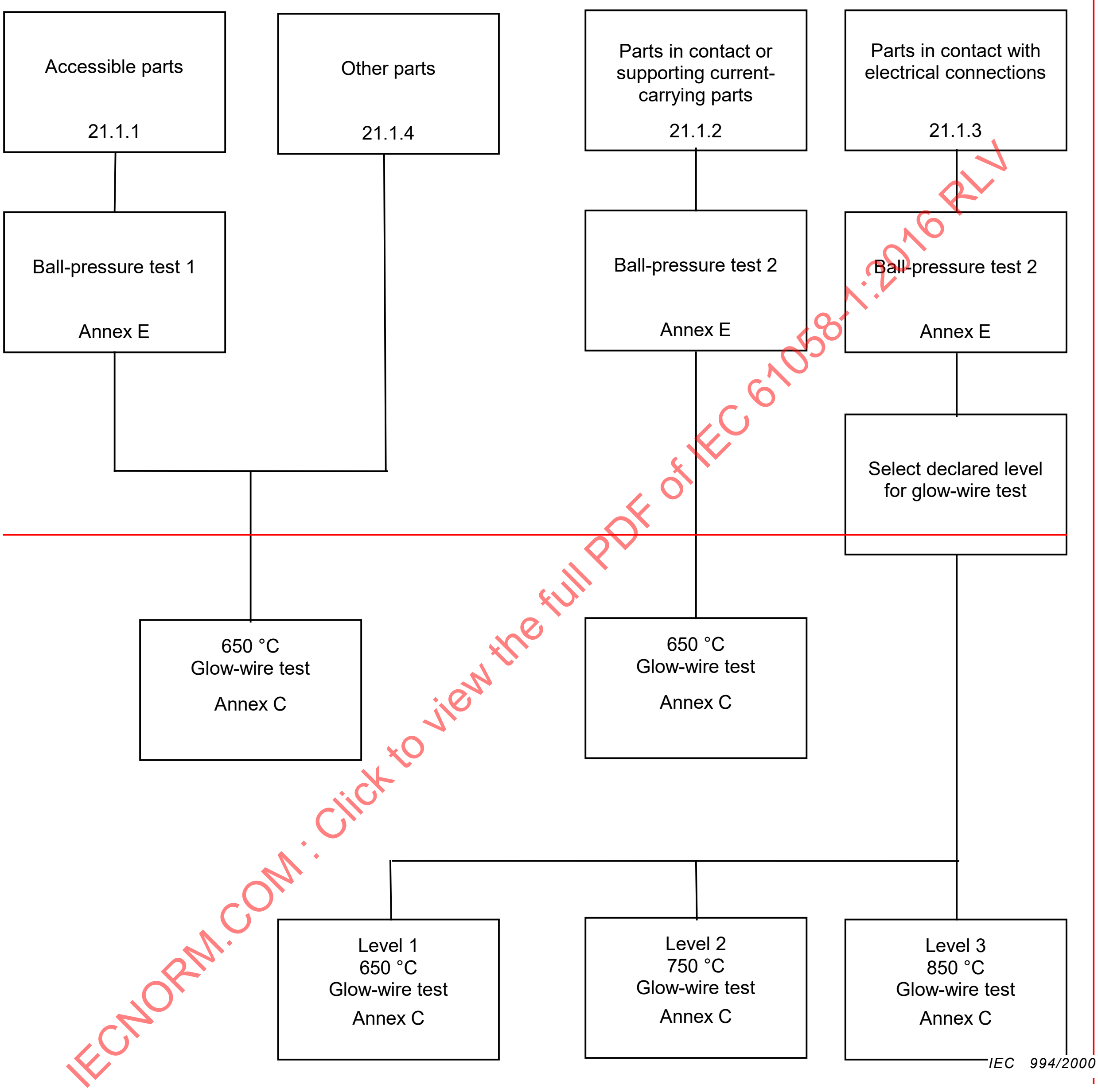
~~The insertion and withdrawal forces shall be within the limits according to table H.1.~~

~~Table H.1 – Insertion and withdrawal forces for flat quick-connect terminations~~

~~Tab size~~	~~First insertion~~	~~First withdrawal~~			~~Sixth withdrawal~~	
	~~Maximum individual force~~	~~Maximum force~~	~~Minimum force~~		~~Minimum force~~	
~~mm~~	~~N~~	~~N~~	~~Average~~ ~~N~~	~~Individual~~ ~~N~~	~~Average~~ ~~N~~	~~Individual~~ ~~N~~
~~Unplated brass tab and unplated brass female connector~~						
~~2,8~~	~~53~~	~~44~~	~~13~~	~~9~~	~~9~~	~~5~~
~~4,8~~	~~67~~	~~89~~	~~22~~	~~13~~	~~13~~	~~9~~
~~6,3~~	~~80~~	~~80~~	~~27~~	~~18~~	~~22~~	~~18~~
~~9,5~~	~~100~~	~~80~~	~~30~~	~~20~~	~~30~~	~~20~~
~~Unplated brass tab and tin plated female connector~~						
~~2,8~~	~~53~~	~~44~~	~~13~~	~~9~~	~~9~~	~~5~~
~~4,8~~	~~67~~	~~89~~	~~22~~	~~13~~	~~13~~	~~9~~
~~6,3~~	~~76~~	~~76~~	~~22~~	~~13~~	~~18~~	~~13~~
~~9,5~~	~~100~~	~~80~~	~~40~~	~~23~~	~~40~~	~~23~~

~~Annex J~~
~~(informative)~~

~~Selection and sequence of tests of clause 21~~



Annex E
(normative)

Relation between rated impulse withstand voltage, rated voltage and overvoltage category

See Table E.1.

Table E.1 – Rated impulse withstand voltage for switches energized directly from the low voltage mains

Nominal voltage of the supply system based on IEC 60038[1)] V		Voltage line to neutral derived from nominal voltages AC or DC up to including V	Rated impulse withstand voltage [2)3)] kV		
Three-phase	**Single-phase**		**Overvoltage category**		
			I	II	III
		50	0,33	0,5	0,8
		100	0,5	0,8	1,5
	125	150	0,8	1,5	2,5
230/400; 277/480	~~120-240~~ 250	300	1,5	2,5	4,0

NOTE 1 For more detailed information, see IEC 60664-1:2007. For example, for the overvoltage category, see 2.2.2.1.1.

NOTE 2 In general, switches for appliances are considered to fall within overvoltage category II. Overvoltage category I is applicable if special precautions against transient overvoltage are built into the appliance.

1) The / mark indicates a four-wire three-phase distribution system. The lower value is the voltage line-to-neutral, while the higher value is the voltage line-to-line.

2) Switches with these rated impulse withstand voltages can be used in installations in accordance with IEC ~~60364-4-443~~ 61140.

3) For switches capable of generating an overvoltage at the switch terminals, the rated impulse withstand voltage implies that the switch shall not generate overvoltage in excess of this value when used in accordance with the relevant appliance standard and instructions of the manufacturer.

Annex F
(normative)

Pollution degree

The ~~micro-~~environment determines the effect of pollution on the insulation. The macro-environment, however, has to be taken into account when considering the micro-environment.

In general, the macro-environment is the outside of the switch, and the micro-environment is the inside of the switch.

Within a switch, designed for a particular pollution degree, enclosures or sealing may be provided to allow the use of clearances and creepage distances appropriate for a lower pollution degree. Such means to reduce pollution may not be effective when the switch is subject to condensation.

Small clearances can be bridged completely by solid particles, dust and water and therefore minimum clearances are specified where pollution may be present in the ~~micro-~~environment.

NOTE Pollution will become conductive in the presence of humidity. Pollution caused by contaminated water, soot, metal or carbon dust is inherently conductive.

~~Degrees of pollution in the micro-environment~~

For the purpose of evaluating creepage distances and clearances, the following three degrees of pollution in the ~~micro-~~environment are established.

– 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.

Conductive pollution by ionized gases and metallic depositions may occur in arc chambers of switches. For this type of pollution, no pollution degree is specified.

Safety aspects are checked during the tests of Clause 17.

Annex G
(normative)

Impulse voltage test

The purpose of this test is to verify that clearances will withstand specified transient overvoltage. The impulse withstand voltage test is carried out with a voltage having a 1,2/50 µs wave form as specified in IEC 60060-1 and is intended to simulate overvoltage of atmospheric origin. It also covers overvoltages due to switching of low-voltage equipment.

The test shall be conducted for a minimum of three impulses of each polarity with an interval of at least 1 s between pulses.

~~NOTE~~ The output impedance of the impulse generator should not be higher than 500 Ω. When testing specimens incorporating components across the test circuit, a much lower output impedance may be used.

When surge suppression is provided inside the specimen, the impulse shall have the following characteristics:

– the waveform 1, 2/50 µs for the no-load voltage with amplitudes equal to the values in Table G.1;

– the waveform 8/20 µs for an appropriate surge current.

~~NOTE~~ The voltage waveform of the test voltage source is applicable whether or not the specimen is equipped with surge suppression. If the specimen is provided with surge suppression, the impulse voltage wave may be chopped but the specimen should be in a condition to operate normally again after the test.

If the specimen is not provided with surge suppression and it withstands the impulse voltage, the waveform will not be noticeably distorted.

Table G.1 – Test voltages for verifying clearances at sea-level

Rated impulse withstand voltage $\hat{U}$ kV	Impulse test voltage at sea-level $\hat{U}$ kV
0,33	0,35
0,5	0,55
0,8	0,91
1,5	1,75
2,5	2,95
4,0	4,8
6,0	7,3

NOTE 1 When testing clearances, associated solid insulation will be subjected to the test voltage. As the impulse test voltage of Table G.1 is increased with respect to the rated impulse withstand voltage, solid insulation will have to be designed accordingly. This results in an increased impulse withstand capability of the solid insulation.

NOTE 2 The test may be made with the pressure adjusted to the value corresponding to the altitude of 2 000 m (80 kPa) and 20 °C with the test voltage corresponding to the rated impulse withstand voltage. In this case, solid insulation will not be subjected to the same withstand requirements as when testing at sea-level.

NOTE 3 Explanations concerning the influencing factors (air pressure, altitude, temperature, humidity) with respect to dielectric strength of clearances are given in 4.1.1.2.1.2 of IEC 60664-1:2007.

Annex H
(normative)

Altitude correction factors

As the dimensions given in Table 12 are valid for altitudes up to and including 2 000 m above sea-level, clearances for altitudes above 2 000 m shall be multiplied by the altitude correction factor as specified in Table H.1

Table H.1 – Altitude correction factors

Altitude m	**Normal barometric pressure** kPa	**Multiplication factor for clearances**
2 000	80,0	1,00
3 000	70,0	1,14
4 000	62,0	1,29
5 000	54,0	1,48
6 000	47,0	1,70
7 000	41,0	1,95
8 000	35,5	2,25
9 000	30,5	2,62
10 000	26,5	3,02
15 000	12,0	6,67
20 000	5,5	14,50

Annex I
(normative)

Types of coatings for rigid printed board assemblies

Type 1 coating: Provides only protection against pollution by improving the environment for spacings between printed wiring conductors under the coating to pollution degree 1. The clearance and creepage distance requirements of 20.1, 20.2 and 20.4 apply to the rigid printed board assembly under the coating.

Type 2 coating: Provides protection against pollution and insulation by enclosing the conductors in solid insulation so that the clearance and creepage distance requirements of 20.1, 20.2 and 20.4 are not applicable between conductors under the coating.

NOTE 1 Coating can be effective between two conducting parts if it covers either one or both conductive parts, together with at least 80 % of the creepage distance between them. As a result, some coated rigid printed board assemblies can be used with higher voltage or reduced clearances and creepage distances between conductive parts compared to the same rigid printed board assembly when uncoated.

NOTE 2 Clearance and creepage distance requirements according to 20.1, 20.2 and 20.4 apply to all uncoated parts of the rigid printed board assembly and between conductive parts over the coating.

Annex J
(normative)

Measuring the insulation distance of a coated printed board with type 1 coating

See Figure J.1.

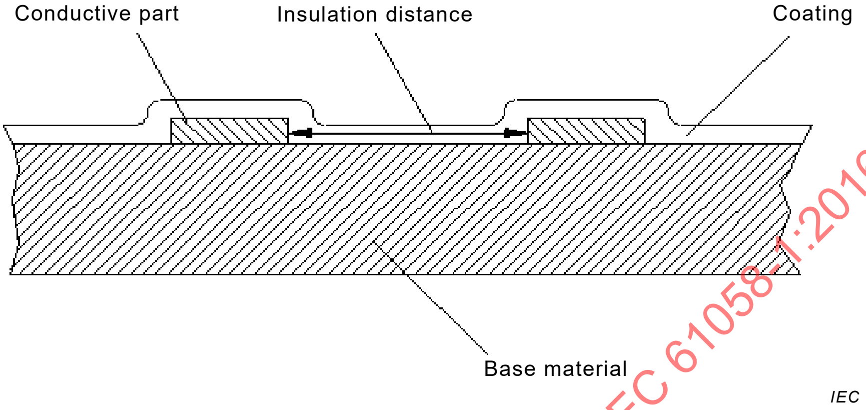


Figure J.1 – Measurement of the insulation distance

The insulation distance is measured under the coating on the base material.

Annex K
(normative)

Routine tests

Routine tests are prescribed in those situations where detection on a sampling basis is considered to be essential for safety.

Clearances for basic or functional insulation which are less than the values given in Table 12 shall be confirmed by routine test, using the test of Annex G.

In cases where the switch does not pass the relevant tests, corrective actions shall be made.

Annex L
(informative)

Sampling tests

L.1 General

Annex L is provided for guidance as a means to confirm that products manufactured after type testing to this standard continue to perform in the declared manner. Test plans other than as described in Annex L may be used if determined to satisfy the same purpose.

L.2 General considerations

Tests specified in Annex L may be considered as part of a product examination test plan. The product examination is applied during ongoing production of the switch.

In cases where the switch does not pass the relevant tests, corrective action should be taken.

Tests according to Clause L.3 are conducted on samples taken randomly from the production line, in accordance with written procedures. The need, nature and frequency of the tests and the sampling rates used for these tests may be influenced by:

- the construction of the product;
- the quality control system used, and;
- the quantity of products manufactured.

Tests may be carried out with different test methods than those applied in conjunction with the type tests if the alternate test methods can be shown to be equivalent.

The quality control system used should include the elements of an ISO 9000 quality control system which apply to manufacturing and production systems. The requirements of the quality control system may be met by other means.

L.3 Tests

L.3.1 The following tests apply as part of a sampling plan on all production, independently of switch types or switch groupings.

- Check of content of marking according to Clause 8, legibility and durability of marking according to 8.8.

NOTE 1 The test may be omitted when ongoing conformity is found (e.g., by use of moulding, etching or similar processes).

- Dielectric strength test according to Clause 15 without humidity treatment.

NOTE 2 The test may be omitted when ongoing conformity is found (e.g. by design).

L.3.2 Within a time period specified in written procedures, the following tests should be conducted in the order given:

- dielectric strength test according to Clause 15;
- heating test on contacts and terminals according to Clause 16;
- endurance test according to Clause 17.

The tests should be conducted on individual switch types, which may be selected from switch families, according to Annex M. The number of test samples is according to Table 101 of IEC 61058-1-1:2016 or Table 101 of IEC 61058-1-2:2016. They may be grouped into switch families according to Annex M, and the tests may then be carried out with samples selected according to Annex M. Annex M gives an example system for grouping switch types into switch families for this purpose. Other grouping systems may also be appropriate for this purpose.

L.3.3 Within a time period specified in written procedures, glow wire tests and ball pressure tests according to Clause 21, and proof tracking tests according to Annex C, should be conducted on samples of material representing the different switch constructions and materials in production. However, these tests do not apply if it is otherwise verified that the same raw materials, moulds and processes are used as for the type test. This may be accomplished as part of a moulder's verification program. These tests may be part of incoming inspection rather than as part of production testing.

Annex M
(normative)

Switch families

M.1 Overview

Annex M gives an example system for grouping switch types into switch families, as relates to tests specified in L.3.2. Other grouping systems may be appropriate for this purpose. As used in Annex M, a "switch family" refers to a single grouping of different switch types that are representative of one another in construction and performance.

M.2 General

Switch types may be grouped into switch families in such a way that the most severe case for the switch family can be represented by the tests each time the tests are conducted.

Alternatively, when switch families include switch types with different ratings, the switches should be selected for test in proportion to production volume, and, the severest rating of the selected switch type should be tested each time.

A switch family may include the following variations:

a) different electrical ratings for switches that employ
   1) the same basic contact construction, except for the diameter, thickness or material of the contacts;
   2) the same configuration of internal contacts, base and actuator; and
   3) the same number of poles;
b) different external parts such as terminals and actuating members;
c) one-way, two-way, and multiway types;
d) normally open and normally closed biased types of switches;
e) different contact constructions under the following conditions: switches with the same or with different electrical ratings that employ the same basic contact construction, except for the diameter, thickness, or material of the contacts, may be included in the same switch family, provided the switches have the same configuration of internal contacts, base and actuator, and the same number of poles;
f) single-pole, double-pole, and multiple-pole types when the electrical rating is the same and there is a similar configuration of internal contacts, base and actuator;
g) different combinations of electrical rating, temperature and number of operating cycles within identical constructions.

M.3 Guidelines for selection of switches in switch families for testing

M.3.1 One-way / two-way; or biased switches in same switch family: selection should be made on an as-available basis.

M.3.2 Different number of poles in same switch family: selection should be rotated in proportion to production volume.

M.3.3 Different operating cycle ratings for the same electrical rating within identical constructions and different combinations of electrical, temperature and operating cycle ratings: rotate selection in proportion to relative production volume of each type.

M.3.4 Same contacts but different electrical ratings in same switch family: if the switch family includes various ratings, rotate selection in proportion to relative production volume of each type. The endurance test should be conducted at the maximum volt-ampere rating at the highest voltage applicable to the selected switch type and the heating test should be conducted at the highest current rating applicable to the selected switch type.

M.3.5 Different contacts and different ratings in same switch family: selection of switch types for test should be rotated based on production volume of each contact type used. The endurance test should be conducted at the maximum volt-ampere rating at the highest applicable voltage applicable to the selected contact each time. The heating test should be conducted at the highest applicable current rating applicable to the selected contact type each time.

M.3.6 Co-ordinated electrical ratings (i.e., same volt-ampere ratings with different voltage and ampere ratings) in same switch family: selection should be rotated on the basis of production volume, considering maximum ratings in the switch family as specified in M.3.4.

Annex N
(informative)

Dimensions of tabs forming part of a switch

Refer to IEC 61210.

Annex O
(informative)

Common end product standards

Switches complying with this standard may be used in end products with additional requirements.

End product standards of interest include the following.

- IEC 60065: *Audio, video and similar electronic apparatus – Safety requirements*
- IEC 60335 (all parts): *Household and similar electrical appliances – Safety*
- IEC 60745(all parts): *Hand-held motor-operated electric tools –Safety*
- IEC 60950 (all parts): *Information technology equipment – Safety*

Bibliography

IEC 60034-1:2010, *Rotating electrical machines – Part 1: Rating and performance*

IEC 60050-151:2001, *International Electrotechnical Vocabulary – Part 151: Electrical and magnetic devices*

IEC 60050-411:1996, *International Electrotechnical Vocabulary – Chapter 411: Rotating machinery*

IEC 60050-441:1984, *International Electrotechnical Vocabulary – Chapter 441: Switchgear, controlgear and fuses*
Amendment 1:2000

IEC 60050-826:2004, *International Electrotechnical Vocabulary – Part 826: Electrical installations*

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

IEC 60085:2007, *Electrical insulation – Thermal evaluation and designation*

IEC 60228:2004, *Conductors of insulated cables*

IEC 60335-1, *Household and similar electrical appliances – Safety – Part 1: General requirements*

IEC 60335-2 (all parts), *Household and similar electrical appliances – Safety*

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

IEC 60893-1:2004, *Insulating materials – Industrial rigid laminated sheets based on thermosetting resins for electrical purposes – Part 1: Definitions, designations and general requirements*

IEC 60998-2-3:2002, *Connecting devices for low-voltage circuits for household and similar purposes – Part 2-3: Particular requirements for connecting devices as separate entities with insulation-piercing clamping units*

IEC 61000 (all parts), *Electromagnetic compatibility (EMC)*

IEC 61140, *Protection against electric shock – Common aspects for installation and equipment*

IEC 61058-1

Edition 4.0 2016-07

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Switches for appliances –
Part 1: General requirements

Interrupteurs pour appareils –
Partie 1: Exigences générales

IEC 61058-1:2016-07(en-fr)

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

SWITCHES FOR APPLIANCES –

Part 1: General requirements

FOREWORD

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

International Standard IEC 61058-1 has been prepared by subcommittee 23J: Switches for appliances, of IEC technical committee 23: Electrical accessories.

This fourth edition cancels and replaces the third edition published in 2000, Amendment 1:2001 and Amendment 2:2007. This edition constitutes a technical revision.

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

a) requirements for mechanical switches are now given in IEC 61058-1-1;
b) requirements for electronic switches are now given in IEC 61058-1-2.

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

FDIS	Report on voting
23J/401/FDIS	23J/405/RVD

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

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

A list of all parts in the IEC 61058 series, published under the general title *Switches for appliances*, can be found on the IEC website.

In this part, the following print types are used:

- requirements proper: roman type;
- test specifications: *italic type*;
- notes: smaller roman type.

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

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

SWITCHES FOR APPLIANCES –

Part 1: General requirements

1 Scope

This part of IEC 61058 applies to switches for appliances. The switches are intended to control electrical appliances and other equipment for household or similar purposes with a rated voltage not exceeding 480 V and a rated current not exceeding 63 A.

Switches for appliances are intended to be operated by

– a person via an actuating member,
– indirect actuation,
– an actuating sensing unit.

Transmission of a signal between the actuating member or sensing unit and the switch may be connected by optical, acoustic, thermal, electrical or other relevant connection and may include remote controlled units.

This part of IEC 61058 applies to switches for appliances provided with additional control functions governed by the switch provided with electronic circuits and devices that are necessary for the intended and/or correct operation of the switch.

This part of IEC 61058 applies to circuitry when evaluated with a switch and necessary for the switching function.

This part of IEC 61058 applies in general to switches for appliances in conjunction with the following parts:

– *Part 1-1: Requirements for mechanical switches*, and/or
– *Part 1-2: Requirements for electronic switches*.

This part of IEC 61058 does not apply to devices covered by:

– IEC 60669 (all parts), *Switches for household and similar fixed-electrical installations*, and
– IEC 60730 (all parts), *Automatic electrical controls*.

This part of IEC 61058 does not contain requirements for safety isolating switches (IEC 60050-811:1991, 811-29-17).

NOTE 1 For switches used in tropical climates, additional requirements may be necessary.

NOTE 2 Attention is drawn to the fact that the end product standards for appliances may contain additional or alternative requirements for switches.

NOTE 3 Throughout this part of IEC 61058, the word "appliance" means "appliance or equipment".

2 Normative references

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

IEC 60038, *IEC standard voltages*

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

IEC 60065:2014, *Audio, video and similar electronic apparatus – Safety requirements*

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

IEC 60112:2003, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*
Amendment 1:2009

IEC 60127 (all parts), *Miniature fuses*

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

IEC 60269-3, *Low-voltage fuses – Part 3: Supplementary requirements for fuses for use by unskilled persons (fuses mainly for household or similar applications) – Examples of standardized systems of fuses A to F*

IEC 60384-14, *Fixed capacitors for use in electronic equipment – Part 14: Sectional specification – Fixed capacitors for electromagnetic interference suppression and connection to the supply mains*

IEC 60417, *Graphical symbols for use on equipment* (available at: http://www.graphical-symbols.info/equipment)

IEC 60529:1989, *Degree of protection provided by enclosures (IP code)*
Amendment 1:1999
Amendment 2:2013

IEC 60617, *Graphical symbols for diagrams* (available at: http://std.iec.ch/iec60617)

IEC 60664-3:2003, *Insulation coordination for equipment within low-voltage systems – Part 3: Use of coating, potting or molding for protection against pollution*
Amendment 1:2010

IEC 60691, *Thermal-links – Requirements and application guide*

IEC 60695-2-11, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products*

IEC 60695-10-2, *Fire hazard testing – Part 10-2: Abnormal heat – Ball pressure test method*

IEC 60695-11-10, *Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods*

IEC 60695-11-20, *Fire hazard testing – Part 11-20: Test flames – 500 W flame test method*

IEC 60730 (all parts), *Automatic electrical controls*

IEC 60730-1:2013, *Automatic electrical controls – Part 1: General requirements*

IEC 60730-2-9:2015, *Automatic electrical controls – Part 2-9: Particular requirements for temperature sensing control*

IEC 60738-1, *Thermistors – Directly heated positive temperature coefficient – Part 1: Generic specification*

IEC 61000-3-2, *Electromagnetic compatibility (EMC) – Part 3.2: Limits – Limits for harmonic current emissions (equipment input current ≤ 16 A per phase)*

IEC 61000-3-3, *Electromagnetic compatibility (EMC) – Part 3-3: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current ≤16 A per phase and not subject to conditional connection*

IEC TS 61000-3-5, *Electromagnetic compatibility (EMC) – Part 3-5: Limits – Limitation of voltage fluctuations and flicker in low-voltage power supply systems for equipment with rated current greater than 75 A*

IEC 61000-4-2, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61000-4-3, *Electromagnetic compatibility (EMC) – Part 4-3: Testing and measurement techniques – Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-4, *Electromagnetic compatibility (EMC) – Part 4-4: Testing and measurement techniques – Electrical fast transient/burst immunity test*

IEC 61000-4-5, *Electromagnetic compatibility (EMC) – Part 4-5: Testing and measurement techniques – Surge immunity test*

IEC 61000-4-8, *Electromagnetic compatibility (EMC) – Part 4-8: Testing and measurement techniques – Power frequency magnetic field immunity test*

IEC 61000-4-11, *Electromagnetic compatibility (EMC) – Part 4-11: Testing and measurement techniques – Voltage dips, short interruptions and voltage variations immunity tests*

IEC 61032:1997, *Protection of persons and equipment by enclosures – Probes for verification*

IEC 61058-1-1, *Switches for appliances – Part 1-1: Requirements for mechanical switches*

IEC 61058-1-2, *Switches for appliances – Part 1-2: Requirements for electronic switches.*

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

CISPR 14-1, *Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus – Part 1: Emission*

CISPR 15:2013, *Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment*

3 Terms and definitions

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

3.1 General terms and definitions

3.1.1
mechanical switching device
switching device designed to close and open one or more electric circuits by means of separable contacts

Note 1 to entry: In the IEC 61058 series the terms “switching devices” and “switches” are used interchangeably.

[SOURCE: IEC 60050-441:1984, 441-14-02]

3.1.2
conductive part
part which is capable of conducting current although it may not necessarily be used for carrying service current

[SOURCE: IEC 60050-441: 1984, 441-11-09]

3.1.3
live part
conductor or conductive part intended to be energized in normal operation, including a neutral conductor, but by convention not a PEN/PEM/PEL conductor

Note 1 to entry: For appliance switches, “live part” implies a risk of electric shock.

Note 2 to entry: Unless otherwise specified, parts connected to a SELV supply or equal to or less than 24 V are not considered to be live parts.

3.1.4
pole of a switch
portion of a switching device associated exclusively with one electrically separated conducting path of its main circuit and excluding those portions which provide a means for mounting and operating all poles together

Note 1 to entry: A switch is called "single pole" if it has only one pole. If it has more than one pole, it may be called "multipole" (two-pole, three-pole, etc.) provided that the poles are coupled in such a manner as to operate together.

[SOURCE: IEC 60050-441:1984, 441-15-01, modified — Pole of a switching device replaced by pole of a switch]

3.1.5
detachable part
part which is removable without the use of a tool when the switch is mounted as in normal use

3.1.6
tool
screwdriver, coin, or any other object which may be used to operate a nut, a screw or a similar part

3.1.7
normal use
use of the switch for the purpose for which it was made and declared

3.1.8
unique type reference
UT
identification marking on a switch such that by quoting it in full to the switch manufacturer a unique switch model can be identified

Note 1 to entry: This note applies to the French language only.

3.1.9
common type reference
CT
identification marking on a switch which does not require any further specific information additional to that provided by the marking requirements of this part of IEC 61058 for selection, installation and use in accordance with this part of IEC 61058

Note 1 to entry: This note applies to the French language only.

3.1.10
cover
cover plate
protective cover
cover made of insulating material, used to cover live parts in order to avoid accidental electric contact and which is accessible when the switch is mounted as in normal use but which can be removed with the aid of a tool

3.1.11
signal indicator
device associated with a switch to indicate the circuit state visually

Note 1 to entry: The device may or may not be controlled by the switch.

3.1.12
unprepared conductor
a conductor which has been cut and the insulation of which has been removed for insertion into a terminal.

[SOURCE: IEC 60050-442:1998, 442-01-26]

3.1.13
prepared conductor
a conductor the end of which is fitted with an attachment such as eyelet, sleeve or cable lug

[SOURCE: IEC 60050-442:1998, 442-01-27]

3.1.14
polarity reversal
change of the polarity on the terminals connected to the load by a switching action

3.1.15
semiconductor device
SD
device whose essential characteristics are due to the flow of charge carriers within a semiconductor

Note 1 to entry: Previous editions of IEC 61058-1 refer to a semiconductor device as a “semiconductor switching device or solid state device (SD)”.

[SOURCE: IEC 60050-521:2002, 521-04-01]

3.1.16
semiconductor circuit
circuit containing multiple components, where at least one is a semiconductor device

3.1.17
electronic switch
switch for appliances provided with a semiconductor device or a semiconductor circuit in its intended load path

Note 1 to entry: The electronic switch may be provided with series and/or parallel mechanical contacts. See examples in Table 15 in IEC 61058-1-2:2016.

3.1.18
duty
statement of the load to which the switch is subjected, including, if applicable, making, controlling and breaking and including their durations and sequence in time

3.1.19
duty-type
continuous, short-time or periodic duty comprising one or more loads remaining constant for the duration specified, or a non-periodic duty in which generally the load varies within the permissible operating range

[SOURCE: IEC 60050-411:1996, 411-51-13, modified – "speed" is deleted]

3.1.20
protective impedance
component or assembly of components whose impedance and construction are intended to limit steady-state touch current and electric charge to non-hazardous levels

3.2 Terms and definitions relating to voltage and current

3.2.1
rated voltage
voltage assigned by the manufacturer for a specified operating condition

Note 1 to entry: It is measured in r.m.s. unless specifically indicated otherwise.

Note 2 to entry: This value is the maximum value and covers all lower values.

3.2.2
safety extra-low voltage
SELV
voltage which does not exceed 50 V AC r.m.s. or 120 V DC between conductors or between any conductor and earth in a circuit which is insulated from the supply mains

Note 1 to entry: SELV is an unearthed extra low voltage (see IEC 61140).

3.2.3
rated current
current assigned by the manufacturer for a specified operating condition

Note 1 to entry: It is measured in r.m.s. unless specifically indicated otherwise.

Note 2 to entry: This value is the maximum value and covers all lower values.

3.2.4
rated load
type of load assigned by the manufacturer, according to classifications

3.2.5
over-current
current exceeding the rated current

[SOURCE: IEC 60050-441:1984, 441-11-06]

3.2.6
overload
operating conditions in an electrically undamaged circuit, which cause an over-current

[SOURCE: IEC60050-441:1984, 441-11-08]

3.2.7
working voltage
highest r.m.s. value of the AC or DC voltage across any particular insulation which can occur when the switch is supplied at rated voltage

Note 1 to entry: Transients are disregarded.

Note 2 to entry: Both open-circuit conditions and normal operating conditions are taken into account.

3.2.8
overvoltage
voltage having a peak value exceeding the corresponding peak value of maximum steady-state voltage at normal operating conditions

3.2.9
overvoltage category
numeral defining a transient overvoltage condition

Note 1 to entry: See Annex E.

3.2.10
impulse withstand voltage
highest peak value of impulse voltage of prescribed form and polarity which does not cause breakdown of insulation under specified conditions

3.2.11
minimum load
load at which when declared, the electronic switch still operates correctly

3.2.12
thermal current
continuous resistive current which, under the test conditions declared by the manufacturer (which may also include the ambient temperature), generates, without forced cooling, the same heating as when the electronic switch is operating under specified ambient conditions at rated load in the appliance with forced cooling present, if any

Note 1 to entry: The concept "thermal current" allows simplified testing of electronic switches, which in normal application have complex cooling conditions. The thermal current will always be determined by tests of the switch positioned on a table or in a simple test rig and comparative tests in the appliance in question. Consequently, the thermal current will normally be lower than the rated current. This necessitates additional tests of the terminals, contacts, etc., in order to verify that they will be able to carry the rated current, when the electronic switch is mounted in the appliance. These additional tests are specified in Clauses 16 and 17 in IEC 61058-1-1:2016 or IEC 61058-1-2:2016.

3.3 Terms and definitions relating to the different types of switches

3.3.1
incorporated switch
switch intended for incorporation in or on an appliance, which however can be tested separately

[SOURCE: IEC 60050-442:1998, 442-04-01]

3.3.2
integrated switch
switch, the function of which is depending on its correct mounting and fixing in an appliance, and which can be tested only in combination with the relevant parts of that appliance

[SOURCE: IEC 60050-442:1998, 442-04-02]

3.3.3
rotary switch
switch where the actuating member is a shaft or a spindle which has to be rotated to one or more indexed positions in order to achieve a change in contact state

Note 1 to entry: The rotation of the actuating member may be unlimited or restricted in either direction.

3.3.4
lever switch
switch where the actuating member is a lever which has to be moved (tilted) to one or more indexed positions in order to achieve a change in contact state

3.3.5
rocker switch
switch where the actuating member is a low profile lever (rocker) which has to be tilted to one or more indexed positions in order to achieve a change in contact state

3.3.6
push-button switch
switch where the actuating member is a button which has to be pushed in order to achieve a change in contact state

Note 1 to entry: The switch may be provided with one or more actuating members.

3.3.7
cord-operated switch
switch where the actuating member is a pull-cord which has to be pulled in order to achieve a change in contact state

[SOURCE: IEC 60050-442:1998, 442-04-08, modified — "operating means" changed to "actuating member"]

3.3.8
push-pull switch
switch where the actuating member is a rod which has to be pulled or pushed to one or more indexed positions in order to achieve a change in contact state

3.3.9
biased switch
switch where the contacts and actuating member return to a predetermined position when the actuating member is released from the actuated position

3.4 Terms and definitions relating to the operation of the switch

3.4.1
actuation
movement of the actuating member of the switch by hand, by foot, or by any other human activity

3.4.2
indirect actuation
movement of the actuating member of the switch indirectly by a part of an appliance into which the switch is incorporated or integrated

Note 1 to entry: For example, a switch can be incorporated or integrated in the door of an appliance.

3.4.3
actuating member
part which is pulled, pushed, turned or otherwise influenced to cause an operation

3.4.4
actuating means
part which may be interposed between the actuating member and the contact mechanism in order to achieve contact operation

3.4.5
disconnection
interruption of an electrical circuit in a pole so as to provide insulation between the supply and those parts intended to be disconnected from the supply

3.4.6
micro-disconnection
disconnection that provides correct functional performance by contact separation in the case of long-term temporary overvoltage

3.4.7
electronic-disconnection
disconnection that provides a non-cycling correct functional performance by a semiconductor device (SD) in the case of long-term temporary overvoltage

3.4.8
full-disconnection
disconnection that provides correct functional performance by contact separation in the case of short-term and long-term temporary overvoltage and impulse withstand voltage equivalent to basic insulation

3.4.9
all-pole disconnection single-phase
concurrent disconnection of all supply conductors, except the earthed conductor, by a single switching action for AC and DC appliances

3.4.10
operating cycle
succession of operations from one position to another and back to the first position through all other positions, if any

[SOURCE: IEC 60050-441:1984, 441-16-02]

3.4.11
electronic actuating member
part, component or component group which controls the actuating means or the switching device

Note 1 to entry: An optical or acoustic sensing unit is an example of a component group.

3.4.12
electronic actuating means
part, component or component group which controls electronically the switching device

3.4.13
abnormal conditions
conditions leading to reduced safety, which may occur in the appliance or in the switch during normal operation

Note 1 to entry: These conditions (e.g. rise in temperature, lack of protection against shock) may be the consequence of faults of the switch or related ambient conditions, which in case of defects or deteriorated operation of other components of the application are foreseeable. (Intended) misuse is not covered.

3.4.14
sensing unit
unit adjustable by other than mechanical means containing electronic components and controlling the output via electronic components or unit that is activated by any physical phenomenon or combination of phenomena

3.4.15
fault conditions
abnormal conditions which are caused by a failure within the switch, which can be simulated by modifications of the switch

3.5 Terms and definitions relating to connections to the switch

3.5.1
external conductor
cable, cord or conductor which is external to a switch

3.5.2
integrated conductor
conductor which is either inside a switch or is used to permanently interconnect terminals or terminations of a switch

3.6 Terms and definitions relating to terminals and terminations

3.6.1
terminal
conductive part of a switch, provided for connecting the switch to one or more external conductors

3.6.2
screw type terminal
terminal for the connection and/or interconnection and subsequent disconnection of one or more conductors, the connection being made directly or indirectly by means of screws or nuts of any kind

Note 1 to entry: Examples of screw type terminals include those in Figures 1 through 5.

3.6.3
screwless terminal
terminal for the connection and/or interconnection and subsequent disconnection of one or more conductors, the connection being made, directly or indirectly, by means other than screws

Note 1 to entry: Examples of screwless type terminals are shown in Figure 6.

Note 2 to entry: Push-in terminals, which are wire terminals that lock a stripped conductor when inserted in the terminal, are covered by the definition of screwless terminals.

3.6.4
termination
arrangement provided for making the connections between the switch internal leads and the external conductors

3.6.5
flat quick-connect termination
electrical connection consisting of a male tab and a female connector which can be inserted and withdrawn with or without the use of a tool

[SOURCE: IEC 60050-442:1998, 442-06-07]

3.6.6
tab
portion of a flat quick-connect termination which is inserted into the female connector and is a part integral with the switch

Note 1 to entry: Examples of tabs are shown in IEC 61210.

3.6.7
female connector
portion of a flat quick-connect termination which is pushed onto the tab

Note 1 to entry: An example of a female connector is shown in Figure 7.

3.6.8
solder terminal
conductive part of a switch provided to enable a termination to be made by means of solder

3.7 Terms and definitions relating to insulation

3.7.1
basic insulation
insulation applied to live parts to provide basic protection against electric shock

3.7.2
supplementary insulation
independent insulation applied in addition to the basic insulation in order to provide protection against electric shock in the event of a failure of the basic insulation

3.7.3
double insulation
insulation comprising both basic insulation and supplementary insulation

3.7.4
reinforced insulation
single insulation system applied to live parts which provides a degree of protection against electric shock equivalent to double insulation

Note 1 to entry: The term “insulation system” does not imply that the insulation is one homogeneous piece. It may consist of several layers which cannot be tested separately as supplementary or basic insulation.

3.7.5
functional insulation
insulation between live parts which is necessary only for the proper functioning of the switch

3.7.6
coating
solid insulating material laid on one or both sides of the surface of the printed board

Note 1 to entry: Coating can be varnish, a dry film applied to the printed board or can be achieved by thermal deposition.

Note 2 to entry: Coating and base material of the printed board form an insulating system that may have properties similar to solid insulation.

3.7.7
solid insulation
insulation material interposed between two conductive parts

Note 1 to entry: In the case of a printed board assembly with a coating, solid insulation consists of the printed board itself as well as the coating. In other cases, solid insulation consists of the encapsulating material.

3.7.8
class 0 appliance
appliance in which protection against electric shock relies upon basic insulation, which implies that there are no means for the connection of accessible conductive parts, if any, to the protective conductor in the fixed wiring of the installation, reliance in the event of a failure of the basic insulation being placed upon the environment

3.7.9
class I appliance
appliance in which protection against electric shock does not rely on basic insulation only, but which includes an additional safety precaution in such a way that means are provided for the connection of conductive parts (which are not live parts) to the protective (earthing) conductor in the fixed wiring in such a way that these parts cannot become live in the event of a failure of the basic insulation

3.7.10
class II appliance
appliance in which protection against electric shock does not rely on basic insulation only, but in which additional safety precautions such as double insulation or reinforced insulation are provided, there being no provision for protective earthing or reliance upon installation conditions

Note 1 to entry: A class II appliance may be provided with means for maintaining the continuity of protective circuits, provided that such means are within the appliance and are insulated from accessible surfaces according to the requirements of class II.

3.7.11
class III appliance
appliance in which protection against electric shock relies on supply at SELV and in which voltages higher than those of SELV are not generated

3.7.12
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

[SOURCE: IEC 60050-212: 2010,212-11-59]

3.8 Terms and definitions relating to pollution

3.8.1
pollution
addition of solid, liquid, or gaseous foreign matter that can result in a reduction of dielectric strength or surface resistivity of the insulation

3.8.2
micro-environment
immediate environment of the insulation which particularly influences the dimensioning of creepage distances

Note 1 to entry: For self-produced pollution in arc chambers of switches, see Annex F.

3.8.3
macro-environment
environment of the room or other location in which the switch is installed or used

3.8.4
pollution degree
numeral characterizing the expected pollution of the micro-environment

Note 1 to entry: Pollution degree 1, 2 and 3 are used (see 7.8, 7.9 and Annex F).

3.9 Terms and definitions relating to manufacturers' tests

3.9.1
routine test
test to which each individual switch for appliances is subjected during and/or after manufacture to ascertain whether it complies with the relevant requirements of this part of IEC 61058 (see Annex K).

3.9.2
sampling test
test on a number of switches taken at random from a batch

Note 1 to entry: Sampling tests are specified in Annex L.

[SOURCE: IEC 60050-811:1991, 811-10-06, modified — "devices" replaced by "switches"]

3.9.3
type test
test of one or more switches made to a certain design to show that the design meets certain specifications

[SOURCE: IEC 60050-811:1991, 811-10-04, modified — "devices" replaced by "switches"]

4 General requirements

Switches shall be designed and constructed so that in normal use they function safely so as to cause no danger to persons or surroundings even in the event of such careless use as may occur in normal use, as specified in the IEC 61058-1 series.

Compliance is checked by carrying out all the relevant tests.

5 General information on tests

5.1 Testing shall be performed according to the general guideline information provided in Clause 5

5.1.1 *In general, the test conditions for higher ratings of a switch may represent test conditions for lower ratings. See 5.2.*

5.1.2 *In all tests, the measuring instruments or the measuring means shall be such as not to affect appreciably the quantity being measured.*

5.1.3 *If only one of the specimen does not satisfy the requirements of a test in Clauses 14, 15, 16 and 17 (Clause 17 in IEC 61058-1-1:2016 or IEC 61058-1-2:2016), that test and any preceding which may have influenced the results of the test shall be repeated and also the tests which follow shall be carried out in the required sequence with new specimens, all of which shall comply with the requirements.*

5.1.4 *Unless otherwise specified in this standard, the specimens are tested as delivered, at an ambient temperature of 25 °C ± 10 °C.*

5.1.5 *The specimens are mounted as declared by the manufacturer, but, if significant, using the most unfavourable method if more than one method is declared.*

5.1.6 *For the tests of this standard, actuation may be performed by test equipment. Actuation may be applied to either the actuating member or the actuating means. A switch is not required to provide the actuating member if it is declared to be detachable.*

5.1.7 *Switches to be used with a non-detachable conductor are tested with the appropriate conductor connected.*

5.1.8 *If the switches are provided with tabs, for the tests according to Clauses 16 (in IEC 61058-1) and 17 (in IEC 61058-1-1:2016 or IEC 61058-1-2:2016), new female connectors shall be used. The female connectors shall be of a type suitable for the rated ambient temperature of the switch, and the crimped conductors shall be soldered or welded to the crimping area of the female connector, if any.*

5.1.9 *If it is necessary to have parts with double insulation or reinforced insulation in switches for class 0 or class I appliances, such parts are checked for compliance with the requirements specified for switches for class II appliances. Similarly if it is necessary to have parts in switches operating at SELV, such parts are also checked for compliance with the requirements specified for switches for class III appliances.*

5.2 Electrical information

5.2.1 *When more than one rating is combined or represented by testing as described below, the following applies to all testing.*

Dielectric strength test (Clause 15 and TE3) – based on the highest voltage.

Heating/temperature rise (Clause 16 and TE2) – based on the highest current rating.

5.2.2 *Representative endurance testing for the same classified load type (see 7.2) is allowed according to the following conditions:*

a) *Voltage – testing required for ratings at a higher voltage represents testing required for ratings at a lower voltage.*

NOTE For example 5 A, 125 V AC and 5 A, 250 V AC is tested as 5 A, 250V AC.

b) Current – testing at a higher current represent testing at a lower current.

NOTE For example 10 A, 250 V AC and 5 A, 250 V AC is tested as 10 A, 250 V AC.

5.2.3 *Switches with 2 or more ratings are endurance tested for each rating on an additional 3 specimens unless permitted to use representative testing.*

5.2.4 *DC polarity rated switches without polarity markings are endurance tested with 3 specimens with one polarity and an additional 3 specimens with the opposite polarity.*

5.2.5 *DC and AC rated switches are endurance tested with DC voltage to represent AC if the DC voltage and current ratings for the classified load type (see 7.2) are equal to or greater than the AC ratings.*

NOTE For example AC and DC rating 4 A 48 V AC as well as 4 A 48 V DC are endurance tested 4 A 48 V DC.

5.2.6 *AC only rated switches for each type of load with 2 or more current ratings, rated nominal 100 – 480 V AC, at the same power, are tested at the highest voltage.*

NOTE *For example AC rating 10 A 125 V AC as well as 5 A 250 V AC as well as 4,5 A 277 V AC are tested at 4,5 A 277 V AC.*

5.2.7 *AC only rated switches for each type of load, with 2 or more current ratings, rated nominal 20 up to 100 V AC, at the same power, are endurance tested at the highest current.*

NOTE *For example AC rating 10 A 24 V AC / 5 A 48 V AC is endurance tested at 10 A 24 V AC.*

5.2.8 *Switches with a rated frequency are endurance tested at that frequency. Switches without a rated frequency are tested at 50 Hz. Switches with a rated frequency range are tested at the most unfavourable frequency within that range.*

NOTE For example a switch classified as 50 Hz to 60 Hz is tested at 50 Hz.

5.2.9 *Switches intended to be operated from a specific supply, are tested with that specific supply.*

5.3 Test loads on multiway switches

Multiway switches are loaded according to Table 1. The load for the other switch positions is that resulting from the loads necessary to achieve the conditions specified above.

Table 1 – Test loads for multiway switches

Operating cycles	Switch position of	Load
First half	Highest load	I_R
	Next lower load	0,8 × I_R
	Further next lower load	0,533 × I_R
Second half	Highest load	I_R
	Next lower load	0,5 × I_R
	Further next lower load	0,333 × I_R

5.4 Test specimens

The minimum number of test specimens shall be according to IEC 61058-1-1 or IEC 61058-1-2. Unless otherwise stated testing may be carried out in any order.

6 Rating

6.1 The maximum rated voltage is 480 V.

6.2 The maximum rated current is 63 A.

6.3 Switches with signal indicators may have different rated voltages for the signal indicators.

Compliance with 6.1 to 6.3 is checked by inspection in conjunction with Clause 8.

6.4 A switch having more than one circuit needs not have the same classification for each circuit. Annex D may be used for determining whether a particular switch rating is suitable for controlling the circuit in the actual application.

7 Classification

7.1 According to nature of supply

7.1.1 switches for AC only

7.1.2 switches for DC only;

7.1.3 switches for both AC and DC

7.2 According to type of load to be controlled by each circuit of the switch

7.2.1 circuit for a substantially resistive load with a power factor not less than 0,9;

7.2.2 circuit for either a resistive load, a motor load with a power factor not less than 0,6, or a combination of both;

7.2.3 circuit for a combination of resistive and capacitive loads;

7.2.4 circuit for ordinary tungsten filament lamp load;

7.2.5 circuit for a declared specific load;

7.2.6 circuit for a current not exceeding 20 mA.

7.2.7 circuit for specific lamp load;

7.2.8 circuit for an inductive load with a power factor of not less than 0,6;

7.2.9 circuit for specific load of motor with a locked rotor and with a power factor not less than 0,6.

7.2.10 general purpose load with a power factor of not less than 0,75;

7.3 According to ambient temperature

7.3.1 Switches with all parts intended to be used 0 °C ≤ T ≤ 55 °C.

7.3.2 Switches not classified as 7.3.1 and 7.3.3.

7.3.3 Switches with accessible parts in one ambient temperature and non-accessible parts in a different ambient temperature according to

– accessible member and parts 0 °C ≤ T ≤ 55 °C, and
– other parts of the switch not classified to the range of 0 °C ≤ T ≤ 55 °C.

7.4 According to number of operating cycles

7.4.1 100 000 operating cycles;

7.4.2 50 000 operating cycles;

7.4.3 25 000 operating cycles;

7.4.4 10 000 operating cycles;

7.4.5 6 000 operating cycles;

7.4.6 3 000 operating cycles;

7.4.7 1 000 operating cycles;

7.4.8 300 operating cycles.

7.4.9 operating cycles – as declared for a specific application.

7.5 Degree of protection against solid foreign objects

NOTE Determined according to IEC 60529 with the switch mounted as declared.

7.5.1 if no declaration, the switch is non-protected against solid foreign objects (IP0X);

7.5.2 protected against solid foreign objects of 50 mm diameter and greater (IP1X);

7.5.3 protected against solid foreign objects of 12,5 mm diameter and greater (IP2X);

7.5.4 protected against solid foreign objects of 2,5 mm diameter and greater (IP3X);

7.5.5 protected against solid foreign objects of 1,0 mm diameter and greater (IP4X);

7.5.6 dust-protected (IP5X);

7.5.7 dust-tight (IP6X).

7.6 Degree of protection against ingress of water

NOTE Determined according to IEC 60529 with the switch mounted as declared.

7.6.1 if no declaration, the switch is non-protected against ingress of water (IPX0);

7.6.2 protected against vertically falling water drops (IPX1);

7.6.3 protected against vertically falling water drops when enclosure tilted up to 15° (IPX2);

7.6.4 protected against spraying water (IPX3);

7.6.5 protected against splashing water (IPX4);

7.6.6 protected against water jets (IPX5);

7.6.7 protected against powerful water jets (IPX6);

7.6.8 protected against the effects of temporary immersion in water up to 1 m (IPX7).

7.6.9 protected against the effects of immersion in water greater than 1 m (IPX8).

7.6.10 protected against the effects of high pressure water (IPX9).

7.7 According to degree of protection against electric shock for an incorporated switch for use in

7.7.1 a class 0 appliance;

7.7.2 a class I appliance;

7.7.3 a class II appliance;

7.7.4 a class III appliance.

NOTE Explanations of classes are given in 3.7.8, 3.7.9, 3.7.10 and 3.7.11.

7.8 According to degree of pollution inside the switch

7.8.1 Micro-environment pollution degree 1

7.8.2 Micro-environment pollution degree 2

7.8.3 Micro-environment pollution degree 3

7.9 According to degree of pollution outside the switch

7.9.1 Macro-environment pollution degree 1

7.9.2 Macro-environment pollution degree 2

7.9.3 Macro-environment pollution degree 3

NOTE Details for the micro and macro pollution degrees are specified in 3.8 and Annex F.

7.10 According to marking

7.10.1 Switch with limited marking UT (unique type reference, UT);

7.10.2 Switch with full marking CT (common type reference, CT).

NOTE Explanations of type references are given in 3.1.8 and 3.1.9.

7.11 According to resistance to ignitability by the glow wire temperature

7.11.1 650 °C;

7.11.2 750 °C;

7.11.3 850 °C;

7.11.4 960 °C.

The resistance to abnormal heat for the switch represents the lowest glow wire temperature of the materials of parts which are in contact with, maintain or retain in position electrical connections including those parts which maintain an electrical connection under spring force.

7.12 According to the rated impulse withstand voltage

7.12.1 330 V;

7.12.2 500 V;

7.12.3 800 V;

7.12.4 1 500 V;

7.12.5 2 500 V;

7.12.6 4 000 V.

NOTE The relation between rated impulse withstand voltage, rated voltage and overvoltage category is given in Annex E.

7.13 According to the rated overvoltage category

7.13.1 Category I

7.13.2 Category II

7.13.3 Category III

NOTE The relation between rated impulse withstand voltage, rated voltage and overvoltage category is given in Annex E.

7.14 According to type of disconnection

7.14.1 electronic disconnection;

7.14.2 micro disconnection;

7.14.3 full disconnection.

7.14.4 switches with a combination of disconnections shall be declared specifically depending on their construction.

NOTE Explanations of disconnections are given in 3.4.6, 3.4.7 and 3.4.8.

7.15 According to the type of coating for rigid printed board assemblies

7.15.1 type 1 coating;

7.15.2 type 2 coating.

NOTE Explanations for type 1 and type 2 coating are given in Annex I.

7.16 According to type and/or connection of switches

7.16.1 number of poles

7.16.2 number of ways

7.16.3 polarity reversal

7.16.4 all-pole disconnection

7.16.5 number of non-switchable through connections

7.16.6 according to code of switch type given in Table 2

NOTE Details for types of switches and connections are specified in Table 2.

7.17 According to configuration of switching device

7.17.1 electronic switch with SD without mechanical switching device;

7.17.2 electronic switch with SD with series mechanical switching device;

7.17.3 electronic switch with SD with parallel mechanical switching device;

7.17.4 electronic switch with SD with series and parallel mechanical switching device;

7.17.5 electronic switch with only mechanical switching device without SD. SD to be provided in the end application;

7.17.6 mechanical switch with or without electronics, which does not impact the safety of the switch;

7.17.7 mechanical switch with electronics, which impacts the safety of the switch.

7.18 According to duty type

7.18.1 continuous duty – Duty type S1 (see Figure 12);

7.18.2 short-time duty – Duty type S2 with defined ON and OFF times (see Figure 13);

7.18.3 intermittent periodic duty – Duty type S3 with defined ON and OFF times (see Figure 14).

7.18.4 as declared for a specific application.

NOTE The concept duty-type is taken from IEC 60034-1.

7.19 According to linkage between contact and actuator speed

7.19.1 Speed of contact closure or opening is dependent on the actuator speed.

7.19.2 Speed of contact closure and opening is independent of the actuator speed.

7.20 According to the type of terminals

7.20.1 Terminals intended for the connection of unprepared conductors,

7.20.2 Terminals intended for the connection of prepared conductors;

NOTE Twisting of a stranded conductor to consolidate the end is not considered as special preparation.

7.20.3 Terminals intended for the connection of flexible stranded conductors;

7.20.4 Terminals intended for the connection of rigid stranded conductors;

7.20.5 Terminals intended for the connection of solid conductors,

7.20.6 Terminals intended for conductor size range according to Table 4;

7.20.7 Terminals intended for a declared limited conductor size range;

7.20.8 Terminals intended for the connection of only one conductor;

7.20.9 Terminals intended for the interconnection of two or more conductors;

7.20.10 Terminals intended for assembling one time.

7.20.11 Terminals intended for assembling and disassembling more than one time.

NOTE A push-in terminal intended for only one insertion (no disconnection means) is considered to be intended for assembling one time. A push-in terminal with a disconnect means or screw terminal is considered to be intended for assembling and disassembling more than one time.

7.20.12 Screw terminals and connections;

7.20.13 Push-in terminals and connections;

7.20.14 Flat quick-connect termination;

NOTE Standard termination dimensions are found in IEC 61210.

7.20.15 Solder terminals

7.20.16 Welding or ridged terminals

7.20.17 Wires for connections;

7.20.18 Terminals for piercing conductors

7.20.19 Terminals as declared by the manufacturer.

NOTE Terminals may have multiple characteristics.

7.21 According to the type of built in protection

7.21.1 Built in protection provided

7.21.2 None provided

NOTE Explanations of testing for Built in Protection are given in Clause 23.

7.22 According to the type of forced cooling

7.22.1 Not requiring forced cooling.

7.22.2 Forced cooling required, with description of forced cooling.

NOTE Explanations of testing for forced cooling are given in Clause 23.

7.23 According to the capacitor provided with the switch

7.23.1 Capacitor class X1,

7.23.2 Capacitor class X2,

7.23.3 Capacitor class X3,

7.23.4 Capacitor class Y2,

7.23.5 Capacitor class Y4.

NOTE 1 Capacitor class definitions are given in IEC 60384-14.

NOTE 2 Explanations of capacitor requirements are given in 24.3.

Table 2 – Type and connection of switches *(1 of 8)*

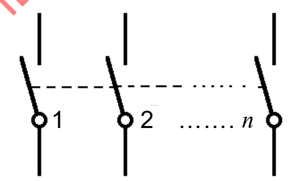
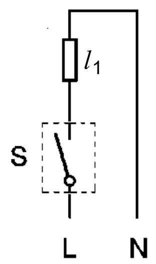
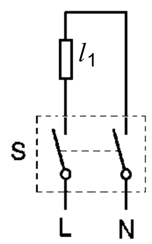
Code[1)]	Type of switch	Type of connection	Test circuit[2)]
	One-way switch		
	Principle of one-way switches with one to n poles		
1.1	The number of poles, type of connection and load as declared		
1.2	Single pole	Single load (single-pole disconnection)	 S = Specimen
1.3	Double pole	Single load (all-pole disconnection)	 S = Specimen

Table 2 *(2 of 8)*

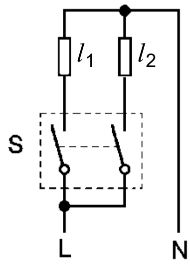
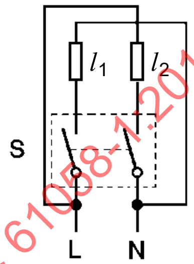
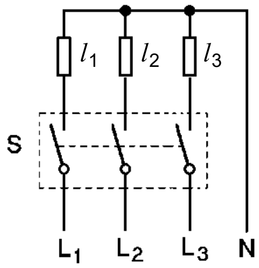
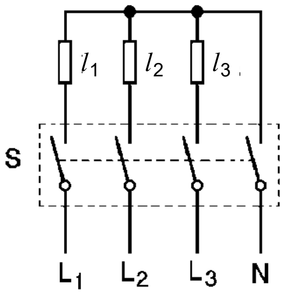
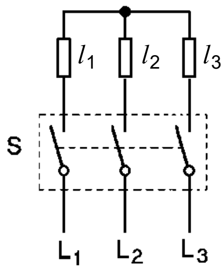
Code1)	Type of switch	Type of connection	Test circuit2)
1.4 [1.2]	Double pole	Double load (single-pole disconnection)	 S = Specimen
1.5 [1.2] [1.4]	Double pole	Double load (single-pole disconnection, load connected to opposite polarity)	 S = Specimen
1.6	Three pole	Three loads unswitched neutral. (three-pole disconnection)	 S = Specimen
1.7	Four pole	Three loads switched neutral. (four-pole disconnection)	 S = Specimen
1.8	Three pole	Three loads (three-pole disconnection)	 S = Spécimen

Table 2 *(3 of 8)*

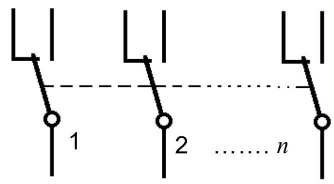
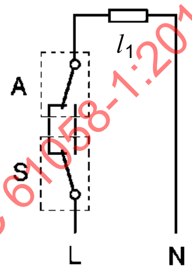
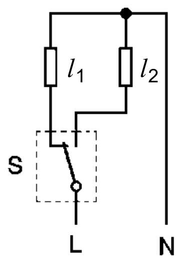
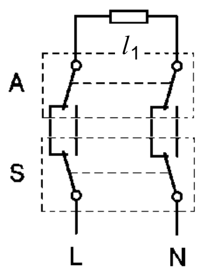
Code[1)]	Type of switch	Type of connection	Test circuit[2)]
One-way switch			
	Principle of one-way switches with one to *n* poles		
2.1	The number of poles, type of connection and load as declared		
2.2 [1.2]	Single pole	Single load (single-pole disconnection)	 S = Specimen A = Auxiliary switch
2.3	Single pole	Double load (single-pole disconnection)	 S = Specimen
2.4 [1.3]	Double pole	Single load (all-pole disconnection)	 S = Specimen A = Auxiliary switch

Table 2 *(4 of 8)*

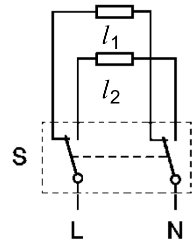
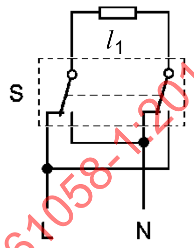
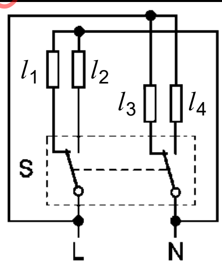
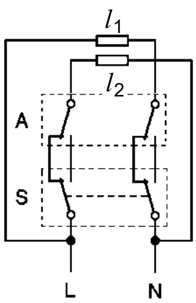
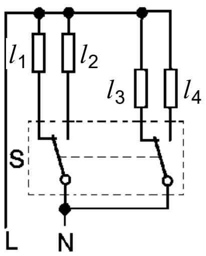
Code[1)]	Type of switch	Type of connection	Test circuit[2)]
2.5	Double pole	Double load (all-pole disconnection)	 S = Specimen
2.6	Double pole	Single load with polarity reversal	 S = Specimen
2.7	Double pole	Four load (single-pole disconnection, load connected to opposite polarity)	 S = Specimen
2.8	Double pole	Double load (single-pole disconnection, load connected to opposite polarity)	 S = Specimen A = Auxiliary switch
2.9	Double pole	Four load (single-pole disconnection)	 S = Specimen

Table 2 *(5 of 8)*

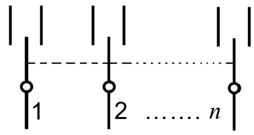
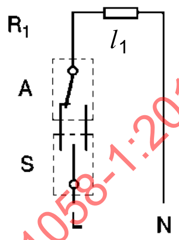
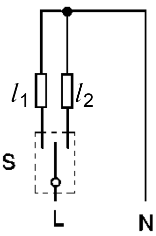
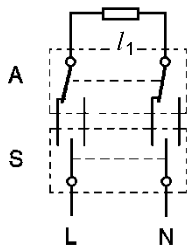
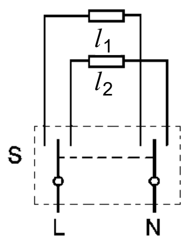
Code[1)]	Type of switch	Type of connection	Test circuit[2)]
Two-way switch with centre position for disconnection			
	Principle of two-way switches with center position and one to *n* poles		
3.1	The number of poles, type of connection and load as declared		
3.2	Single pole	Single load (single-pole disconnection)	 S = Specimen A = Auxiliary switch
3.3	Single pole	Double load (single-pole disconnection)	 S = Specimen
3.4	Double pole	Single load (all-pole disconnection)	 S = Specimen A = Auxiliary switch
3.5	Double pole	Double load (all-pole disconnection)	 S = Specimen

Table 2 *(6 of 8)*

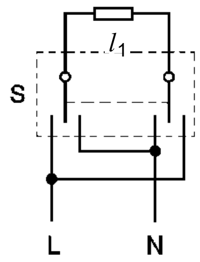
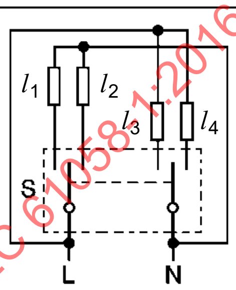
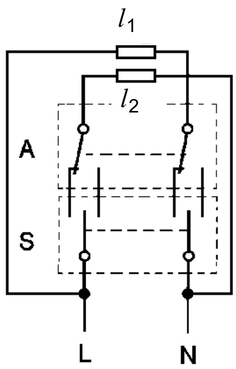
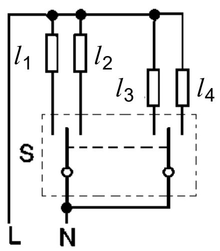
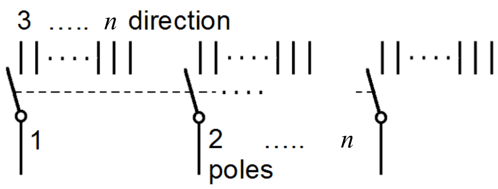
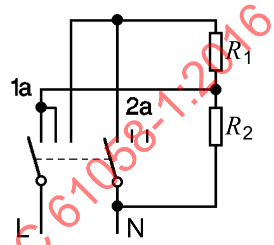
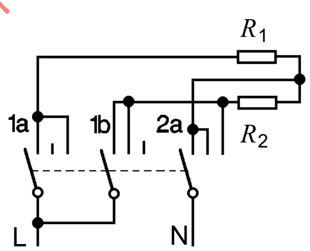
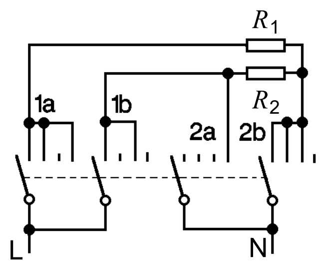
Code[1)]	Type of switch	Type of connection	Test circuit[2)]
3.6	Double pole	Single load with polarity reversal (all-pole disconnection)	 S = Specimen
3.7 [3.3]	Double pole	Four load (single-pole disconnection, load connected to opposite polarity)	 S = Specimen
3.8	Double pole	Double load (single-pole disconnection, load connected to opposite polarity)	 S = Specimen A = Auxiliary switch
3.9 [3.3]	Double pole	Four load (single-pole disconnection)	 S = Specimen

Table 2 *(7 of 8)*

<table>
<tr><th>Code[1)]</th><th>Type of switch</th><th>Type of connection</th><th>Test circuit[2)]</th></tr>
<tr><td colspan="4">Multiway switches</td></tr>
<tr><td></td><td colspan="2">Principle of multiway switches with 3 to n ways and 1 to n poles</td><td>
</td></tr>
<tr><td>4.1</td><td colspan="3">The number of poles, type of connection and load as declared</td></tr>
<tr><td>4.2</td><td colspan="2">Single pole

Four positions with polarity reversal (single-pole disconnection)</td><td>
</td></tr>
<tr><td>4.3</td><td colspan="2">Double pole

Four positions with polarity reversal (all-pole disconnection)</td><td>
</td></tr>
<tr><td>4.4</td><td colspan="2">Double pole

Five positions with polarity reversal (all-pole disconnection)</td><td>
</td></tr>
<tr><td>4.5</td><td colspan="2">Double pole

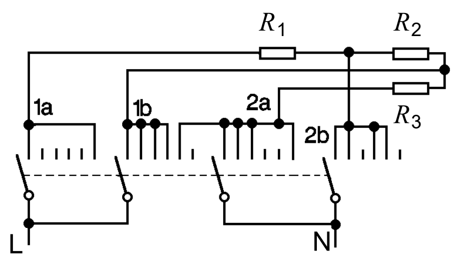
Seven positions with polarity reversal (all-pole disconnection)</td><td>
</td></tr>
</table>

Table 2 *(8 of 8)*

1) For switches of the same basic design, the test is considered to cover the tests for the code of switch given in square brackets. Switches are considerd to be the same basic design if: – all parts are the same, except those which have to be different because of the different poles and number of contact paths; – the basic dimensions and mechanical constructions are the same; – multipole switches are either composed of single-pole switches or built up from the same components as the single-pole switches, having the same overall dimensions per pole. A separate test on a switch with momentary action (monostable switch) is not necessary, if it can be shown that the contact function is equivalent to a bistable switch of equivalent construction.
2) The indication of L and N only symbolizes the connection to the mains.

8 Marking and documentation

8.1 Switch information

8.1.1 General

The switch manufacturer shall provide adequate information to ensure that

– the appliance manufacturer can select and install a switch;
– the end user can use a switch as intended by the switch manufacturer;
– the corresponding tests can be performed in accordance with this standard.

The information shall be provided in a clear and unambiguous manner.

This information shall be provided in one or more of the following ways by marking and/or documentation and as detailed in Table 3.

8.1.2 By switch marking

The information shall be provided by marking on the switch itself.

8.1.3 By documentation

The information shall be provided by separate documentation, which may consist of a specification sheet, or a drawing, etc.

The content of the documentation shall be made available to the appliance manufacturer or end-user as appropriate in any suitable format.

NOTE 1 Where Marking/Documentation is indicated, the information can be provided by either marking or documentation.

NOTE 2 The format in which this information is presented is not within the scope of this standard.

Table 3 – Switch information and loads placed in groups

No	Characteristic	Subclause	Means of information	
			Common type reference CT (7.10.2)	unique type reference UT (7.10.1)
1	**SWITCH IDENTIFICATION**			
1.1	Manufacturer's or responsible vendor's identification mark (name or trade mark)	8.1	Marking	Marking
1.2	Switch identifier such as type reference	8.1	Marking	Marking
2	**SWITCH ENVIRONMENT/MOUNTING**			
2.1	Degree of protection provided for the switch when mounted according to documentation (IP Code of IEC 60529)	7.5 and 7.6	Documentation	Documentation
2.2	Degree of protection against electric shock, from outside an appliance	7.7	Documentation	Documentation
2.3	Method of mounting and actuating the switch and method of providing earthing, if appropriate. The intended method(s) of mounting and the intended orientation(s) shall be declared. The declared methods of mounting, together with any earthing terminal, are deemed to be the methods of earthing conductive parts unless otherwise specified.	7.1.7 and 7.1.7.7	Documentation	Documentation
2.4	Pollution degree micro	7.8	Documentation	Documentation
2.5	Pollution degree macro	7.9	Documentation	Documentation
3	**TEMPERATURE**			
3.1	Ambient temperature limits if different from 0 °C to 55 °C	7.3	Marking	Documentation
4	**ELECTRICAL LOAD**			
4.1	Rated voltage or rated voltage range	6.1	Marking	Documentation
4.2	Nature of supply if the switch is not intended for both AC and DC or if the rating is different for AC and DC	7.1	Marking	Documentation
4.3	Frequency or frequency range if different from 50 Hz or 50 Hz to 60 Hz	5.2.8	Marking	Documentation
4.4	The rated current and the electrical load type	7.2	Marking	Documentation
4.5	For switches for more than one circuit, the current applicable to each circuit and to each terminal. If these are different from each other, then it shall be made clear to which circuit or which terminal the information applies	7.16 and 5.2 if applicable	Marking / Documentation	Documentation
4.6	Rated impulse withstand voltage Note: not required when 4.7 is declared	7.12	Documentation	Documentation
4.7	Overvoltage category	7.13	Documentation	Documentation
4.8	Duty-type and relevant (ON/OFF-time)	7.18	Documentation	Documentation
4.9	Type and/or connection of switch	7.16	Documentation	Documentation
4.10	configuration of switching device	7.17	Documentation	Documentation
5	**TERMINALS/CONDUCTORS**			
5.1	All terminals shall be suitably identified, or their purpose self-evident, or the switch circuitry visually apparent. For terminals intended for the connection of supply conductors, the identification may take the form of a letter L, a number or of an arrow	8.1	Marking	Marking

No	Characteristic	Subclause	Means of information	
			Common type reference CT (7.10.2)	**unique type reference UT (7.10.1)**
5.2	Terminals for the connection of earthing conductors shall be marked with the protective earth symbol	8.2	Marking	Marking
5.3	The method of connection and disconnection for push-in terminals.	11.2.2	Documentation	Documentation
5.4	The type of conductor to be connected to the terminal (solid or stranded)	7.20	Documentation	Documentation
5.5	The suitability of the terminal for connection of conductors indicated (maximum and minimum conductor diameter).	7.20	Documentation	Documentation
5.6	The suitability of the terminal for two or more conductors	7.20	Documentation	Documentation
5.7	The type of solder terminal mechanical securement before soldering, iron, bath, etc.	7.20	Documentation	Documentation
5.8	For terminals with specific connection method, such as solder temperatures or process shall be declared.	7.20	Documentation	Documentation
5.9	Terminals for prepared conductors indicate the method for preparing the conductors, (such as solder dipped, crimp connector, etc).	7.20	Documentation	Documentation
5.10	For tabs with dimensions other than those according to IEC 61210, the appropriate female connector (size, material, insulation if applicable, etc.).	7.20	Documentation	Documentation
6	**OPERATING CYCLES/SEQUENCE**			
6.1	Number of operating cycles	7.4	Marking	Documentation
6.2	Operating sequence for switches with more than one circuit, if significant. For multi-circuit switches the operating sequence of the pairs of contacts shall be declared if this is of importance for the safety of the user. Contacts which "make before break" or "break before make" are examples.	13.5 and 5	Documentation	Documentation
6.3	Forces applied to end stops or full travel of actuating member (optional)	17.4 IEC 61058-1-1 or IEC 61058-1-2	Documentation	Documentation
7	**SIGNAL INDICATORS**			
7.1	Maximum power of tungsten filament signal lamps. The marking shall be visible when replacing the lamp	6.3	Marking	Marking
7.2	Intended function or operation of the signal indicator	8.1 and 12.2.5	Documentation	Documentation
8	**CIRCUIT DISCONNECTION**			
8.1	Electronic disconnection	7.14.1	Marking	Documentation
8.2	Micro disconnection	7.14.2	Marking	Documentation
8.3	Full disconnection	7.14.3	Documentation	Documentation
8.4	Combination	7.14.4	Documentation	Documentation
9	**INSULATING MATERIALS**			
9.1	Tracking PTI or CTI	20.4	Documentation	Documentation

No	Characteristic	Subclause	Means of information	
			Common type reference CT (7.10.2)	unique type reference UT (7.10.1)
9.2	Glow-wire temperatures	7.11	Documentation	Documentation
9.3	Type of coating for rigid printed board assemblies	7.15	Documentation	Documentation
10	**COOLING CONDITION**			
10.1	Not requiring forced cooling	7.22	Documentation	Documentation
10.2	Requiring cooling	7.22	Documentation	Documentation
10.3	Direction of air for forced cooling	7.22	Documentation	Documentation
10.4	Speed of air for forced cooling	7.22	Documentation	Documentation
10.5	Thermal resistance of heat sink	7.22	Documentation	Documentation
10.6	Incoming temperature, density and other details of the air stream	7.22	Documentation	Documentation
11	**PROTECTIVE DEVICE**			
11.1	Rated current/fusing characteristic/breaking capacity of replaceable built-in protection	7.21	Marking	Documentation
11.2	Type/function of non-replaceable built-in protection	7.21	Documentation	Documentation
11.3	External protective device rated current, fusing characteristic, breaking capacity	24.2	Documentation	Documentation
12	**TEST CONDITIONS**			
12.1	Test condition for switches having a contact making and breaking speed independent from the speed of actuation	7.19	Documentation	Documentation
12.2	Special requirements for testing such as minimum electric load as defined in 3.2.11, thermal current (3.2.12)		Documentation	Documentation

8.2 Symbols

When symbols are used, they shall be in accordance with IEC 60417, IEC 60529 and IEC 60617, examples include the following.

Ampere – current		A
Volt – voltage		V
Watt – power		W
Volt-Amperes – power of AC loads		VA
Alternating Current (single-phase) “AC”, ”a.c.” or “ac” or symbol or combination of one set of characters and symbol, with or without punctuation.		∿
	example	∿ AC
	example	AC
Direct Current “DC”, ”d.c.” or “dc” or symbol or combination of one set of characters and symbol, with or without punctuation.		⎓
	example	⎓ DC
	example	DC
Symbol for tungsten filament lamp load		⊗
Protective earth symbol		⏚

Hertz – Frequency of supply		Hz
Number of operating cycles		See 8.5
Symbol for micro disconnection		µ
Symbol for the "OFF" position or the direction of actuation to the "OFF" position	circle	O
Symbol for the "ON" position or the direction of actuation to the "ON" position	straight bar	|
Electronic disconnection	Greek epsilon	ε

8.3 Load rating

8.3.1 General

Information about rated current and rated voltage may be provided by using figures alone, the figure for the rated current preceding or being placed above that for the rated voltage and separated from it by a line.

In cases where the switch is rated for more than one type of load as specified in 7.2, several different current/ load type/voltage figures given by appropriate markings are permitted.

8.3.2 Substantially resistive load

For switches classified to operate substantially resistive load according to 7.2.1, the rated current is marked first, followed by the rated voltage. The symbol for the nature of the supply is placed after the voltage rating.

Resistive current, voltage and nature of supply may be indicated as in the following examples:

For substantially resistive loads, it is recommended to use V AC (instead of V ~).

16 RA 250 V AC

or 16 / 250 ~

or 16 A 250 V ~

or $\frac{16}{250\sim}$

8.3.3 Resistive load and motor load

For switches classified to operate resistive load and motor load according to 7.2.2, the rated current for motor load is placed between round brackets and immediately follows the rated current for resistive load. The symbol for the nature of the supply is placed before or after the current and voltage ratings.

Current, voltage and nature of supply may accordingly be indicated as in the following examples:

16(3) A 250 V ~

or 16(3) / 250 ~

$$\text{or} \quad \frac{16(3)}{250\sim}$$

8.3.4 Resistive load and capacitive load

For switches classified to operate resistive load and capacitive load according to 7.2.3, the marking of the peak surge current is separated from the marking of the rated current for resistive load by a stroke and follows immediately the rated current for resistive load. The symbol for the nature of the supply is placed after the current and voltage ratings.

Resistive current, peak surge current, voltage and nature of supply may be indicated accordingly as in the following examples:

2/8 A 250 V ~

$$\text{or} \quad \frac{2/8}{250\sim}$$

Figure 8,9 and 10 indicate the current time characteristics of capacitive loads.

8.3.5 Resistive load and tungsten filament lamp load

For switches classified to operate resistive load and tungsten filament lamp load according to 7.2.4, the marking shall be according to a) or b):

The marking in item b) is not recommended for new designs.

a) The rated current for tungsten filament lamp load is placed after the symbol for tungsten filament lamp and follows immediately the rated current for resistive load. The symbol for the nature of the supply is placed after the current and voltage ratings.

Resistive current, current for tungsten filament lamp load, voltage and nature of supply may be indicated accordingly as in the following examples:

6⊗1 A 250 V ~

or 6⊗1/ 250 ~

$$\text{or} \quad \frac{6\otimes1}{250\sim}$$

b) The peak surge current for tungsten filament lamp load is placed between square brackets and follows immediately the rated current for resistive load. The symbol for the nature of supply is placed after the current and voltage ratings.

Resistive current, peak surge current, voltage and nature of supply may be indicated accordingly as in the following examples:

6[16] A 250 V ~

or 6[16] / 250 ~

or $\frac{6[16]}{250\sim}$

8.3.6 Declared specific load

For switches classified to operate declared specific loads according to 7.2.5, the information may be given by reference to drawings or to types, for example:

"Electric motor, drawing number ......, parts list No. ...., made by......", or "5 × 80 W fluorescent lamp load".

8.3.7 Inductive loads

For switches classified to operate inductive load according to 7.2.8, the marking shall be according to method a) or b):

The marking in item b) is not recommended for new designs.

a) For circuits for inductive load according to 7.2.8, the rated current for inductive load is followed by the upper case letter “L” (indicating Inductance) followed by the letter “A”. See examples.

4LA 250 V ~

or 4L/ 250 ~

b) For inductive loads using the historical marking indication, the rated current for inductive load placed between double, pointed brackets. The symbol for the nature of the supply is placed before or after the current and voltage ratings. See examples.

The marking “b” is not recommended for new designs.

[[4 A]] 250 V ~

8.3.8 General Purpose loads

For switches classified to operate General Purpose loads according to 7.2.10, the symbol “GP” follows the Amp symbol. See example.

10 A GP 250 V ~

8.4 Temperature rating

8.4.1 Information about rated ambient temperature shall be provided by indicating the negative (less than zero degrees Celsius) temperature value preceding the letter "T", the higher temperature value (greater than 55 °C) following the letter "T".

If no lower temperature value is given, the lower temperature value is 0 °C:

25T85 (meaning –25 °C up to +85 °C)

T85 (meaning 0 °C up to +85 °C)

If no information is given, for mechanical switches and electronic switches the rated ambient temperature range is 0 °C up to 55 °C.

8.4.2 For switches only partially suitable for a rated ambient temperature higher than 55 °C (according to 7.3.3), the information shall be provided as follows:

T 85/55 (meaning up to 85 °C for the switch body and up to 55 °C for the actuating member).

Examples:

25T85/55

or T65/55.

8.5 Operating cycles

Information about the rated operating cycles shall be provided in a scientific manner by using symbol "E", indicating the exponent. For switches for 10 000 operating cycles according to 7.4.4, this information is not necessary:

Examples:

1E3 = 1 000 25E3 = 25 000 1E5 = 100 000

8.6 Switches intended for use in Class II equipment or appliances

The symbol ⧈ (symbol 5172 of IEC 60417) shall not be marked on the switch. This symbol applies to equipment or an appliance, and not an individual switch.

8.7 Required marking

Required marking on a switch shall preferably be on the body of the switch. It may, however, be placed on non-detachable parts but not on screws, removable washers or other parts which might be removed when connecting conductors and during installation of the switch. The marking for characteristics of any replaceable fuse incorporated in a switch shall be placed on the fuse-holder or in the proximity of the fuse. The characteristics may be indicated by symbols (see IEC 60127).

For switches of small dimensions, the marking may be on different surfaces.

8.8 Legibility and durability of marking

The required marking shall be legible and durable.

Compliance with the requirements of 8.1 to 8.8 is checked by inspection and by rubbing the marking by hand as follows:

The test is made by rubbing the marking by hand for 15 s with a piece of cotton cloth soaked with water, and again for 15 s with a piece of cotton cloth soaked with aliphatic solvent hexane with a content of aromatics of maximum 0,1 % by volume, a kauributanol value of 29, an initial boiling point approximately 65 °C, a dry-point of approximately 69 °C and a density of approximately 0,68 g/cm^3.

Marking made by impressing, moulding, laser or engraving is not subjected to this test.

After this test, the marking shall be easily legible.

8.9 Switches with their own enclosure

For switches with their own enclosure and not intended to be incorporated in an appliance, the "OFF" position shall be clearly indicated. Switches with micro-disconnection or electronic disconnection shall not be marked with the symbol "O" for the "OFF" position. For switches where the marking of the switch position is impossible or leads to misunderstanding, for example rocker switches or push-button switches with more than one biased push-button, the direction of actuation(s) shall be marked. For switches having more than one actuating member, this marking shall indicate, for each of the actuating members, the effect achieved by its operation.

For switches classified as unique type, 7.10.1, the OFF marking is to be according to the manufacturer’s declaration.

For push-button switches with a single button, the OFF position is not required to be marked.

NOTE The symbol "O" is used only for full disconnection.

9 Protection against electric shock

9.1 Switches shall be constructed so that there is adequate protection against contact with live parts in any position of use when the switch is mounted and operated as in normal use, and after any detachable parts have been removed, except lamps with caps.

For switches for class II appliances, this requirement applies also to contact with metal parts separated from live parts by basic insulation only, or with basic insulation itself.

NOTE For the purpose of this standard, metal-sensing surfaces which are connected to live parts by means of protective impedance (see 9.1.1) are considered to offer protection against electric shock.

Compliance is checked by inspection and by the following test:

a) *The test is applied to those parts of the switch which are accessible when it is mounted in any position in accordance with the manufacturer's documentation, with any detachable parts, except lamps with caps, removed;*

b) *The insulating properties of lacquer, enamel, paper, cotton, oxide film on metal parts, beads and sealing compounds which soften in heat shall not be relied upon to give the required protection against contact with live parts.*

c) *Probe B according to IEC 61032 (IEC 60529:1989, Figure 1) jointed test finger is applied without force in every possible position. If Probe B is able to enter the opening, the finger is repeated with an electrical contact indicator to show contact, the test allows the finger to be in the angled position. It is recommended to use a lamp for the indication of contact at a voltage not less than 40 V.*

d) *Probe 11 according to IEC 61032 straight unjointed test finger is applied with 20 N of force to any opening that prevents the entry of probe B.*

e) *Test pin Probe 13 according to IEC 61032 is applied to openings in insulation materials and unearthed metal parts without force in every possible position.*

f) *In case of doubt the tests are repeated under the conditions for the test of Clause 16.*

It shall not be possible to touch bare live parts.

For switches which have any parts of double insulation construction, it shall not be possible to touch with the jointed test finger unearthed metal parts which are only separated from live parts by basic insulation, or by the basic insulation itself.

9.1.1 Accessible metal parts which are needed for the operation of a switch (for example, sensing surfaces) may be connected to live parts by means of a protective impedance.

The protective impedance shall consist of resistors and/or capacitors and shall comply with one of the following:

a) At least two independent resistors of the same nominal value in series. The resistors shall comply with the requirements given in 24.4;

b) at least two independent capacitors in series, of the same value. The capacitors shall comply with the requirements for class Y2 according to IEC 60384-14;

c) at least one resistor complying with 24.4 and one capacitor complying with the requirements for class Y2 according to IEC 60384-14 in series The impedance of the resistor and capacitor should be approximately equal

The removal of protective impedances, or their short-circuiting, shall be possible only by destruction of the switch or by rendering the switch obviously unusable. The protective impedances shall be so designed and arranged that along their surfaces and between their surfaces, the requirements according to Clause 20 are met.

Compliance is checked by inspection and by the tests in 24.4.

9.1.2 If a cover or cover-plate or a fuse can be removed without the use of a tool or if the instruction for use specifies that, for the purpose of maintenance, when replacing the fuse, covers or cover-plates fastened by means of a tool have to be removed, the protection against contact with live parts shall be assured even after removal of the cover or cover-plate. If this requirement is achieved after a switch is built into an appliance, the switch itself does not have to comply with this requirement.

Compliance is checked by applying Access Probe C according to Figure 3 IEC 61032:1997, through the hole, applying up to 20 N of force. The pin shall not touch live parts.

9.1.3 An actuating member shall be fixed adequately if the removal of the actuating member gives access to live parts. An actuating member is considered to be fixed adequately if access to live parts can be gained only by breaking or cutting or by dismantling with the aid of a tool.

Compliance is checked by inspection, during the tests according to Clause 18 and by applying the test probe B according to IEC 61032 without force.

9.2 For switches for appliances other than those of class III, accessible parts of actuating members shall be of one of the following types:

a) insulating material;

b) metal separated from basic insulated parts by supplementary insulation;

c) metal separated from live parts by double or reinforced insulation;

d) metal separated from live parts by protective impedances.

Compliance for items a) to c) is checked by inspection, measurement and test as appropriate.

Compliance for item d) is checked as follows:

The measurements are carried out between either a single accessible metal part or any combination of accessible metal parts and earth, through a non-inductive resistor of 2 kΩ at rated voltage (and rated load in ON-state), in ON- and OFF-state, and/or at lowest and highest setting value. During the measurements, each one of the resistors and all other components, if any, in the protective impedance, are short-circuited one at a time.

The current shall not exceed, in any measurement, 0,7 mA (peak value) for AC up to 1 kHz or 2 mA for DC.

For frequencies above 1 kHz, the limit of 0,7 mA is multiplied by the value of the frequency in kHz, but shall not exceed 70 mA.

9.3 Capacitors shall not be connected to unearthed metal parts which are accessible when the switch is mounted in accordance with the manufacturer's declarations. Metal casing of capacitors shall be separated by supplementary insulation from accessible unearthed metal parts, when the switch is mounted in accordance with the manufacturer's declarations.

Compliance is checked by inspection and according to the requirements in Clauses 15 and 20.

10 Provision for earthing

10.1 Switches for class II appliances shall have no provision for earthing the switch or parts thereof. Interconnections for maintaining the earthing circuit are permitted.

Compliance is checked by inspection.

10.2 Earthing terminals, earthing terminations and other earthing means shall not be connected electrically to any neutral terminal.

Compliance is checked by inspection.

10.3 Accessible metal parts of switches for class I appliances which may become live in the event of an insulation fault shall have provision for earthing.

Compliance is checked by inspection.

10.3.1 Parts separated from live parts by double insulation or reinforced insulation, and parts screened from live parts by metal parts connected to an earthing terminal, earthing termination, or other earthing means are not regarded as likely to become live in the event of an insulation fault.

10.3.2 Accessible metal parts of switches may be connected to earth through their fixing means, provided that provision is made for clean metallic surfaces at the connection points.

10.4 The connection between an earthing terminal, earthing termination or other earthing means and parts required to be connected thereto shall be of low resistance.

Compliance is checked by the following test:

a) *a current of 1,5 times the rated current but not less than 25 A, derived from an AC source, with a no-load voltage not exceeding 12 V, is passed between the earthing terminal, earthing termination, or other earthing means, and each of the parts in turn;*
b) *the voltage drop between the earthing terminal, earthing termination, or other earthing means, and each part connected thereto is measured when steady-state conditions have been achieved and the resistance is calculated on the basis of the current and this voltage drop.*

In no case shall the resistance exceed 50 mΩ.

10.5 Earthing terminals of all types for unprepared conductors shall be of a size equal to, or larger than that required for the corresponding current-carrying terminal. It shall not be possible to loosen the clamping means without the aid of a tool, and they shall be adequately locked against unintentional loosening.

Compliance is checked by inspection, by manual test and by the appropriate tests of Clause 11.

10.5.1 In general, the designs commonly used for terminals according to 11.1 and 11.2 provide sufficient resilience to comply with the requirement for adequate locking against unintentional loosening.

10.5.2 If the switch is subjected to excessive vibration or temperature cycling, special provisions, such as the use of an adequately resilient part (for example, a pressure plate), may be necessary if pillar terminals are used (See Figure 1).

10.6 Thread-cutting and thread-forming screws may be used to provide earthing continuity, provided that it is not necessary to disturb the connection in normal use and at least two screws are used for each connection.

Compliance is checked by inspection and during the tests of 19.2.

10.7 All parts of an earthing terminal shall be such that there is no risk of corrosion resulting from contact between those parts and the copper of the earthing conductor, or any other metal that is in contact with those parts.

10.8 The body of an earthing terminal shall be of brass or other metal no less resistant to corrosion, unless it is a part of the enclosure, when any screws or nuts shall be of brass, plated steel complying with 19.3, or other metal no less resistant to corrosion and rusting.

Compliance is checked by inspection, in case of doubt, compliance is checked by the testing of Clause 22.

10.9 If the body of an earthing terminal is part of a frame or enclosure of aluminium or aluminium alloy, precautions shall be taken to avoid risk of corrosion resulting from contact between copper and aluminium or its alloys.

Compliance with the requirements of 10.7, 10.8 and 10.9 is checked by inspection and in cases of doubt by analysis of the materials and their coatings or platings.

11 Terminals and terminations

11.1 Common requirements to terminals

11.1.1 General

Terminals shall enable a safe and reliable connection for the conductors declared under the conditions of the intended use. The evaluation and tests are done considering the wire sizes given in Table 4 with respect to the resistive currents declared if no other wire sizes are declared by the manufacturer.

Table 4 – Resistive current carried by the terminal and related cross-sectional areas of terminals for unprepared conductors

Resistive current carried by the terminal		Flexible conductors			
		Cross-sectional areas			Terminal size
A		mm^2			
Over	Up to and including	Minimum	Medium	Maximum	
-	3	-	0,5	0,75	0
3	6	0,5	0,75	1,0	0
6	10	0,75	1,0	1,5	1
10	16	1,0	1,5	2,5	2
16	25	1,5	2,5	4,0	3
25	32	2,5	4,0	6,0	4
32	40	4,0	6,0	10,0	5
40	63	6,0	10,0	16,0	6
Resistive current carried by the terminal		**Rigid conductors**			
		Cross-sectional areas			**Terminal size**
A		mm^2			
Over	Up to and including	Minimum	Medium	Maximum	
-	3	0,5	0,75	1,0	0
3	6	0,75	1,0	1,5	1
6	10	1,0	1,5	2,5	2
10	16	1,5	2,5	4,0	3
16	25	2,5	4,0	6,0	4
25	32	4,0	6,0	10,0	5
32	40	6,0	10,0	16,0	6
40	63	10,0	16,0	25,0	7

Screws and nuts for clamping the conductors shall not serve to fix any other part, although they may hold the clamping part in place or prevent it from turning.

Clamping shall be between metal surfaces except that, for terminals intended to be used in circuits carrying a current not exceeding 0,2 A, one of the surfaces may be non-metallic.

Compliance is checked by inspection.

11.1.2 Design of terminals

Terminals shall be designed so that a suitable conductor may be inserted into the aperture to the designed depth without undue force and undue damage to the conductor and terminal.

Compliance is checked by inspection.

11.1.3 Insulation

Terminals shall be designed so, that there is no reduction of the insulation strength when the conductor is attached to the terminal as declared by the manufacturer.

Compliance is checked according to Clause 20 with the conductors connected as declared.

NOTE This can be done having the end of a conductor introduced into the hole visible or that the insertion of the conductor is prevented by a stop if further insertion may reduce creepage distances and/or clearances or influence the mechanism of the switch.

11.1.4 Connection

A terminal shall be designed so that a conductor cannot slip out while being connected or while the switch is being operated as intended.

Compliance is checked by TT1.

11.2 Fixing of terminals

11.2.1 Terminals shall be fixed so, that they will not work loose when the conductor is connected or disconnected. For example this can require that the clamping means are tightened or loosened.

The intended removal of a conductor shall require an action other than a pull at the conductor.

This requirement does not preclude floating terminals or terminals mounted on floating elements, such as those used in some stack-type switches. For terminals declared 7.20.14 (flat quick-connect termination) the tabs shall allow the application and withdrawal of female connectors without damage to the switch such as to impair compliance with this standard.

Compliance is checked by TT2.

11.2.2 For terminals declared 7.20.13 (push in) in combination with conductors declared unprepared (7.20.1):

Compliance is checked by inspection and 11.8.4.

11.3 Location and shielding of terminals

11.3.1 Terminals shall be located or shielded so that when wires are connected there is no reduction of the insulation strength of the terminals, live parts or to accessible metal parts.

11.3.2 Terminals suitable for the connection of flexible conductors (7.20.3) shall be located or shielded so that there is no risk of contact between live parts and accessible metal parts.

11.3.3 For switches for class II appliances there shall be no risk of contact between live parts and metal parts separated from accessible metal parts by supplementary insulation only.

Compliance is checked by inspection and for stranded wires by TT3 (strand escape test).

11.4 Terminals for interconnection of more than one conductors

Terminals intended to be used for the interconnection of more than one conductor (7.20.9) shall be designed so that the combination of the most onerous sizes connected simultaneously, does not result in a hazard.

Compliance is checked by inspection and TT4.

11.5 Thermal stress

Terminals shall withstand thermal stress occurring in normal use. Terminals rated for less than 20 mA are not subjected to this test.

Compliance is checked according to TE2 in Clause 17 of IEC 61058-1-1:2016 or IEC 61058-1-2:2016.

11.6 Test sequences

Depending on terminals allowing the connection of prepared or unprepared conductors, the tests are conducted according Table 5 in the sequence with increasing TT-number.

Table 5 – Terminal test sequence

Reconnection	**Conductor**	**TT1**	**TT2**	**TT3**	**TT4**	**Examples of terminals** (not exhaustive)
possible (7.20.11)	unprepared (7.20.1).	X	X	X	X	Screw 7.20.12, Piercing 7.20.18, Push in 7.20.13
possible (7.20.11)	prepared (7.20.2)	X	X	–	–	Screw 7.20.12, Piercing 7.20.18, Push in 7.20.13, Quick connect
not possible (7.20.10)	unprepared (7.20.1).	X	–	–	–	Solder 7.20.15 Welding 7.20.16
not possible (7.20.10)	prepared (7.20.2)	–	–	–	–	Fixed wires (7.20.17) and terminations in general
NOTE1 "X" indicates the test is required. NOTE 2 Column descriptions and test codes: TT1 Conductor escape test. TT2 Terminal displacement test. TT3 Strand escape test TT4 Multiple conductors						

11.7 Conductor escape test (TT1)

Conductors to be fitted are selected as declared by the manufacturer or of maximum cross-sectional areas according to Table 4.

The conductor is inserted into the terminal over a length equal to the minimum distance prescribed or, if no distance is prescribed, until an end-stop is reached or until the conductor just projects from the far side of the terminal and in the position most likely to assist a strand to escape.

The test is repeated with the terminal fitted with conductors as declared or of minimum cross-sectional area according to Table 4.

For terminals declared suitable for prepared conductors (7.20.2) the declared type shall be used.

For terminals declared suitable for rigid conductors (7.20.5), before insertion into the terminal, the wires are straightened.

For terminals declared suitable for stranded conductors (7.20.3 or 7.20.4), these are twisted in one direction, so that a uniform twist of one complete turn in a length of approximately 2 cm is obtained.

For terminals declared screw type terminals (7.20.12) these are tightened with the torque according to Table 10.

For terminals declared suitable for the connection of two or more conductors (7.20.9), the test is repeated with the terminal fitted with the declared numbers of conductors;

For terminals declared for solder or welding terminals (7.20.15 or 7.20.16) or if the connection is designed so that a slip out is prevented by design, no test is necessary.

Compliance of test:

After the test, the conductor shall not have escaped into or through the gap between the clamping means and retaining device.

11.8 Terminal displacement test (TT2)

11.8.1 Connection test

A conductor shall be connected and disconnected 10 times using the parameters of TT1, if no test according to 11.8.2 is required.

For terminals declared for only one time connection (7.20.10) this test is not required.

Compliance of test:

After the test, the terminal shall not have displaced from its intended position.

11.8.2 Screw-type terminal

For terminals declared 7.20.12 "screw" additionally the following test is conducted on the same samples:

a) The screw-type terminal is fitted with a conductor of the smallest or declared cross-sectional area specified in Table 4, the terminal screw being tightened with a torque equal to that specified in the appropriate column of Table 10.

b) If the screw has a hexagonal head with a slot, the torque applied is equal to that specified in column III of Table 10.

c) The conductor is subjected to a pull of the force as given in Table 6, the pull being applied without jerks, for 1 min, in the direction of the axis of the conductor space.

d) repeat a) to c) with the largest wire size.

   For terminals declared suitable for the connection of two or more conductors (7.20.9), the test is repeated with the terminal fitted with the declared number of conductors.

   For terminals declared suitable for two or more conductors (7.20.9), the appropriate pull is applied consecutively to each conductor.

During the test, the conductor shall not move noticeably in the terminal.

11.8.3 Flat quick-connect termination

For terminals declared 7.20.14 (flat quick-connect termination) compliance is checked by applying the axial forces without jerks to the tab equal to those specified in IEC 61210:2010, Table 6 (retention force). No significant displacement or damage shall occur.

11.8.4 Push in terminals

For terminals declared 7.20.13 (push in) in combination with conductors declared unprepared (7.20.1), the test procedure is:

Conductors to be fitted are selected as declared by the manufacturer or of maximum cross-sectional areas according to Table 4.

Perform steps a) to f).

The test is repeated with the terminal fitted with conductors as declared or of minimum cross-sectional area according to Table 4.

Step a) – Insert the conductor into the terminal, either as far as possible or insert so that adequate connection is obvious.

Step b) – Twist it through 90° in an axial direction.

Step c) – Apply a pull force in opposite to direction of insertion as specified in Table 6; the pull is applied without jerks, for 1 min

Step d) – Disconnect the conductor, use the designed disconnect means other than a pull on the conductor only.

Step e) – Select a new conductor for each of the next 3 insertions indicated above.

Step f) – At the 5th insertion, the conductor used for the 4th insertion is reused (the intention is that the conductor be used twice and gripped at the same place on the conductor).

Compliance of the test:

During the application of the pull, the conductor shall not come out of the terminal. After these tests, neither the terminal nor the clamping means shall have worked loose.

Table 6 – Pulling forces for screw-type terminals

Terminal size	0	1	2	3	4	5	6	7
Pulling force (N)	35	40	50	60	80	90	100	135

11.9 Strand escape test (TT3)

The insulation from the end of a stranded conductor having the minimum or declared cross-sectional area specified in Table 4 is removed for a length of 8 mm. One strand of the flexible conductor is separated and left free and the remainder are fully inserted into the terminal and clamped.

For terminals declared suitable for unprepared stranded conductors 7.20.3 and 7.20.4 this test is required.

Compliance of the test:

The free strand shall be bent without tearing the insulation back and without making sharp bends in every possible direction.

The free strand of the flexible conductor shall not touch relevant parts mentioned in 11.3.

The free strand of a flexible conductor connected to an earthing terminal shall not touch any live part.

11.10 Multiple conductors (TT4)

Conductors to be fitted are selected as declared by the manufacturer or of maximum cross-sectional areas according to Table 4.

For conductors classified 7.20.13, perform steps a) to c) of TT2 Clause 11.8.4.

For conductors classified 7.20.12 perform steps a) to c) of TT2 Clause 11.8.2.

For terminals declared suitable for the connection of two or more conductors (7.20.9), the test is repeated with the terminal fitted with the declared number of conductors;

For terminals declared suitable for two or more conductors (7.20.9), the appropriate pull is applied consecutively to each conductor.

Compliance of the test:

During the application of the pull, the conductor shall not come out of the terminal. After these tests, neither the terminal nor the clamping means shall have worked loose.

12 Construction

12.1 Constructional requirements relating to protection against electric shock

12.1.1 When double insulation is used the design shall be such that the basic insulation and the supplementary insulation can be tested separately unless compliance with regard to the properties of both insulations is provided in another way.

Compliance is checked by inspection.

a) If the basic and the supplementary insulation cannot be tested separately, or if compliance with regard to the properties of both insulations cannot be obtained in another way, the insulation is considered to be reinforced insulation.

b) Specially prepared specimens, or specimens of the insulating parts, are considered to be ways of providing means of determining compliance.

12.1.2 Switches shall be designed so that creepage distances and clearances cannot be reduced, as a result of wear, below the values specified in Clause 20. They shall be constructed so that if any conductive part of the switch becomes loose and moves out of position, it cannot get so disposed in normal use that creepage distances or clearances across supplementary insulation or reinforced insulation are reduced.

Compliance is checked by inspection, by measurement and by manual test.

For the purpose of this test:

- *it is not to be expected that two independent fixings will become loose at the same time;*
- *parts fixed by means of screws or nuts provided with locking washers are regarded as not liable to become loose, provided that these screws or nuts are not required to be removed during user maintenance or servicing;*
- *springs and spring parts are not regarded as being liable to become loose or fall out of position if they do not do so during the tests of Clauses 18 and 19.*

12.1.3 Integrated conductors shall be rigid, fixed, or insulated so that in normal use creepage distances and clearances shall not be reduced below the values specified in Clause 20.

Insulation, if any, shall be such that it cannot be damaged during mounting or in normal use.

Compliance is checked by inspection and by the tests of Clause 20.

If the insulation of a conductor is not at least electrically equivalent to that of cables and cords complying with the appropriate IEC standard or does not comply with the dielectric strength test made between the conductor and metal foil wrapped around the insulation under the conditions specified in Clause 15, the conductor is considered to be a bare conductor.

12.1.4 Full disconnection or micro-disconnection can only be achieved using a series mechanical contact (without a parallel path or a parallel path evaluated using the impulse withstand test).

12.1.5 Electronic disconnection is formed by any parallel components or path across a series contact, or when no mechanical contact is provided in the switch.

12.2 Constructional requirements relating to safety during mounting and normal operation of the switch

12.2.1 Covers, cover plates, removable actuators and the like providing safety shall be fixed in such a way that they cannot be displaced or removed except by use of a tool. The fixings for a cover or cover plate shall not serve to fix any other part except an actuating member.

It shall not be possible to mount removable parts, for example cover PLATES bearing indicators or knobs, such that indication of switch positions does not correspond with the actual switch position.

12.2.2 Fixing screws of covers or cover plates shall be captive.

The use of tight-fitting washers of cardboard or similar material is deemed to be adequate for this purpose.

12.2.3 A switch shall not be damaged when its actuating member is removed as intended.

Compliance with the requirements of 12.2.1, 12.2.2 and 12.2.3 is checked by inspection after removing the actuating member and, by the tests of 18.3 and 18.4.

12.2.4 A pull-cord shall be insulated from live parts and designed such that it shall be possible to fit or to replace it without removing parts causing live parts to become accessible.

Compliance is checked by inspection.

12.2.5 If an illuminated indicator is incorporated in a switch, it shall provide the correct indication as declared by the manufacturer.

Compliance is checked by connecting the switch to a voltage not deviating by more than ± 10 % of the marked voltage for the lamp circuit or rating of the switch, whichever is applicable.

12.3 Constructional requirements relating to the mounting of switches and to the attachment of cords

12.3.1 Switches shall be designed so that the methods of mounting in accordance with the manufacturer's declarations do not adversely affect compliance with this standard.

These methods of mounting shall be such that the switch cannot rotate, or be otherwise displaced, and cannot be removed from an appliance without the aid of a tool. If the removal of a part, such as a key, is necessary during the normal use of the switch, then the requirements of Clauses 9, 15 and 20 shall be satisfied before and after such removal.

Compliance is checked by inspection and by manual test.

a) Switches fixed by a nut and a single bush concentric with the actuating means are deemed to comply with this requirement, provided that the tightening and/or loosening of the nut requires the use of a tool, and that the parts have adequate mechanical strength.

b) An incorporated switch mounted by screwless fixing is deemed to comply with this requirement if the use of a tool is required before the switch can be removed from the appliance.

12.3.2 A conductor intended to be disconnected, shall indicate an obvious method for insertion and disconnection of the conductors. The intended disconnection of a conductor shall require an operation, other than a pull at the conductor.

12.3.3 Openings for the use of a tool intended to assist the insertion or disconnection shall be clearly distinguishable from the opening for the conductor.

13 Mechanism

Switches with series contacts shall comply with the following:

13.1 For DC switches with a voltage rating above 28 V dc in combination with a current rating above 0,1 A the speed of contact making and breaking shall be sufficiently independent of the speed of actuation.

Compliance is checked during the test TC10 according to Clause 17 of IEC 61058-1-1:2016 or IEC 61058-1-2:2016.

13.2 A switch with an intermediate position shall not create an unintended operation.

Compliance with the requirement is checked by the test in 15.3. With the actuator in the intermediate position, apply the withstand test voltage in Table 8 for declared type of disconnection in 7.14 between the adjacent terminals associated with the disconnection.

13.3 When the actuating member is released, it shall take up automatically or stay in the position corresponding to that of the moving contacts, except that, for switches which have only one rest position, the actuating member may take up its normal rest position.

Compliance with the requirements of 13.3 is checked by manual test, the switch being mounted according to the manufacturer's declarations and the actuating member being actuated as in normal use.

If necessary, the adequacy of the separation of the contacts in an intermediate position is determined by a dielectric strength test in accordance with 15.3, the test voltage being applied between the relevant terminals, without removing any cover.

13.4 A cord-operated switch (pull cord) shall be constructed so that, after actuating the switch and releasing the cord, the relevant parts of the mechanism are in a position from which they allow the immediate performance of the next movement in the cycle of actuation.

Compliance is checked by inspection and by the following test.

Cord-operated switches shall be actuated from any one position, to the next position, by the application and removal of a steady pull not exceeding 45 N vertically downwards, or 70 N at 45° to the vertical, with the switch mounted as declared.

13.5 Multi-pole switches shall make and break all related poles substantially together unless otherwise declared according to Table 3 "Operating sequence". For switches with switched neutral, the neutral may make before and break after the others.

Compliance is checked by inspection and, if necessary, by test.

14 Protection against ingress of solid foreign objects, ingress of water and humid conditions

14.1 Protection against ingress of solid foreign objects

Switches shall provide the declared degree of protection as in 13.3 of IEC 60529:1989, against solid foreign objects when mounted and used as declared.

Compliance is checked by the appropriate test specified in IEC 60529.

Detachable parts are removed. A switch which relies on mounting in, or on, an appliance for the declared degree of protection against solid foreign objects shall be suitably mounted in, or on, a closed box to simulate the appliance, and the tests shall be performed using this simulated assembly.

For numerals 5 and 6, the test is carried out according to category 2 with the specimen in the most unfavourable position considering the manufacturer's declarations continued for a period of 8 h. During the 8 h period, the specimen under test shall be alternatively loaded for 1 h with the maximum rated current and 1 h without current.

For the test for first characteristic numeral 5, the switch is deemed to comply if

– *all actions function as declared;*
– *the temperature rise at the terminals does not exceed 55 K when tested in accordance with Clause 16, with the exception that the temperature-rise test at the terminals is carried out at rated current and at an ambient temperature of 25 °C ± 10 °C;*
– *the dielectric strength requirement of 15.3 applies with the exception that the specimens are not subjected to the humidity treatment before the application of the test voltage. The test voltage shall be 75 % of the corresponding test voltage specified in 15.3;*
– *there is no evidence that transient fault between live parts and earth metal, accessible metal parts, or actuating members has occurred.*

For the test for first characteristic numeral 6, the protection is satisfactory if no deposit of dust is observable inside the switch at the end of the test.

14.2 Protection against ingress of water

Switches shall provide the declared degree of protection against ingress of water when mounted and used as declared.

Compliance is checked by the appropriate tests specified in IEC 60529 with the switch placed in any position of normal use. Switches are allowed to stand at 25 °C ± 10 °C for 24 h before being subjected to the following test.

The test is then carried out according to IEC 60529 as follows:

– IPX1 switches as described in 14.2.1 with the drain holes open;
– IPX2 switches as described in 14.2.2 with the drain holes open;
– IPX3 switches as described in 14.2.3 with the drain holes closed;
– IPX4 switches as described in 14.2.4 with the drain holes closed;

– IPX5 switches as described in 14.2.5 with the drain holes closed;
– IPX6 switches as described in 14.2.6 with the drain holes closed;
– IPX7 switches as described in 14.2.7 with the drain holes closed;
– IPX8 switches as described in 14.2.8 with the drain holes closed;
– IPX9 switches as described in 14.2.9 with the drain holes closed.

Immediately after the appropriate test, the switch shall withstand the dielectric strength test specified in 15.3, and inspection shall show that there is no trace of water on insulation which could result in a reduction of creepage and clearance below the values specified in Clause 20.

a) *The switch shall not be electrically loaded during these tests. The water temperature shall not differ from that of the switch by more than 5 K.*

b) *Detachable parts are removed.*

c) *Switches incorporating separate gaskets, screwed glands, membranes or other sealing means, manufactured from rubber or thermoplastic materials are aged in a heating cabinet with an atmosphere having the composition and pressure of the ambient air and ventilated by natural circulation.*

d) *Switches declared 7.3.1 are kept in the cabinet at a temperature of 70 °C ± 2 °C, and switches declared 7.3.2 and 7.3.3 are kept in the cabinet at a temperature of T + 30 °C for 240 h. If the switch is declared according to 7.3.3, the "T" equals the lower of the two values following the letter T in 8.4.2. Switches with glands or membranes are fitted and connected with conductors as specified in Clause 11. Glands are tightened with a torque as specified in Table 11. Fixing screws for enclosures are tightened with a torque as specified in Table 10.*

e) *Immediately after ageing, the parts are taken out of the cabinet and left at 25 °C ± 10 °C, avoiding direct daylight, for at least 16 h.*

f) *A switch which relies on mounting in, or on, an appliance for the declared degree of protection against harmful ingress of water shall be suitably mounted in, or on, a closed box to simulate the appliance, and the tests shall be performed using this simulated assembly.*

g) *For the tests of second characteristic numerals 3 and 4, preferably the hand-held spray nozzle specified in IEC 60529 shall be used.*

14.3 Protection against humid conditions

All switches shall be protected against humid conditions which may occur in normal use.

Compliance is checked by the humidity treatment described in this subclause, followed immediately by the tests of 15.2 and 15.3. Cable inlet openings, if any, and drain-holes are left open. If a drain-hole is provided for a water-tight switch, it is opened.

a) *Before being placed in the humidity cabinet, the specimens are brought to a temperature between t and t + 4 °C (where t is the steady state temperature of the humidity chamber).*

b) *Detachable parts are removed and subjected, if necessary, to the humidity treatment with the main part.*

c) *The humidity treatment is carried out in a humidity cabinet containing air maintained within ±5 °C of any convenient value (t) between 20 °C and 30 °C, with a relative humidity above 91 %. The specimens are kept in the cabinet for a minimum of 96 h.*

d) *After removing the specimens from the cabinet, the testing of 15.2 and 15.3 shall be completed within 2 h under ambient conditions.*

The switch shall not show any damage such as to impair compliance with this standard.

In most cases, the specimens may be brought to the specified temperature by keeping them at this temperature for at least 4 h before the humidity treatment.

In order to achieve the specified conditions within the cabinet, it is necessary to ensure constant circulation of the air and, in general, to use a cabinet which is thermally insulated.

15 Insulation resistance and dielectric strength

15.1 General requirements

The insulation resistance and the dielectric strength of switches shall be adequate.

Compliance is checked by the tests of 15.2 and 15.3, these tests being made immediately after the test of 14.3.

The test voltage according to Table 8 is applied in the case of:

– *Functional insulation: between the different poles of a switch. For the purpose of the test, all the parts of each pole are connected together;*
– *Basic insulation: between all live parts connected together and a metal foil covering the outer accessible surface of the basic insulation and accessible metal parts in contact with the basic insulation;*
– *double insulation: between all live parts connected together and a metal foil covering the outer, normally not accessible surface of basic insulation and non-accessible metal parts; and following this: between two metal foils covering separately the inner, normally not accessible surface of supplementary insulation and connected to non-accessible metal parts, and the outer, accessible surface of supplementary insulation and connected to accessible metal parts;*
– *reinforced insulation: between all live parts connected together and a metal foil covering the outer accessible surface of reinforced insulation and accessible metal parts.*
– *contacts: between the open contacts of each pole of a switch.*

The foils are not pressed into openings but are pushed into corners and the like by means of the jointed test finger (test probe B according to IEC 61032).

In cases where basic insulation and supplementary insulation cannot be tested separately, the insulation provided is subjected to the test voltages specified for reinforced insulation.

The tests are not carried out across protective impedances and poles interconnected by components.

15.2 Measurement of insulation resistance

The insulation resistance is measured with a DC voltage of approximately 500 V applied, the measurement being made 60 s after application of the voltage.

The insulation resistance shall not be less than specified in Table 7.

NOTE Materials such as ceramic or porcelain are considered to have adequate insulation resistance and are not subjected to the insulation resistance tests.

Table 7 – Minimum insulation resistance

Insulation to be tested	Insulation resistance MΩ
Functional	2
Basic	2
Supplementary	5
Reinforced	7

15.3 Insulation test voltage

The insulation is subjected to a voltage of substantially sine-wave form, having a frequency of 50 Hz or 60 Hz. The test voltage shall be raised uniformly from a value not greater than the rated voltage to the value specified in Table 8 within not more than 5 s and held at that value for 60 s.

No flashover or breakdown shall occur. Glow discharges without drop in voltage are neglected.

Table 8 – Dielectric strength

Insulation or disconnection to be tested[2)]	Test voltage (r.m.s.)[1)]			
	rated voltage up to and including 50 V	rated voltage above 50 V up to and including 130 V	rated voltage above 130 V up to and including 250 V	rated voltage above 250 V up to and including 480 V
	V	V	V	V
Functional insulation[3)]	500	1 300	1 500	1 500
Basic insulation[4)]	500	1 300	1 500	1 500
Supplementary insulation[4)]	–	1 300	1 500	1 500
Reinforced insulation[4) 5)]	500	2 600	3 000	3 000
Across electronic disconnection	100	400	500	700
Across micro- disconnection	100	400	500	700
Across full disconnection	500	1 300	1 500	1 500

NOTE 1 Up to 50 V: Not intended to be connected direct to the mains and not expected to be subjected to temporary overvoltagesas defined in IEC 61140.

NOTE 2 Over 50 V: The values are based on IEC 61140.

– For functional, basic and supplementary insulation, and for full disconnection, the values are calculated with the formula: U_N + 1 200 V and rounded.

– For micro and electronic disconnection, the values are calculated with the formula: U_N + 250 V and rounded.

1) The overcurrent relay shall not trip when the output current is less than 100 mA. Care is taken that the r.m.s. value of the test voltage is measured within ±3 %.

2) Special components which might render the test impractical such as discharge lamps, coils, windings, or capacitors are disconnected at one pole, or bridged, as appropriate to the insulation being tested. Where this is not practical on the specimens to be used for the test of Clauses 16 and 17 in IEC 61058-1-1:2016 or IEC 61058-1-2:2016, the test of 15.3 shall be carried out on additional specimens. These may be special specimens with the appropriate components omitted.

3) An example is the insulation between poles (see definition 3.1.4).

4) For the test of basic, SUPPLEMENTARY and REINFORCED INSULATION, all LIVE PARTS are connected together and care is taken to ensure that all moving parts are in the most onerous position.

5) For SWITCHES incorporating REINFORCED INSULATION as well as DOUBLE INSULATION, care is taken that the voltage applied to the REINFORCED INSULATION does not overstress the basic or the supplementary parts of the DOUBLE INSULATION.

16 Heating

16.1 General requirements

Switches shall be constructed so that they do not attain excessive temperatures in normal use. The materials used shall be such that the performance of the switches is not adversely affected by operation in normal use at the rated temperature of the switch.

The procedure to conduct the compliance test is described in 16.4.

16.2 Contacts and terminals

The material and design of the contacts and terminals shall be such that the operation and performance of the switch is not adversely affected by their oxidation or other deterioration.

Compliance is checked by Clause 17.

16.3 Other parts

16.3.1 Switch parts other than the contacts and terminals, in normal use, shall not attain temperatures which impair the performance or operation of the switch or create a hazard to the user.

Compliance is checked by Clauses 17 and 21.

16.3.2 Insulation for conductors provided with the switch shall be rated not less than the relevant maximum temperature rating of the switch.

Compliance is checked/verified on data provided by switch manufacturer.

16.4 Heating test

Unless declared otherwise, the test is carried out on 3 specimens mounted as declared by the manufacturer.

a) *Conductors of an approximate length of 1 m, are fitted to the terminals or leads. The cross-sectional area shall be as declared or specified in Table 4 "medium".*

   NOTE In case of doubt, the cross-sectional area of the conductor is measured to verify that the marked value is the measured value declared or given in Table 4.

b) *Connected conductors when provided are joined to conductors in item a) per the manufacturer's instructions.*

c) *Screw terminals and/or nuts are tightened with a torque equal to two-thirds (2/3) of the appropriate column of Table 10 (see Figures 2 and 6).*

d) *Heating cabinets for testing switches shall be without forced convection or a draught free condition. A cabinet with forced convection may be used, provided the test specimens are not affected by the forced convection.*

e) *The temperature of the air in the heating cabinet is measured as near as possible to the center of the space occupied by the specimens and at a distance not closer than 50 mm to the specimen.*

f) *Switches declared as 7.3.2 or 7.3.3, are placed in a heating cabinet and the temperature is raised to the maximum T-rating of the switch. The temperature of the cabinet is maintained at T ± 5 °C or T ± 5 % (T ± 0,05 T), whichever is greater.*

g) *Partially suitable rated switches declared as 7.3.3, with accessible parts (after the switch is mounted as declared) rated 0 to 55 °C, shall be exposed to a temperature not higher than 55 °C. The internal switch enclosure with a T rating is tested as described for "all parts".*

h) The temperature of mounting surfaces of the test equipment shall be between T and 20 °C.

i) The specimens are subjected to 20 operating cycles with no current flowing. The actuating member is left in the most unfavourable "ON" position. If there are more "ON" positions, then the verification shall be realized at the most unfavourable one. Actuating members of biased switches are fixed in the declared "ON" position.

j) Multi-way switches are loaded as specified in 5.3 resulting in the maximum heating.

k) Switches designed for DC only or AC and DC voltage where no polarity is given, the test performed with DC voltage shall be performed in both polarities and an average value calculated.

l) During the test, the switch state shall not change. Fuses and other protective devices shall not operate. Small unintended variations of the switch state, for example reversible variation of phase angle, are disregarded.

m) Any convenient AC or DC voltage may be used for the test circuit as far as the result is not affected.

n) The load is adjusted to allow the maximum rated current. Resistive loads are used unless declared specifically.

o) If the switch is provided with components generating heat in addition to the heat generated by the contacts, these have to be operated in the most unfavourable mode (e.g. semiconducting devices)

p) The ON period is maintained with the test current until a constant temperature at the terminals is attained. A temperature is considered to be constant when three successive readings taken at intervals of 5 min indicate no change greater than ± 2 °C. For a cycling load, after 1 h, the maximum temperature of the cycle is measured.

q) Thermocouples shall measure the temperature of the surfaces of the switch indicated below. Temperatures shall be determined by means of fine wire thermocouples or other equivalent means, so chosen and positioned that they do have the minimum effect on the temperature of the part under test.

During the test, the temperatures necessary to perform the ball pressure test of 21.1 are to be measured. The non-metallic surfaces likely to attain the highest temperature are measured without disassembling the switch.

17 Endurance

Reference IEC 61058-1-1 for mechanical switch testing.

Reference IEC 61058-1-2 for electronic switch testing.

NOTE Refer to Figure 16.

18 Mechanical strength

18.1 General requirements

Accessible parts shall have adequate mechanical strength to withstand a minimum level of force during normal use.

The specimen may be used for more than 1 test, if cumulative stress as a result of sequential testing is avoided. When a specimen is damaged a new specimen shall be used for the next test.

18.2 Impact

Switches rated equal to or above 0 °C are tested at 25 °C± 10 °C.

Switches rated below 0 °C are cooled to the minimum rated temperature T + 0/-5 °C for 2 h prior to testing.

The impact is delivered using the spring hammer test apparatus of IEC 60068-2-75. The impact is equal to 0,5 Nm ± 0,04 Nm, for foot operated switches the impact is equal to 1,0 Nm ± 0,05 Nm.

One specimen is mounted in the test plate of Figure 11. Remove the mounting device and specimen from the cold cabinet, when required. Immediately apply 3 blows, in a direction perpendicular to the switch.

Compliance is checked by inspection and in case of doubt by Clause 9.

18.3 Pull

18.3.1 Cord-operated switches are submitted to an additional pull test as follows.

The switch is mounted as declared by the manufacturer, and the pull-cord is subjected to a force, applied without jerks, first for 60 s in the normal direction, and then for 60 s in a direction 45° maximum from the normal direction. The minimum values of the pull force shall be as specified in Table 9 or three times the values of the normal operating force if that is greater.

Table 9 – Minimum values of pull force

RATED CURRENT A	Force N	
	Normal direction	**45° from normal direction**
Up to and including 4	50	25
Over 4	100	50

The sample shall not be damaged in a way that reduces the electrical safety.

Compliance is checked by inspection.

18.3.2 Pull (switches other than cord operated switches).

One specimen is used for testing, only parts accessible after mounting are tested. Testing is completed at 25 °C ± 10 C.

A pull force shall be applied for 60 s to try to pull off the actuating member.

The pull to be applied is 15 N, but if the actuating member is intended to be pulled in normal use, the force is increased to 30 N.

The sample shall not be damaged in a way that reduces the electrical safety.

Compliance is checked by inspection.

18.4 Push

A push force of 30 N, using a switch not subjected to the pull force, shall be applied for 60 s to try to push the actuating members in.

The sample shall not be damaged in a way that reduces the electrical safety.

Compliance is checked by inspection.

19 Screws, current-carrying parts and connections

19.1 General requirements for electrical connections

Electrical connections shall be designed so that contact pressure is not transmitted through insulating material other than ceramic, pure mica or other material with characteristics no less suitable, unless there is visual evidence of sufficient resiliency in the metallic parts to compensate for any possible shrinkage or distortion of the insulating material.

The suitability of the material is considered in respect to the stability of the dimensions within the temperature range applicable to the switch.

This requirement is not applicable to connections internal to a switch where the connection is used for lamps for indicating purposes and where the current in this circuit is equal or below 20 mA.

Compliance is checked by inspection.

19.2 Screwed connections

19.2.1 Screwed connections, not tested in Clause 11, electrical or other, shall withstand the mechanical stresses occurring in normal use.

19.2.2 Screws transmitting contact pressure shall be in engagement with a metal thread. Such screws shall not be of metal which is soft or liable to creep, such as zinc or aluminium.

19.2.3 Mechanical connections to be used during installation of switches may be made using thread-forming tapping screws or thread-cutting tapping screws, only if the screws are supplied together with the piece in which they are intended to be inserted. In addition, thread-cutting tapping screws intended to be used during installation shall be captive with the relevant part of the switch..

19.2.4 Thread-forming (metal sheet) screws shall not be used for the connection of current-carrying parts, unless they clamp these parts directly in contact with each other and are provided with a suitable means of locking. Thread-cutting (self-tapping) screws shall not be used for the electrical connection of current-carrying parts, unless they generate a full metric ISO thread or a thread of equivalent effectiveness. Such screws shall not, however, be used if they are likely to be operated by the user or installer, unless the thread is formed by a swaging action.

Compliance is checked by inspection.

For screws and nuts which are likely to be operated while the switches are being mounted and connected, compliance is checked by the following test.

The screws or nuts are tightened and loosened:

– *10 times for screws in engagement with a thread of insulating material;*
– *5 times in all other cases.*

Nuts concentric with the button or lever are tightened and loosened five times. If either thread is of insulating material, the torque is 0,8 Nm. If the threads are of metal, the torque is 1,8 Nm.

Screws and nuts are tightened and loosened by means of a suitable test screwdriver or spanner. The torque applied when tightening being equal to that specified in the appropriate column of Table 10, if not otherwise specified.

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

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

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

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

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

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

Where a screw has a hexagonal head with a slot and the values in columns III and IV are different, the test is made twice, first applying to the hexagonal head the torque specified in column IV, and then, on another set of specimens, applying the torque specified in column III by means of a screwdriver. If the values in columns III and IV are the same, only the test with the screwdriver is made.

During the test, terminals shall not work loose and there shall be no damage, such as breakage of screws or damage to the head slots, threads, washers or stirrups that could impair the further use of the screwed connection.

For mantle terminals, the specified nominal diameter is that of the slotted stud (see Figure 5).

The shape of the blade of the test screwdriver shall suit the head of the screw to be tested. The screws and nuts shall not be tightened in jerks.

NOTE Screws or nuts which are likely to be operated while the switches are being mounted and connected include terminal screws or nuts, screws for fixing covers, etc.

Table 10 – Torque values

Nominal diameter of thread mm		Torque Nm				
Over	**Up to and including**	**I**	**II**	**III**	**IV**	**V**
–	1,6	0,05	–	0,1	0,1	–
1,6	2,0	0,10	–	0,2	0,2	–
2,0	2,8	0,2	–	0,4	0,4	–
2,8	3,0	0,25	–	0,5	0,5	–
3,0	3,2	0,3	–	0,6	0,6	–
3,2	3,6	0,4		0,8	0,8	–
3,6	4,1	0,7	1,2	1,2	1,2	1,2
4,1	4,7	0,8	1,2	1,8	1,8	1,8
4,7	5,3	0,8	1,4	2,0	2,0	2,0
5,3	6	–	1,8	2,5	3,0	3,0
6	8	–	2,5	3,5	6,0	4,0
8	10	–	3,5	4,0	10,0	6,0
10	12	–	4,0	–	–	8,0
12	15	–	5,0	–	–	10,0

19.2.5 Switches having screwed glands are submitted to the following test.

Screwed glands are fitted with a cylindrical metal rod having a diameter equal to the nearest integer value less than the internal diameter of the packing, in millimetres. The glands are then tightened by means of a suitable spanner, the torque specified in Table 11 being applied to the spanner for 60 s.

Table 11 – Torque values for screwed glands

Diameter of the test rod mm		Torque Nm	
Over	**Up to and including**	**Metal glands**	**Glands of insulating material**
–	14	6,25	3,75
14	20	7,5	5,0
20	–	10,0	7,5

After the test neither the glands nor the enclosure of the specimen shall show any damage within the meaning of this standard.

19.2.6 Correct introduction of the screws which are operated during mounting or connection of the switch into the screw holes or nuts shall be ensured.

The requirement of correct introduction is met if introduction of the screw in a slanting manner is prevented, for example, by guiding the screw by the part to be fixed, by a recess in the female thread or by the use of a screw with the leading thread removed.

Compliance is checked by inspection and by manual test.

19.2.7 Screws which make a mechanical connection between different parts of the switch shall be locked against loosening if the connection carries current. Rivets used for current-carrying connections shall be secured against loosening if these connections are subject to torsion in normal use.

Compliance is checked by inspection and by manual test.

Spring washers may provide adequate locking. For rivets, a non-circular shank or an appropriate notch may be sufficient.

Sealing compound which softens in heat provides adequate locking only for screw connections not being subject to torsion in normal use.

19.2.8 Screws and nuts for clamping the conductors shall have a metric ISO standard thread or a thread comparable in pitch and mechanical strength.

Compliance is checked by inspection and by the tests of 19.2.

19.3 Current-carrying parts

Current-carrying parts and parts in an earthing path shall have adequate mechanical strength and resistance to corrosion.

Compliance is checked by inspection, in case of doubt, compliance is checked by the testing of Clause 22.

20 Clearances, creepage distances, solid insulation and coatings of rigid printed board assemblies

20.1 General requirements

Switches shall be constructed so that the clearances, creepage distances, solid insulation and coatings of rigid printed board assemblies are adequate to withstand the electrical, mechanical and thermal stresses taking into account the environmental influences that may occur during the anticipated life of the switch. Creepage distances and clearances are measured as shown in Annex A.

Clearances, creepage distances, solid insulation and coatings of rigid printed board assemblies shall comply with the relevant subclauses 20.2 to 20.6.

NOTE The requirements and tests are based on IEC 60664-1 and IEC 60664-3.

Compliance is checked with detachable parts removed and movable parts which can be assembled in different orientations placed in the most unfavourable position.

Distances through slots or openings in surfaces of insulating material are measured to a metal foil in contact with the surface. The foil is pushed into comers and the like by means of the jointed test finger of IEC 61032 Probe B (IEC 60529:1989, Figure 1), but is not pressed into openings.

A force is applied to bare conductors and accessible surfaces in order to attempt to reduce clearances and creepage when making the measurement.

The force is:

- *2 N for bare conductors;*
- *30 N for accessible surfaces.*

The force is applied by means of a straight unjointed test finger Probe 11 of IEC 61032 the same dimensions as the jointed test finger Probe B of IEC 61032 (Figure 1 of IEC 60529:1989).

When applied to openings as specified in 9.1, the distance through insulation between live parts and the metal foil shall not be reduced below the values specified.

NOTE 1 Movable parts are for example hexagonal nuts, the position of which cannot be controlled throughout an assembly.

NOTE 2 A flow chart for the dimensioning of clearances is given in Annex B.

NOTE 3 A creepage distance cannot be less than the associated clearance.

20.2 Clearances

20.2.1 General

The clearances shall be dimensioned to withstand the rated impulse voltage declared by the manufacturer according to 7.12 considering the rated voltage and the overvoltage category as given in Annex E and the applicable pollution degree declared by the manufacturer according to 7.8 and 7.9.

20.2.2 Clearances for basic insulation

The clearances for basic insulation shall not be less than the values given in Table 12.

However, smaller clearances, except those values marked in Table 12 with note 5, may be used if the switch meets the impulse withstand voltage test of Annex G but only if the parts are rigid or located by mouldings, or if the construction is such that there is no likelihood of the distances being reduced by distortion, or by movement of the parts during mounting, connection and normal use.

Compliance is checked by measurement and, if necessary, by the test of Annex G. For production where Annex G was used to show compliance, routine testing shall be conducted in accordance with Annex K.

20.2.3 Clearances for functional insulation

The clearances for functional insulation shall not be less than the values specified for basic insulation in 20.2.2.

Compliance is checked by measurement and, if necessary, by the requirements of Annex G. For production where Annex G was used to show compliance, routine testing shall be conducted in accordance with Annex K.

20.2.4 Clearances for supplementary insulation

The clearances for supplementary insulation shall not be less than the values given in Table 12.

Compliance is checked by measurement.

Table 12 – Minimum clearances for basic insulation

Rated impulse withstand voltage[2]	Minimum clearances in air in millimetres up to 2 000 m above sea-level[1) 7) 3)]		
kV	Pollution degree 1	Pollution degree 2	Pollution degree 3
0,33	0,01	0,2[4) 5)]	0,8[5)]
0,50	0,04	0,2[4) 5)]	0,8[5)]
0,80	0,10	0,2[4) 5)]	0,8[5)]
1,5	0,5	0,5	0,8[5)]
2,5	1,5	1,5	1,5
4,0	3	3	3
6[6)]	5,5	5,5	5,5

1) Clearances for altitudes above 2 000 m sea-level shall be multiplied by the altitude correction factor specified in Annex H.

2) This voltage is:
- for functional insulation: the maximum impulse voltage expected to occur across the clearance;
- for basic insulation directly exposed to or significantly influenced by transient overvoltage from the low-voltage mains: the rated impulse withstand voltage of the switch
- for other basic insulation: the highest impulse voltage that can occur in the circuit.

3) Details for pollution degree are given in Annex F.

4) For printed wiring material, the values for pollution degree 1 apply, except that the value shall not be less than 0,04 mm.

5) Minimum clearance values based on experience rather than on fundamental data.

6) This voltage is only applicable when determining reinforced insulation for a impulse withstand voltage of 4,0 kV.

7) The values for clearances on rigid printed boards do not apply under the provision that the requirements of Clause 23 are fulfilled and that the overcurrent protection provides full disconnection.

NOTE The values given in Table 12 are equal to IEC 60664-1 and are not increased because only minimal reduction of clearances, for example, due to mechanical abrasion during the lifetime of the switch, is expected and because of the, in general, small overall dimension of switches for appliances.

20.2.5 Clearances for reinforced insulation

The clearances for reinforced insulation shall be not less than the values specified for basic insulation in 20.2.2 but using the next higher step for the rated impulse withstand voltage in Table 12. Smaller clearances than those specified in Table 12 are not allowed.

Compliance is checked by measurement.

20.3 Clearances for disconnection

20.3.1 Electronic disconnection

No clearances are specified for electronic disconnection.

20.3.2 Micro-disconnection

Clearances between terminals and terminations shall fulfil the requirement for functional insulation according to 20.2.3.

No clearances are specified for the distance across the contacts.

For switches with a rated impulse withstand voltage less than 1,5 kV, clearances between other current-carrying parts which are separated by the action of the switch shall be equal to or greater than the actual value of the distance between the relevant contacts. Switches with a rated impulse withstand voltage of 1,5 kV the clearance of the other current carrying parts which are separated by action of the switch shall be at least 0,5 mm.

NOTE The values for clearances on rigid printed boards do not apply under the provision that the requirements of Clause 23 are fulfilled and that the overcurrent protection provides full disconnection.

20.3.3 Full disconnection

The clearances for full disconnection shall not be less than the values for basic insulation specified in 20.2.2, except that smaller values than those given in Table 12 are not allowed.

In switches where clearances in any one pole between parts separated by the action of the switch is provided by two or more breaks in series, the separation is considered to be the sum of the distances of the breaks. Each break shall be not less than one-third of the prescribed distance.

20.4 Creepage distances

20.4.1 General

The creepage distances shall be dimensioned for the voltage which is expected to occur in normal use taking into account the pollution degree as declared by the manufacturer according to 7.8 and 7.9 and the material group.

The relationship between material group and Proof Tracking Index (PTI) values is as follows:

Material group I	*600 ≤ PTI*
Material group II	*400 ≤ PTI < 600*
Material group IIIa	*175 ≤ PTI < 400*
Material group IIIb	*100 ≤ PTI < 175*

These PTI values are obtained in accordance with the proof tracking test of Annex C.

NOTE 1 Attention is drawn to the fact that certain IEC 60335-2 parts require a minimum PTI or CTI value of 250.

NOTE 2 For glass, ceramics and other inorganic materials which do not track, creepage distances need not be greater than their associated CLEARANCE.

CTI (Comparative tracking index) may be substituted for PTI in Clause 20. If a CTI of 175 or greater is needed, and the data is not available, the material group can be established with a test for proof tracking index (PTI) as detailed in IEC 60112.

20.4.2 Creepage distances for basic insulation

The creepage distances for basic insulation shall not be less than the values given in Table 13

Compliance is checked by measurement.

Table 13 – Minimum creepage distances for basic insulation

Rated voltage r.m.s. [a] V	Creepage distance in millimetres [b]						
	Pollution degree 1	Pollution degree 2			Pollution degree 3		
		Material group			Material group		
		I	II	IIIa/IIIb	I	II	IIIa/IIIb
50[c]	0,2	0,6	0,9	1,2	1,5	1,7	1,9
125	0,3	0,8	1,1	1,5	1,9	2,1	2,4
250	0,6	1,3	1,8	2,5	3,2	3,6	4,0
320	0,75	1,6	2,2	3,2	4	4,5	5
400	1,0	2,0	2,8	4,0	5,0	5,6	6,3
500	1,3	2,5	3,6	5,0	6,3	7,1	8,0

[a] This voltage is the voltage rationalized through Table 3a and Table 3b of IEC 60664-1 based on the rated voltage.

[b] Details for pollution degrees are given in Annex F.

[c] Concerning SELV, the last paragraph of 9.1 should be considered.

20.4.3 Creepage distances for functional insulation

The creepage distances for functional insulation shall not be less than the values given in Table 14.

Compliance is checked by measurement.

Table 14 – Minimum creepage distances for functional insulation

Working voltage r.m.s. 1)	Printed board assemblies		Pollution degree 2) 6)						
	Pollution degree								
	1 3)	2 4)	1 3)	2			3		
				Material group			Material group		
				I	II	III 5)	I	II	III 5)
V	mm	mm	mm	mm	mm	mm	mm	mm	mm
10	0,025	0,04	0,08	0,4	0,4	0,4	0,95	0,95	0,95
12,5	0,025	0,04	0,09	0,42	0,42	0,42	1,0	1,0	1,0
16	0,025	0,04	0,1	0,45	0,45	0,45	1,05	1,05	1,05
20	0,025	0,04	0,11	0,48	0,48	0,48	1,1	1,1	1,1
25	0,025	0,04	0,125	0,5	0,5	0,5	1,2	1,2	1,2
32	0,025	0,04	0,14	0,53	0,53	0,53	1,25	1,25	1,25
40	0,025	0,04	0,16	0,56	0,8	1,1	1,3	1,3	1,3
50	0,025	0,04	0,18	0,6	0,85	1,2	1,4	1,6	1,8
63	0,04	0,063	0,2	0,63	0,9	1,25	1,5	1,7	1,9
80	0,063	0,1	0,22	0,67	0,95	1,3	1,6	1,8	2,0
100	0,1	0,16	0,25	0,74	1	1,4	1,7	1,9	2,1
125	0,16	0,25	0,28	0,75	1,05	1,5	1,8	2,0	2,2
160	0,25	0,4	0,32	0,8	1,1	1,6	1,9	2,1	2,4
200	0,4	0,63	0,42	1	1,4	2	2,0	2,2	2,5
250	0,56	1	0,56	1,25	1,8	2,5	2,5	2,8	3,2
320	0,75	1,6	0,75	1,6	2,2	3,2	3,2	3,6	4,0
400	1	2	1	2	2,8	4	4,0	4,5	5,0
500	1,3	2,5	1,3	2,5	3,6	5	5,0	5,6	6,3
630	1,8	3,2	1,8	3,2	4,5	6,3	6,3	7,1	8
800	2,4	4	2,4	4	5,6	8	8	9	10
1 000	3,2	5	3,2	5	7,1	10	10	11	12,5

1) Interpolation for intermediate values is allowed.

2) Details for pollution degrees are given in annex F.

3) Material groups I, II, IIIa and IIIb.

4) Material group I, II, IIIa.

5) Material groups III includes IIIa, and IIIb.

6) The values for creepage distances on rigid printed boards do not apply under the provision that the requirements of Clause 23 are fulfilled and that the overcurrent protection provides full disconnection.

20.4.4 Creepage distances for supplementary insulation

The creepage distances for supplementary insulation shall not be less than the values specified for basic insulation in 20.4.2.

Compliance is checked by measurement.

20.4.5 Creepage distances for reinforced insulation

The creepage distances for reinforced insulation shall not be less than double the values specified for basic insulation in 20.4.2.

Compliance is checked by measurement.

20.4.6 Creepage distances for disconnection

The creepage distances for disconnection shall not be less than the values specified for functional insulation in 20.4.3.

Compliance is checked by measurement.

NOTE 1 For conductive pollution, see Annex F, last paragraph.

NOTE 2 The values for creepage distances on rigid PRINTED BOARDS do not apply under the provision that the requirements of Clause 23 are fulfilled and that the overcurrent protection provides full disconnection

20.5 Solid insulation

Solid insulation shall be capable of durably withstanding electrical and mechanical stresses as well as thermal and environmental influences which may occur during the anticipated life of the switch.

Compliance is checked during the tests of Clauses 14, 15, 16 and 17 in IEC 61058-1-1:2016 or IEC 61058-1-2:2016.

The distance through accessible supplementary solid insulation shall have a minimum value of 0,8 mm.

The distances through accessible reinforced solid insulation shall have the following minimum values:

– for rated impulse withstand voltage equal to or less 1 500 V: 0,8 mm;
– for rated impulse withstand voltage equal to or larger 2 500 V: 1,5 mm.

NOTE 1 The values take into consideration the possibility of cracks as a single fault occurring in the solid insulation. The values corresponding to basic insulation are taken from Table 12, considering pollution degree 3.

NOTE 2 No minimum thickness is specified for functional, basic, inaccessible supplementary and inaccessible reinforced insulation.

Compliance is checked by inspection and by measurement.

NOTE 3 An abrasion test for accessible insulation is under consideration.

20.6 Coatings of rigid printed board assemblies

20.6.1 General

Coatings of rigid printed board assemblies shall provide protection against pollution and/or insulation depending on the type 1 or type 2 coating used.

NOTE Explanations for type 1 and type 2 coating are given in Annex I.

20.6.2 Type 1 coating

The insulation distances of a rigid printed board assembly with type 1 coating, as declared by the manufacturer, shall comply with the highest value for pollution degree 1 of the clearances given in Table 12 and of the creepage distances given in Table 14. Details for the measuring of the insulation DISTANCE of a coated printed board are given in Annex J.

Compliance is checked by measurement and for the type 1 coating by the relevant tests of Clause 6 of IEC 60664-3:2003 with the test levels or conditions as given in Table 15.

Test specimens can be

– standard test specimens as specified in 5.1 and 5.2 of IEC 60664-3:2003, or
– any representative rigid printed board assemblies as specified in 5.3 of IEC 60664-3:2003

Table 15 – Test levels and conditions

IEC 60664-3:2003 subclause	Test levels and conditions
6.6.1 Cold storage	–25 °C
6.6.3 Rapid change of temperature	Degree of severity 2 (–25 °C to 125 °C)
6.7 Electromigration	Not applicable
6.8.6 Partial discharge	Not applicable

20.6.3 Type 2 coating

A rigid printed board assembly with type 2 coating as declared by the manufacturer shall comply with the requirements for solid insulation as specified in 20.5. No clearances and creepage distances are specified between conductors on printed boards under the coating.

Compliance for the type 2 coating is checked by the relevant test of Clause 6 of IEC 60664-3:2003 with the test levels or conditions as given in Table 15 and the test specimens as specified in 20.6.2.

21 Fire hazard

21.1 Resistance to heat

21.1.1 Parts of non-metallic material shall be resistant to heat.

This requirement applies to the following:

– Actuators integral with the actuating means.
– Critical parts when deteriorated by heat, will result in a reduction of the declared degree of protection against electrical shock.

The resistant to heat requirement does not apply to the following:

– small parts (when not critical),
– decorative trims, and
– actuators which are not integral with the actuating means

NOTE The definition for small parts is given in IEC 60695-4.

21.1.2 *Compliance is checked with new samples using the ball pressure test according to IEC 60695-10-2 at the temperatures using either the (A) heating test results or (B) calculated temperatures.*

The heating test results method can be used only when stable steady state temperatures can be achieved. Switches that do not achieve a stable steady state temperature shall use the calculated temperature method.

21.1.3 Heating test results A

a) *The test temperature is 20 °C ± 2° C plus the value of the maximum temperature measured during the heating test of Clause 16 or as declared, or at 75 °C ± 2 °C whichever is the highest:*

   1) *for parts which are accessible when the switch is mounted as declared, and the deterioration of which may result in the switch becoming unsafe (e.g. reduction in the declared degree of protection, or reduction of creepage and clearances below those values required according to Clause 20).*

b) *The test temperature is T plus 20° C ± 2 °C with a minimum value of 125 °C or the maximum temperature recorded during the heating test of Clause 16 if this would lead to a higher temperature:*

   1) *for parts which are in contact with, maintain or retain in position electrical connections including those parts which maintain an electrical connection under spring force, for example a connection within the switch maintained in position by a spring in association with a non-metallic part, the deterioration of which could cause overheating;*

   2) *for parts which are in contact with or support heat-sources (for example, heat sinks); where "T" is the rated maximum temperature of the switch.*

21.1.4 Calculated temperatures B

a) *T or 75 °C whichever is the highest.*

   1) *for parts which are accessible when the switch is mounted as declared, and the deterioration of which may result in the switch becoming unsafe (e.g. reduction in the declared degree of protection, or reduction of creepage and clearances below those values required according to Clause 20).*

b) *T + 70 °C or 125 °C whichever is the highest.*

   1) *for parts which are in contact with, maintain or retain in position electrical connections including those parts which maintain an electrical connection under spring force, for example a connection within the switch maintained in position by a spring in association with a non-metallic part, the deterioration of which could cause overheating;*

   2) *for parts which are in contact with or support heat-sources (for example, heat sinks); where "T" is the rated maximum temperature of the switch.*

Insulation external to the switch (such as non-detachable conductors) shall be minimum the T value of the switch.

Coil windings shall be minimum the T value of the switch.

The switch conductive materials are evaluated during testing according to Clause 17.

21.2 Resistance to abnormal heat

Parts of non-metallic material shall be resistant to abnormal heat.

This resistance to abnormal heat requirement does not apply to the following:

– small parts where no reduction of the declared degree of protection against electric shock will result from deterioration by abnormal heat;

– decorative trims;

– actuators which are not integral with the actuating means.

NOTE The definition for small parts is given in IEC 60695-4 .

In cases where it is neither practical nor possible to carry out the tests on a complete switch, e.g. when the switch is of an inconvenient shape, then the test is carried out using a specimen of the material from which the relevant part is manufactured. The size of the specimen shall be a minimum of 25 mm × 25 mm and having a thickness equal to the minimum thickness as measured for the relevant part.

Compliance is checked with one new sample using the glow wire test of IEC 60695-2-11 at the declared glow wire temperature:

a) the declared glow wire temperature for parts which are in contact with, maintain or retain in position electrical connections including those parts which maintain an electrical connection under spring force, for example a connection within the switch maintained in position by a spring in association with a non-metallic part, the deterioration of which could cause overheating at the declared glow wire temperature;

b) 650 °C for all other parts.

The test specimen is considered to have passed the glow-wire test if flames or glowing of the test specimen extinguish within 30 s after removal of the glow wire and there is no ignition of the layer of wrapping tissue.

If there is no flame or ignition, this shall be reported.

22 Resistance to rusting

Ferrous parts, the rusting of which might impair safety, 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 an appropriate cleaning 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 25 °C ± 10 °C.

Without drying, but after shaking off any drops, the parts are placed for 10 min in a box containing air saturated at a temperature of 25 °C ± 10 °C with a relative humidity above 91 %. After the parts have been dried for 10 min in a heating cabinet at a temperature of 100 °C ± 5 °C, their surfaces shall show no signs of rust.

Traces of rust on sharp edges and any yellowish film removable by rubbing are ignored. For small helical springs and the like, and for inaccessible parts exposed to abrasion, a layer of grease may provide sufficient protection against rusting. Such parts are only subjected to the test if there is doubt about the effectiveness of the grease film, and the test is then made without previous removal of the grease.

23 Abnormal operation and fault conditions for switches

Reference IEC 61058-1-1 for mechanical switch testing.

Reference IEC 61058-1-2 for electronic switch testing.

24 Components for switches

24.1 General requirements

Components which, if they fail, may cause risk of electric shock or fire (for example, SELV transformers, protective impedances, fuses, capacitors which may cause a shock hazard, and capacitors for electromagnetic interference suppression) shall comply either with the requirements of this standard or with the relevant IEC component standard as far as they reasonably apply.

If components are marked with their operating characteristics, the conditions under which they are used in the switch shall be in accordance with these markings, unless a specific exception is made in this standard.

The testing of components which have to comply with other standards is, in general, carried out separately, according to the relevant standard as follows.

If the component is marked and used in accordance with its marking, the number of samples is that required by the relevant standard.

Where no IEC standard exists or when the component has not been tested in accordance with a relevant IEC standard, or is used not in accordance with its specified ratings, the component is tested under the conditions occurring in the switch.

Components incorporated in the switch are subjected to all the tests of this standard as a component of the switch.

NOTE Compliance with the IEC standard for the relevant component does not necessarily ensure compliance with the requirements of this standard.

24.2 Protective devices

24.2.1 General

Protective devices shall be in accordance with the relevant IEC publications and/or the additional requirements specified in the following subclauses:

– 24.2.2 fuses;

– 24.2.3 cut-outs;

– 24.2.7 protective devices which only decrease the current;

– 24.2.8 fusing resistors.

24.2.2 Fuses

Fuses, if any, shall comply with IEC 60127 or IEC 60269-3 and have a rated breaking capacity of at least 1 500 A unless any fault current through the fuse is limited to the breaking capacity of the fuse.

24.2.3 Cut-outs

Cut-outs shall have adequate making and breaking capacity, be selected for the appropriate number of operations and be in compliance with the requirements and test specifications in the following subclauses:

– 24.2.4 non-resettable cut-outs;

– 24.2.5 resettable, non-self-resetting cut-outs;

– 24.2.6 self-resetting cut-outs.

Compliance is checked by subjecting three specimens to the tests according to the following general test specification and the additional tests specified for the relevant type.

If the cut-out in the switch is subjected to a reference temperature outside the range 0 °C to 35 °C or 55 °C (according to 7.3.2 or 7.3.3), the samples are tested at this reference temperature.

During the test, the other conditions shall be similar to those occurring in the switch.

During the test, no sustained arcing shall occur.

After the test, the specimens shall show no damage impairing their further use or the safety of the switch.

The switching frequency of the cut-out may be increased above the normal switching frequency inherent to the switch, provided that no greater risk of failure of the cut-out is induced.

If it is not possible to test the cut-out separately, it will be necessary to submit additional specimens of the switch in which the cut-out is used.

24.2.4 Non-resettable cut-outs

Non-resettable cut-outs shall be thermal links in accordance with IEC 60691 or bi-metallic single operation devices (SOD) according to IEC 60730-2-9.

Compliance is checked by the tests according to 24.2.3.

After the test, the supply shall be cut out and the temperature shall neither exceed the maximum temperatures specified by the manufacturer for abnormal conditions.

24.2.5 Resettable, non-self-resetting cut-outs

Resettable, non-self-resetting cut-outs shall be in accordance with IEC 60730-1 and appropriate parts of IEC 60730-2.

Compliance is checked by the tests according to 24.2.3 and the following additional tests.

Resettable, non-self-resetting cut-outs in the load circuit of the switch are tested at 1,1 times the rated voltage of the switch and with loads as specified below.

The cut-outs are reset after each operation and thus caused to operate 10 times successively.

Cut-outs in switches for incandescent lamps are tested in a non-inductive circuit and are loaded with the conventional fusing current of the protecting fuse;

Cut-outs in switches for speed control circuits are subjected to two series of 10 operations.

In the first series, the cut-out under test closes a circuit through which a current of 9 In (cos φ = 0,8 ± 0,05) passes, this current being interrupted by means of an auxiliary switch 50 ms to 100 ms after each closure.

In the second series, the circuit through which a current of 6 In (cos φ = 0,6 ± 0,05) passes is closed by an auxiliary switch and opened by the cut-out under test.

Cut-outs for other types of load are tested with the opening and closing current declared by the manufacturer.

NOTE 1 The values 6 I_n and 9 I_n are provisional.

NOTE2 "I_n" is the rated current of the switch. If the switch has a rated load instead of a rated current, I_n is calculated under the assumption that cos φ of the motor load is 0,6.

24.2.6 Self-resetting cut-outs

Self-resetting cut-outs shall be in compliance with IEC 60730 series.

Compliance is checked by the tests according to 24.2.3 and the following additional tests.

Self-resetting cut-outs in the load circuit of the switch are tested at 1,1 times the rated voltage of the switch and with loads as specified below:

Cut-outs in switches for incandescent lamps are operated automatically for 200 cycles in a non-inductive circuit and are loaded with the relevant conventional fusing current of the protecting fuse.

NOTE Cut-outs in switches for other types of load are tested as declared by the manufacturer.

24.2.7 Protective devices which only decrease the current (for example PTC resistors)

Protective devices which only decrease the current shall be of a thermistor type according to Annex J in IEC 60730-1:2013 or PTC-S thermistors according to IEC 60738-1.

Compliance is checked by the tests according to 24.2.3 and the following additional tests.

For PTC-S thermistors, the power dissipation of which exceeds 15 W for the rated zero-power resistance at an ambient temperature of 25 °C, the encapsulation or tubing shall comply with the flammability category V-1 or better according to IEC 60695-11-10 and IEC 60695-11-20.

Compliance with the flammability criteria is checked according to IEC 60695-11-10 and IEC 60695-11-20.

24.2.8 Fusing resistors

Fusing resistors shall have adequate breaking capacity and shall not cause emission of flames or burning particles during rupture under fault conditions.

In case of doubt, the test is repeated on a new sample of the same resistor. If again the resistor interrupts in the same way it is accepted as a fusing resistor for protection against the relevant fault condition.

24.3 Capacitors

Capacitors

– which may cause a shock or fire hazard or
– which have a current > 0,5 A through their terminals

shall comply with the requirements of IEC 60384-14.

When determining the current through the terminals of the capacitor a user replaceable fuses shall be short-circuited. For other protective devices, the resistive element is to be replaced by an equivalent impedance, such as 2 Ω or equivalent.

The capacitor class shall comply with Table 16 or as declared (7.23). The voltage rating of the capacitor shall be at least equal to the rating of the switch.

Table 16 – Minimum requirements for capacitors

Application of capacitors			Types of capacitors (according to IEC 60384-14)		
			$U_n \leq 130V$	$130\ V < U_n \leq 480\ V$	
				Without overcurrent protection[1)]	With overcurrent protection[1)]
Between live conductor (L or N) and earth (PE)			Y4	Y2	Y2
Between live conductors (L and N or L1 and L2)					
	- without impedance in series		X2	X2	X2
	- with impedance in series which, by short-circuiting of the capacitor, limits the current to a value				
		• of 0,5 A and higher	X3	X2	X3
		• below 0,5 A	No special requirement	No special requirement	No special requirement
1) Fusing resistor (built-in or external).					

24.4 Resistors

Resistors for protective impedances according to 9.1.1 and resistors the short-circuiting or disconnecting of which would cause an infringement of the requirements for operation under fault conditions (see Clause 23) shall have an adequately stable resistance value under overload and shall comply with the requirements of 14.1 of IEC 60065:2014.

25 EMC requirements

25.1 General

Mechanical switches without electronic circuits are considered not to be affected by electromagnetic disturbances and therefore, no immunity tests are necessary.

Mechanical switches without electronic circuits are considered not to generate continuous electromagnetic disturbances and therefore no emissions tests are necessary.

Incorporated switches for appliances are not subjected to the tests of this Clause 25, as the result of these tests can be affected by the incorporation of the switch in the appliance.

Tests in Clause 25 may however, be carried out on such switches if requested by the manufacturer.

Electronic switches for appliances shall fulfil the requirements for immunity and emission when used in accordance with the manufacturer's specification.

Electronic switches intended to be built in or incorporated in an appliance when applicable comply with the requirements for immunity and emission as evaluated in the end product.

Compliance is checked with the electronic switch incorporated or integrated in the appliance.

25.2 Immunity

25.2.1 General

Electronic switches shall be designed so that the switch state (on or off) and/or setting value is protected against electromagnetic interference.

For the following tests the electronic switch is mounted as in normal use and is loaded as specified in Clause 17 so that at the rated voltage the rated load will be obtained.

Each electronic switch is tested, if applicable, in the following states:

– in the ON state, highest setting;
– in the ON state, lowest setting;
– in the OFF state, highest setting;
– in the OFF state, lowest setting.

25.2.2 Voltage dips and short interruptions

The electronic switch shall be tested as described in 25.2.1 in accordance with Table 17 using the test equipment specified in IEC 61000-4-11 with a sequence of three dips/interruptions with intervals of 10 s minimum (between each test event).

Abrupt changes in supply voltage shall occur at zero crossings.

The change between the test voltage U_T and the changed voltage is abrupt.

Note 100 % U_T is equal to the rated voltage.

A test level of 0 % corresponds to a total supply voltage interruption.

During the test, the electronic switch state and/or setting may alter.

Occasional flickering of luminaires and irregular running of motors during the test are neglected.

After the test, the electronic switch shall be in the original state and the setting shall be unchanged.

Table 17 – Test levels and duration for voltage dips and short interruptions

Test level % U_T	Voltage dip/interruptions % U_T	Duration number of cycles at rated frequency Cycles
0	100	10
40	60	10
70	30	10

25.2.3 Surge immunity test

The tests are carried out according to IEC 61000-4-5 with an open-circuit test voltage of 1 kV (level 2).

During the tests, the switch state and/or setting shall not alter.

Occasional flickering of luminaires and irregular running of motors during the test are neglected.

After the tests the electronic switch shall be in the original state and the setting shall be unchanged.

25.2.4 Electrical fast transient test

The electronic switch shall be subjected to repetitive fast transients (bursts) on supply and control terminals/terminations.

The test is carried out according to IEC 61000-4-4 with the following specification.

The level of the repetitive fast transients consisting of bursts coupled into supply and control terminals/terminations of the electronic switch is in accordance with Table 18.

Both polarities of the test voltage are mandatory.

The duration of the test shall be not less than 1 min.

During the test, the electronic switch state and/or setting may alter.

Occasional flickering of luminaires and irregular running of motors during the test are neglected.

After the test, the switch shall remain in its original state.

Table 18 – Fast transient bursts

Open circuit output test voltage ±10 %	
Supply terminals/terminations	**Control terminals/terminations**
1 kV (level 2)	0,5 kV (level 2)

25.2.5 Electrostatic discharge test

The electronic switch mounted as in normal use shall withstand electrostatic contact and air discharges.

The test is carried out according to IEC 61000-4-2 by applying one positive and one negative discharge, of both types (air/contact), if necessary, to each of the 10 preselected points designated by the manufacturer.

The following levels apply:

– test voltage of contact discharge: 4 kV;
– test voltage of air discharge: 8 kV.

During the test, the switch state and/or setting may alter.

Occasional flickering of luminaires and irregular running of motors during the test are neglected.

After the test, the electronic switch shall remain in its original state.

Electronic switches (for example, passive infrared switches – "PIR switches") with adjustable time delay devices should be adjusted in such a way that the delay time is higher than the testing time.

NOTE Measured values within the test limits are acceptable for the results until the situation on uncertainty measurements has been clarified.

25.2.6 Radiated electromagnetic field test

The electronic switch subjected to electromagnetic fields such as those generated by portable radio transceivers or any other device that will generate continuous wave radiated electromagnetic energy shall be tested as follows.

The test is carried out according to IEC 61000-4-3, applying a field strength of 3 V/m.

After the test, the electronic switch shall be in the original state and the setting shall be unchanged.

During the test, the electronic switch state and/or setting may alter; other changes are not acceptable.

Occasional flickering of luminaires and irregular running of motors during the test are neglected.

25.2.7 Power-frequency magnetic field test

This test is applicable only to electronic switches containing devices susceptible to magnetic fields, for example, Hall elements, electro dynamic microphones, etc.

Electronic switches shall withstand the power frequency magnetic field test.

The test is carried out according to IEC 61000-4-8 by applying a magnetic field of 3 A/m, 50 Hz.

During the test, the state of the electronic switch shall not change.

Occasional flickering of lamps or irregular running of motors during the test is not allowed.

25.3 Emission

25.3.1 Low-frequency emission

Electronic switches intended to be connected to the public low-voltage supply systems shall be so designed that they do not cause excessive disturbances in this network.

Compliance is checked by carrying out tests according to IEC 61000-3-2 and IEC 61000-3-3 or IEC TS 61000-3-5.

The requirements of IEC 61000-3-2 and IEC 61000-3-3 or IEC TS 61000-3-5 apply, except that for harmonics of order 11 and above, an overview of the spectrum is taken.

If this overview shows an envelope of the spectrum with a monotonal decrease according to the increasing order of harmonics, measurements can be restricted to harmonics up to order 11.

25.3.2 Radio-frequency emission

Electronic cord switches and independently mounted switches shall be so designed that they do not cause excessive radio interference.

The electronic switch shall comply with the requirements of CISPR 14-1 or CISPR 15. For electronic switches used for electrical lighting application, CISPR 15 applies.

Subclauses 8.1.4.1 and 8.1.4.2 of CISPR 15:2013 are applicable with the following modifications.

Compliance is checked as follows:

a) *At the main terminals (8.1.4.1 of CISPR 15:2013).*

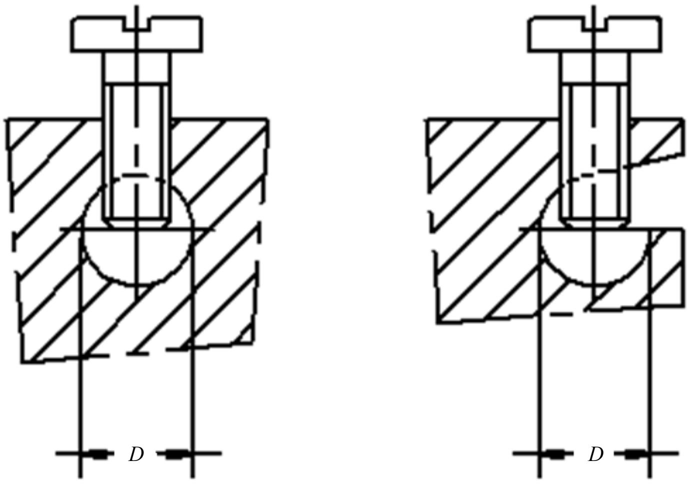
   An initial survey or scan of the complete frequency range 9 kHz to 30 MHz shall be made in on-state at the highest setting. In addition, the following frequencies and at all frequencies at which there is a local maximum disturbances above the predetermined level of 6 dB below the limits given in CISPR 15, the control setting shall be varied for maximum disturbance while connected to the maximum load:

   9 kHz, 50 kHz, 100 kHz, 150 kHz, 240 kHz, 550 kHz, 1 MHz, 1,4 MHz, 2 MHz, 3,5 MHz, 6 MHz, 10 MHz, 22 MHz and 30 MHz.

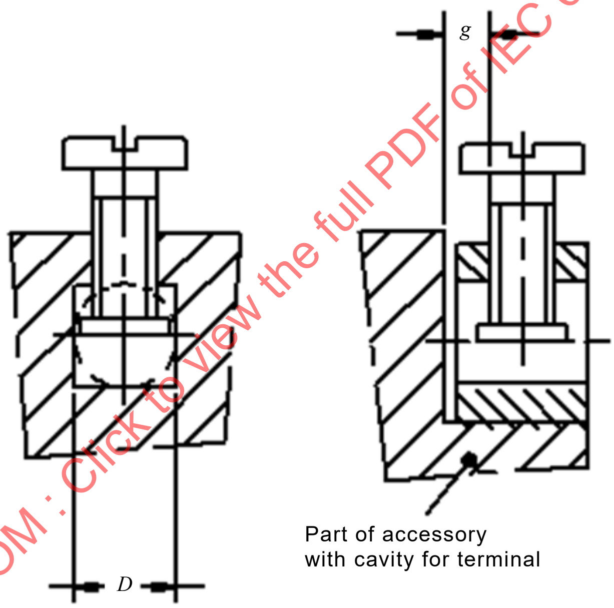
b) *At the load and/or control terminals (8.1.4.2 of CISPR 15:2013).*

   An initial survey or scan of the complete frequency range 150 kHz to 30 MHz shall be made in on-state at the highest setting. In addition, the following frequencies and at all frequencies at which there is a local maximum disturbances above the predetermined level of 6 dB below the limits given in CISPR 15, the control setting shall be varied for maximum disturbance while connected to the maximum load:

   150 kHz, 240 kHz, 550 kHz, 1 MHz, 1,4 MHz, 2 MHz, 3,5 MHz, 6 MHz, 10 MHz, 22 MHz and 30 MHz.



Terminals without pressure plates



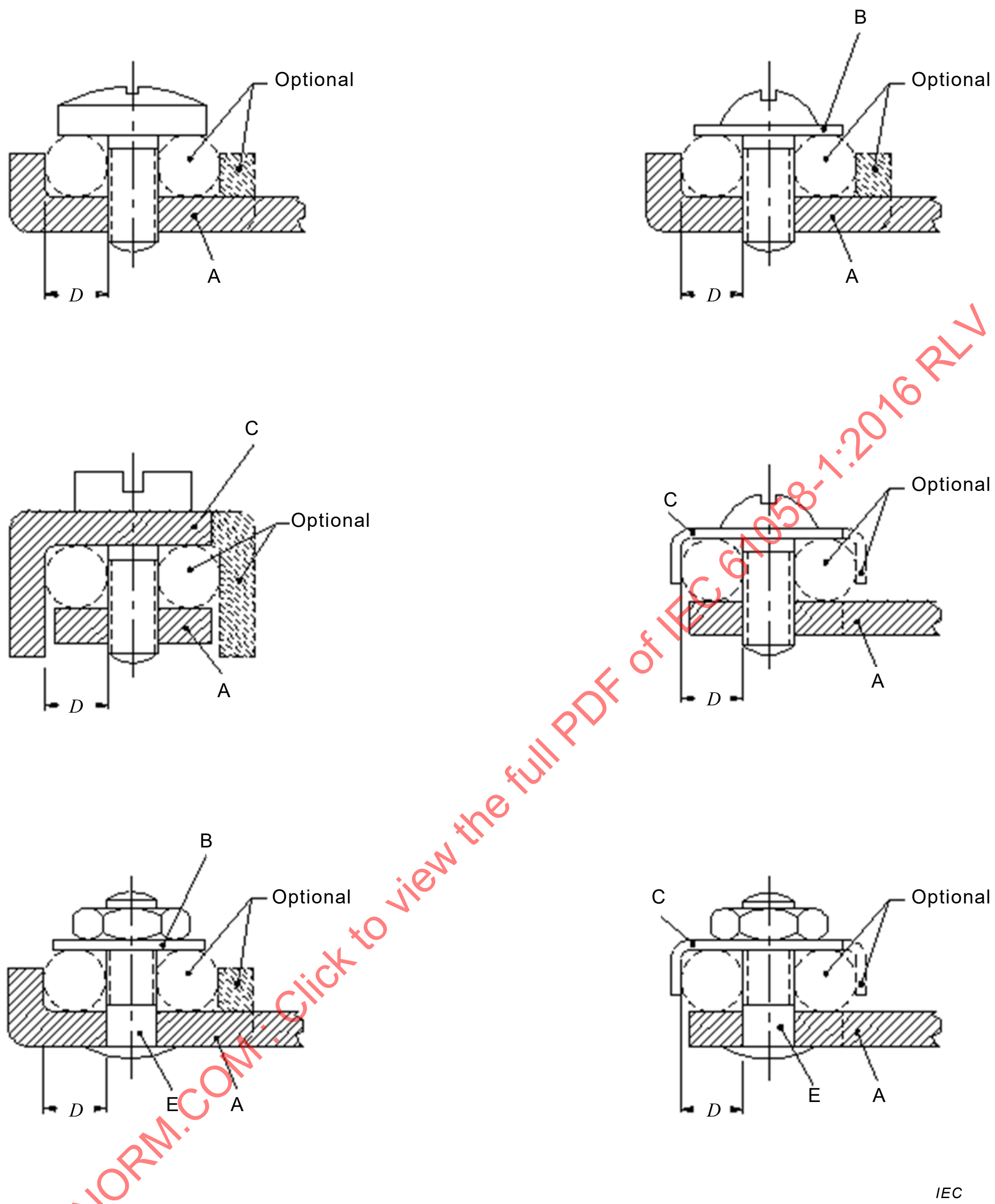
Terminals with pressure plates

Key

D conductor space (not specified)

g distance between clamping screw and end-stop (not specified)

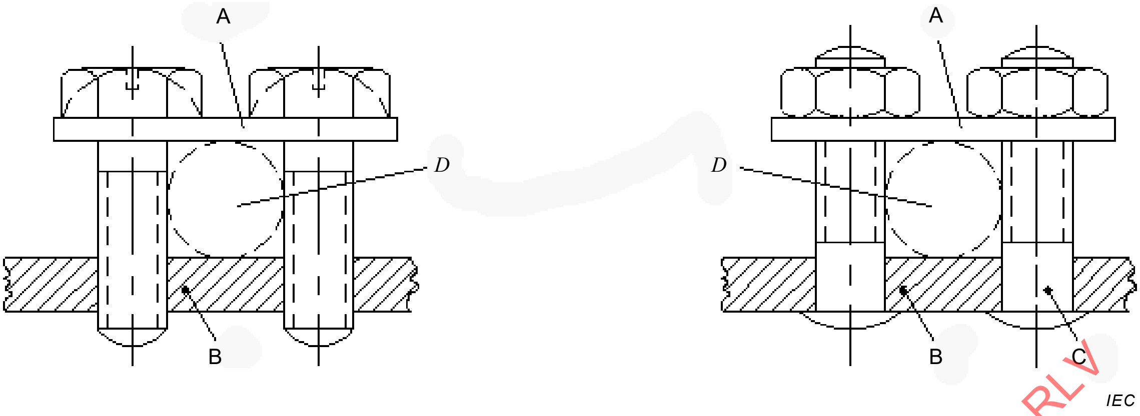
Figure 1 – Examples of pillar terminals



Key

A	fixed part	*D*	conductor space (not specified)
B	washer or clamping plate	E	stud
C	anti-spred device		

Figure 2 – Examples of screw terminals and stud terminals



Key

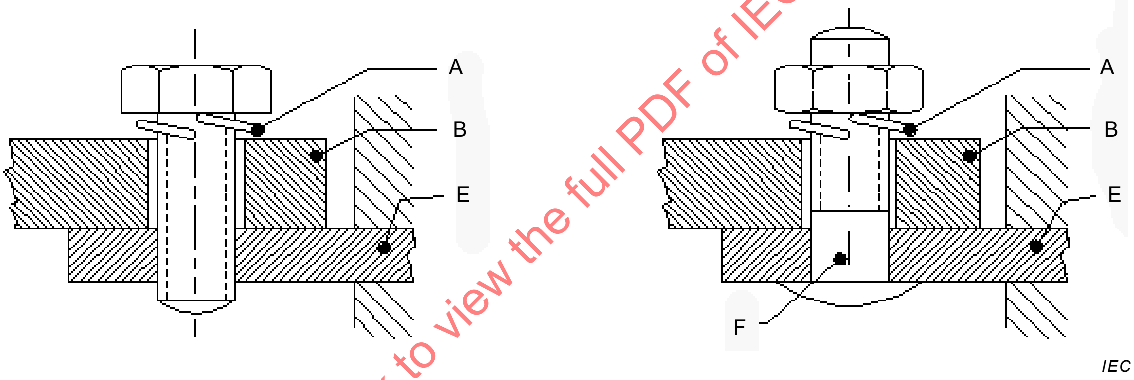
A saddle

B cable lug or bar

C stud

D conductor space (not specified)

Figure 3 – Examples of saddle terminals



Key

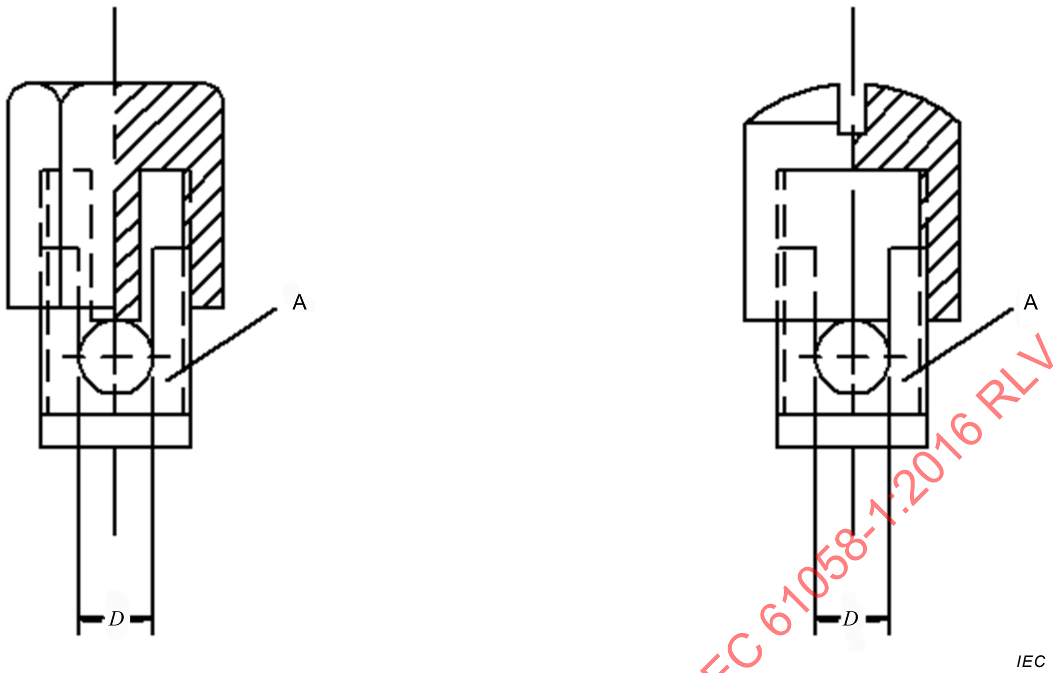
A locking means

B cable lug or bar

E fixed part

F stud

Figure 4 – Examples of lug terminals



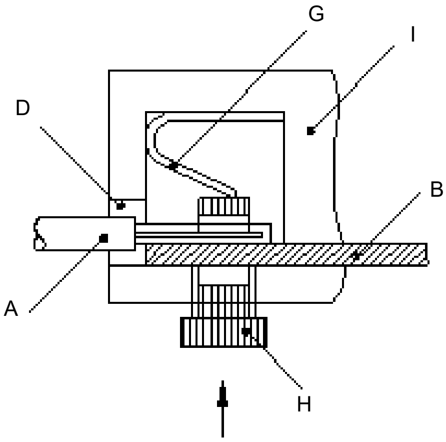
Key

A fixed part

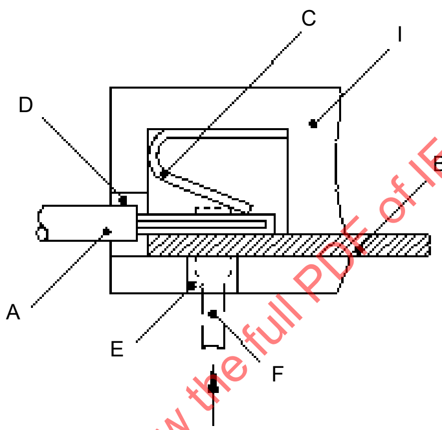
D conductor space (not specified)

The bottom of the conductor space shall be slightly rounded in order to obtain a reliable connection.

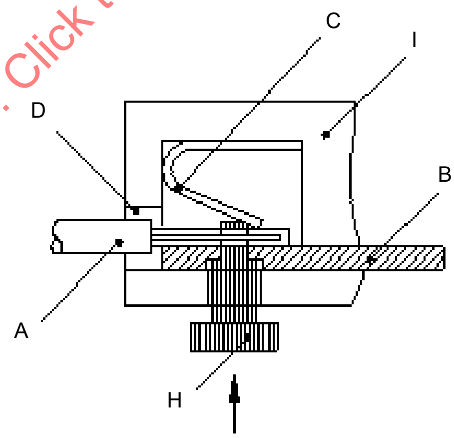
Figure 5 – Examples of mantle terminals



Screwless terminal with indirect pressure clamping means and loosening with an actuating element



Screwless terminal with direct pressure clamping means and loosening with a tool



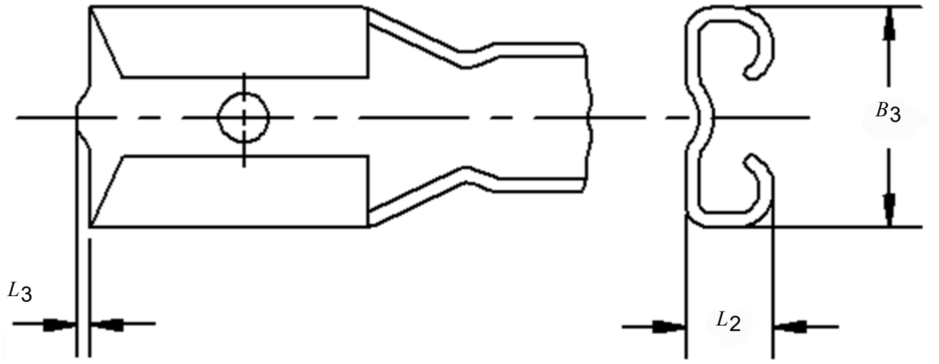
Screwless terminal with direct pressure clamping means and loosening with an actuating element

IEC

Key

A	conductor	D	conductor opening	G	pressure-spring
B	current-carrying part	E	tool opening	H	actuating element
C	clamping spring	F	tool (screwdriver)	I	part at the switch

Figure 6 – Examples of screwless terminals



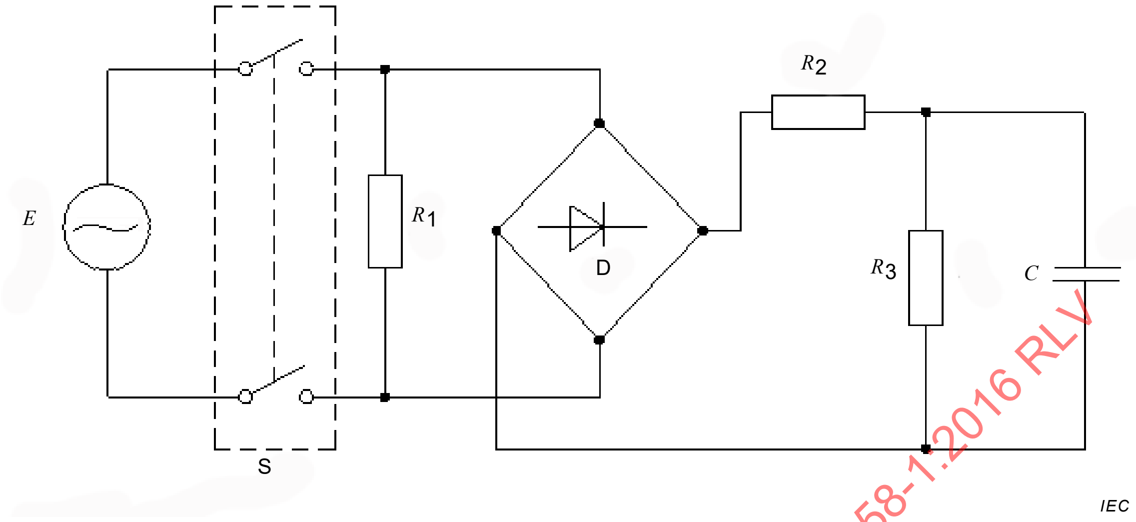
Dimensions of female connectors

Dimensions in millimeters

Connector for tab size	B_3 Max.	L_2 Max.	L_3 Max.
2,8 × 0,5	3,8	2,3	0,5
2,8 × 0,8	3,8	2,3	0,5
4,8 × 0,5[1)]	6,0	2,9	0,5
4,8 × 0,8	6,0	2,9	0,5
6,3 × 0,8	7,8	3,5	0,5
9,5 × 1,2	11,1	4,0	0,5

[1)] Nominal size 4,8 × 0,5 is not recommended for new design.

Figure 7 – Example of female (test) connector of flat quick-connect terminations



Key

$R_1 = E / I$ where E is the rated voltage and I is the rated resistive current or the rated current of the lamp;

$R_2 = R_1 \times 1{,}414 / (X - 1)$ where X is the ratio between the peak surge current and the rated resistive current, or the ratio of the peak inrush current of the cold lamp and the rated current of the lamp;

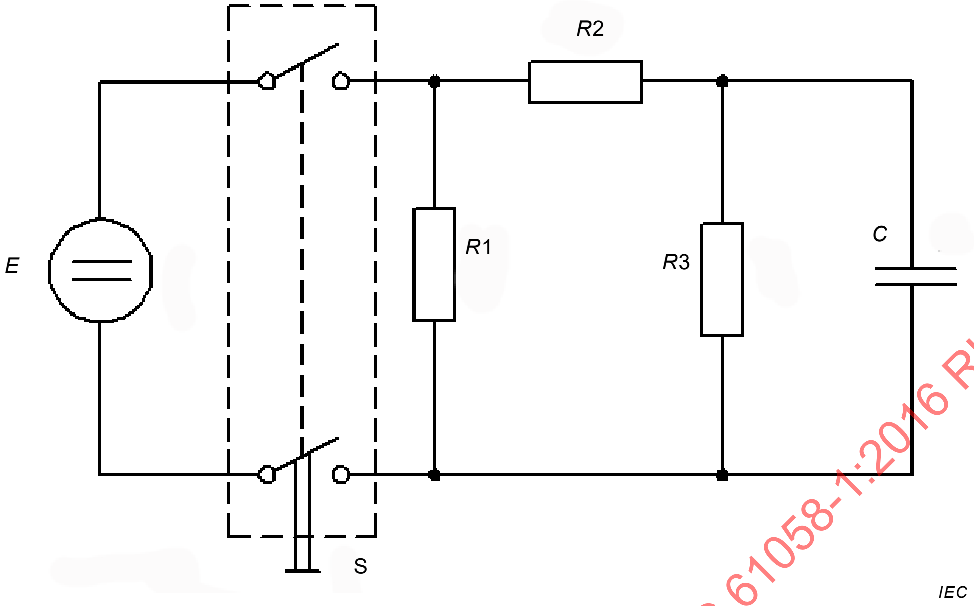
$R_3 = (800/X) \times R_1$

$C \times R_2 = 2\ 500\ \mu s$

D is a rectifier-bridge

The circuit elements and the source impedance are chosen so as to ensure a 10 % accuracy of the surge current, the peak inrush current of the cold lamp, the rated resistive current, or the rated current of the lamp.

Figure 8 – Circuit for capacitive load test and simulated tungsten filament lamp load test for AC circuits



Key

$R_1 = E / I$ where E is the rated voltage and I is the rated resistive current or the rated current of the lamp;

$R_2 = R_1 / (X - 1)$ where X is the ratio between the peak surge current and the rated resistive current, or the ratio of the peak inrush current of the cold lamp and the rated current of the lamp;

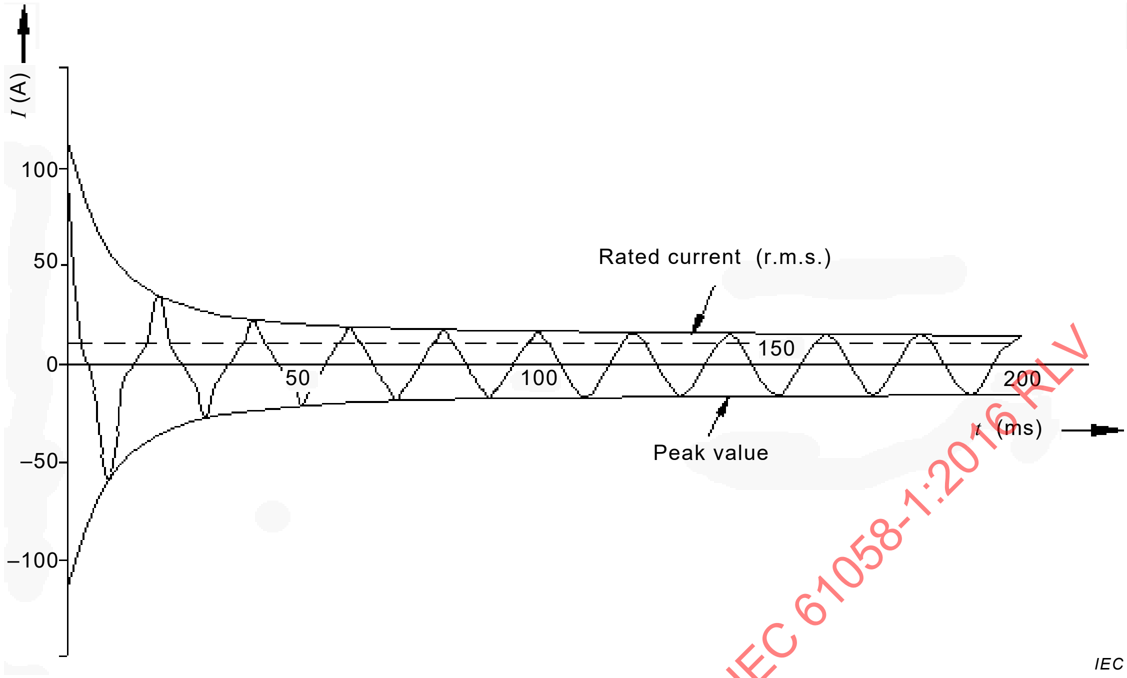
$R_3 = (800/X) \times R_1$

$C \times R_2 = 2\ 500\ \mu s$

S = specimen

The circuit elements and the source impedance are chosen so as to ensure a 10 % accuracy of the surge current, the peak inrush current of the cold lamp, the rated resistive current, or the rated current of the lamp.

Figure 9 – Circuit for capacitive load test and simulated lamp load test for DC circuits



List of values

R_1 = 25 Ω

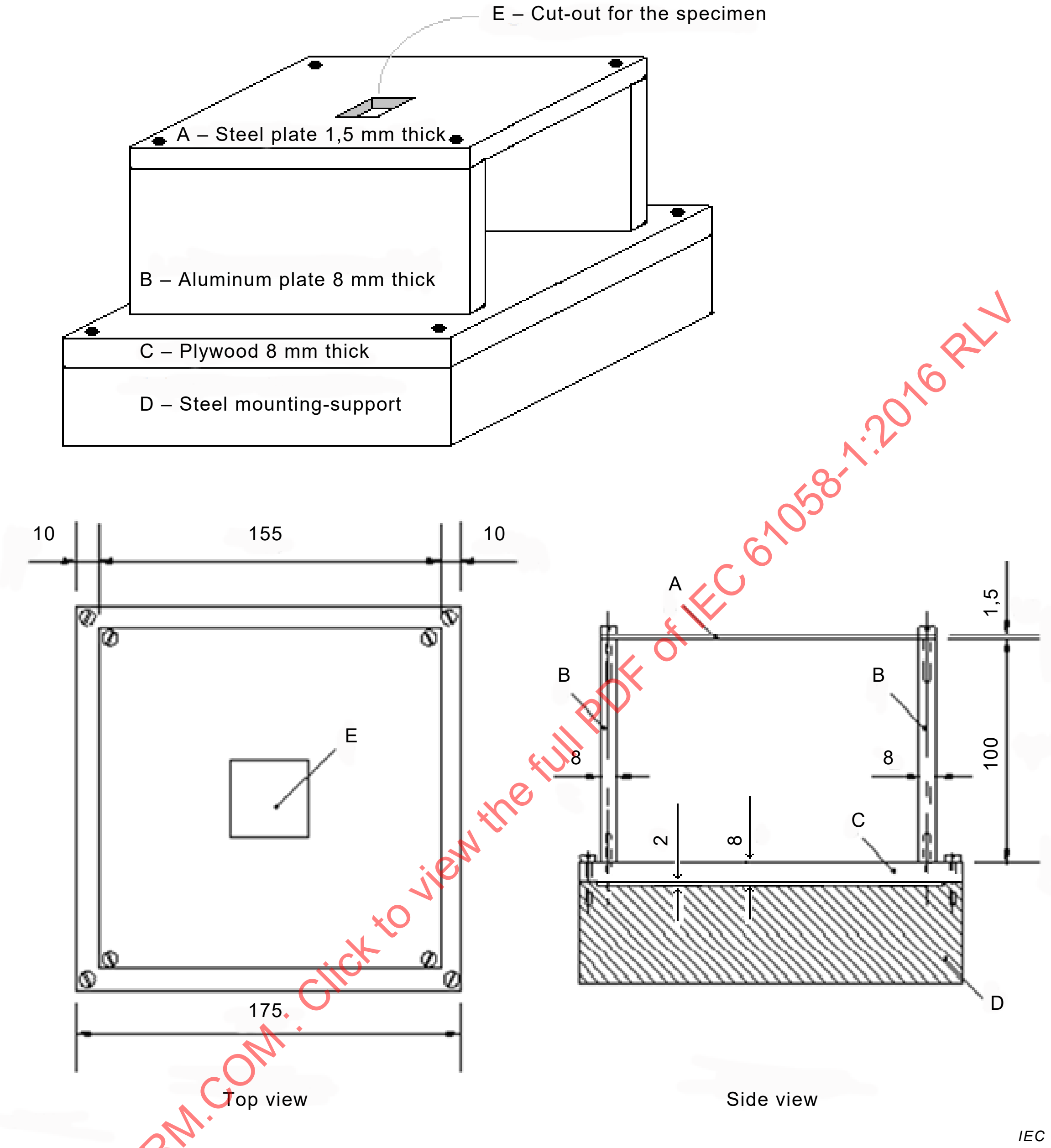
R_2 = 3,93 Ω

R_3 = 2 000 Ω

C = 636 µF

Figure 10 – Values of the capacitive load test circuit for test of switches rated 10/100 A 250 V~

Dimensions in millimeters



Key

A interchangeable steel plate with a thickness of 1,5 mm

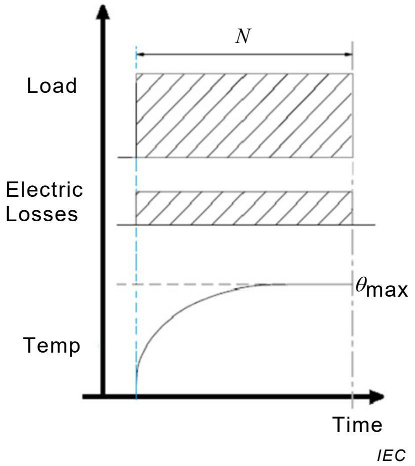
B aluminium plate with a thickness of 8 mm

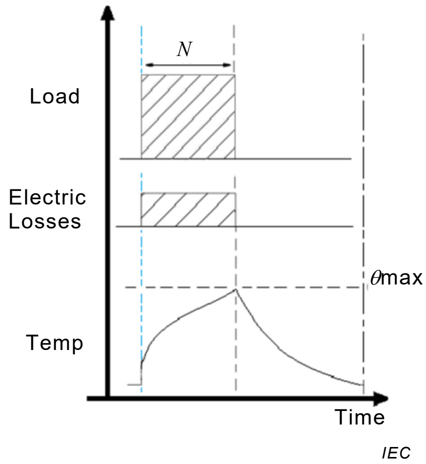
C sheet of plywood with a thickness of 8 mm

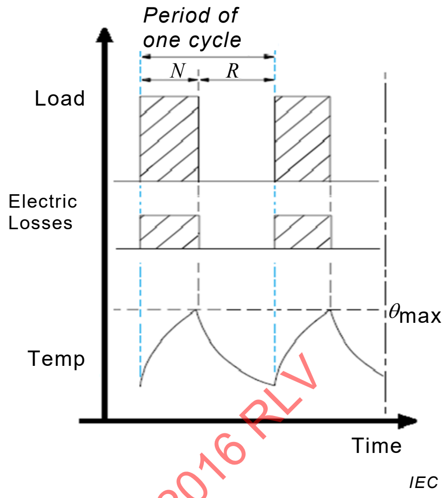
D mounting-support of steel with a minimum mass of 10 kg

E cut-out in the steel plate for the specimen

Figure 11 – Mounting device for the impact tests







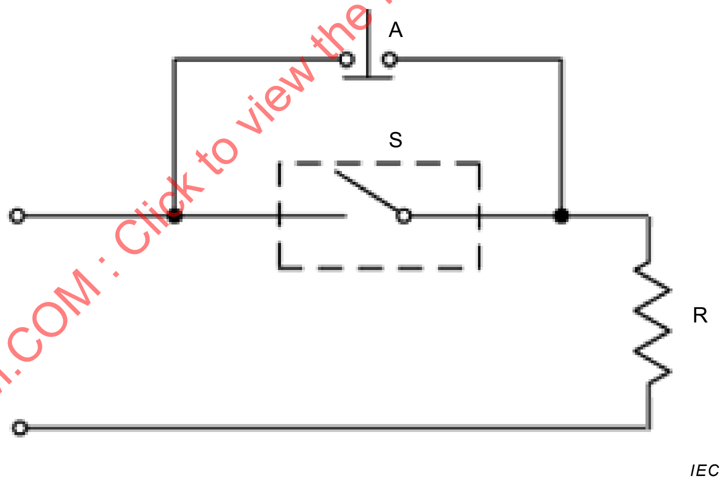
Key

N	Operation at constant load
θmax	Maximum temperature attained
R	At rest and de-energized

Figure 12 – Continuous duty – Duty type S1 (see 7.18.1)

Figure 13 – Short-time duty – Duty type S2 (see 7.18.2)

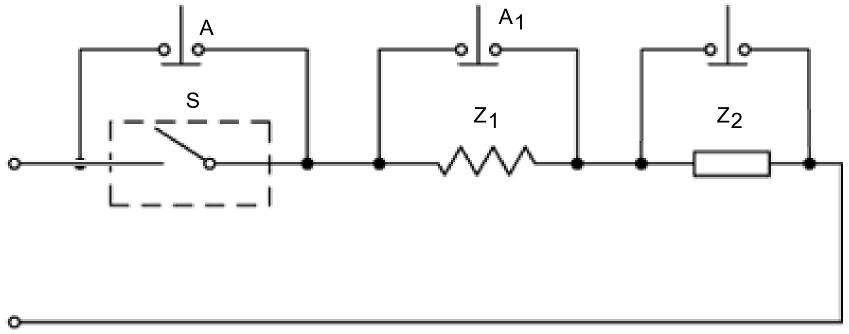
Figure 14 – Intermittent periodic duty – Duty-type S3 (see 7.18.3)



Key

A	Auxiliary switch to set switch load
R	Resistive load to attain current
S	Test specimen

Figure 15 – Diagram for heating test



Components

A Auxiliary switch to set switch load

A_1 Auxiliary switch to attain "break" current

S Test specimen

Z_1 Resistive load to attain "break" current

Z_2 Load for "make" current

The "make" test load is set by closing the auxiliary switches A and A_1 and adjusting Z_2.

The "break" test load is set by closing the auxiliary switch A and adjusting Z_1 with the auxiliary switch A_1 open-circuited.

Throughout the electrical endurance test, the auxiliary switch A is open-circuited.

A_1 is initially closed and is open-circuited time-delayed after the test specimen closes, to reduce the "make" test load to the break load. After the test, the specimen S switches off, and the auxiliary switch A_1 is closed before the next operation of the test specimen.

For the test of electrical contacts, the delay time shall be 50 ms to 100 ms. For the test of electronic switches, where the phase angle of the switched load voltage varies with the movement of the actuating member, the delay time is chosen in such a way that, depending on the operating speed of the actuating mechanism of the test equipment, A_1 is open-circuited at maximum phase angle.

NOTE Some simulated loads, for example 12(2) A, will require auxiliary additional switches in order to set the correct break load.

Figure 16 – Diagram for endurance test

Annex A
(normative)

Measurement of clearances and creepage distances

The methods of measuring clearances and creepage distances which are specified in the following figures are used in interpreting the requirements of this standard.

In the following figures, the minimum values of X are given in Table A.1. Where the distance shown is less than X, the depth of the gap or groove is disregarded when measuring a creepage distance.

Table A.1 is valid only if the required minimum clearance is 3 mm or more. If the required minimum clearance is less than 3 mm, the value of X is the lesser of:

– the relevant value in Table A.1; or

– one third of the required minimum clearance.

Table A.1 – Minimum values for distances with specific pollution degrees

Pollution degree	**Width X**
	Minimum values **mm**
1	0,25
2	1,0
3	1,5

The width X specified in the following examples 1 to 11 in Annex A apply to all examples as a function of the pollution degree as follows:

These cases do not differentiate between gaps and grooves or between types of insulation.

The following assumptions are made:

– any recess is assumed to be bridged with an insulating link having a length equal to the specified width X and being placed in the most unfavourable position (see example 3);

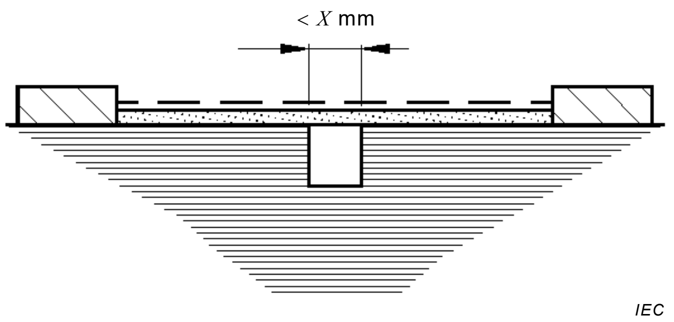
– where the distance across a groove is equal to or larger than the specified width X, the creepage distance is measured along the contours of the groove (see example 2);

– creepage distances and clearances measured between parts which can assume different positions in relation to each other, are measured when these parts are in their most unfavourable position.

Explanation for examples 1 to 11:

clearance

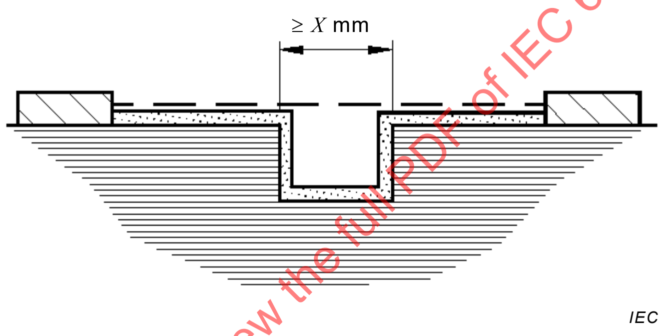
creepage distance



Example 1

Condition: Path under consideration includes a parallel-sided or converging-sides groove of any depth with a width less than X mm.

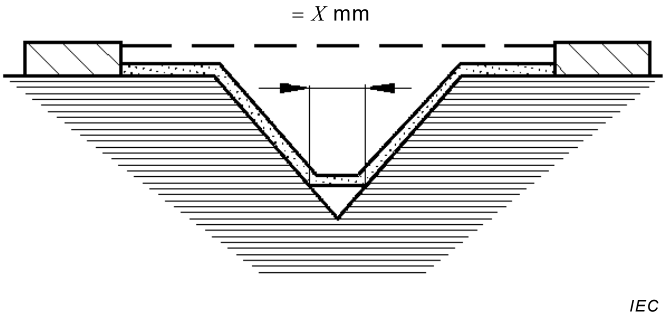
Rule: Creepage distance and clearances are measured directly across the groove as shown.



Example 2

Condition: Path under consideration includes a parallel-sided groove of any depth and with a width equal to or more than X mm.

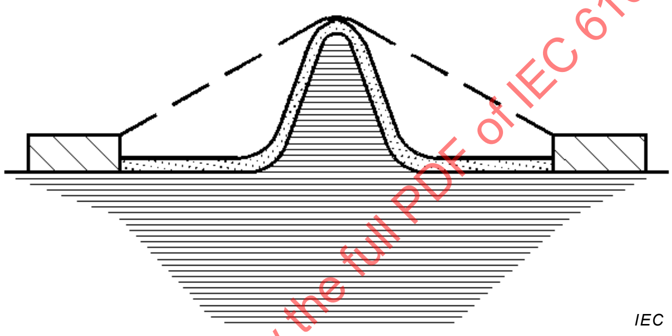
Rule: Clearance is the "line of sight" distance. Creepage path follows the contour of the groove.



Example 3

Condition: Path under consideration includes a V-shaped groove with a width greater than X mm.

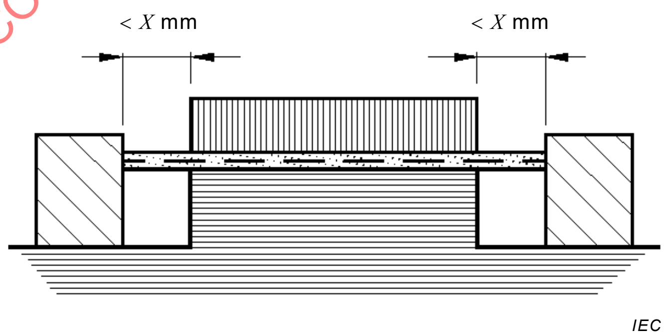
Rule: Clearance is the "line of sight" distance. Creepage path follows the contour of the groove but "short-circuits" the bottom of the groove by an X mm link.



Example 4

Condition: Path under consideration includes a rib.

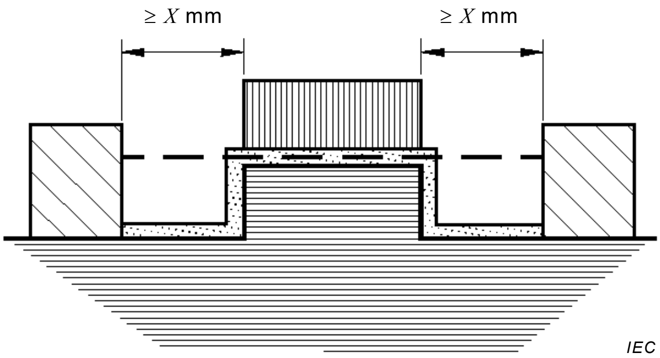
Rule: Clearance is the shortest direct air path over the top of the rib. Creepage path follows the contour of the rib.



Example 5

Condition: Path under consideration includes an uncemented joint with grooves less than X mm wide on each side.

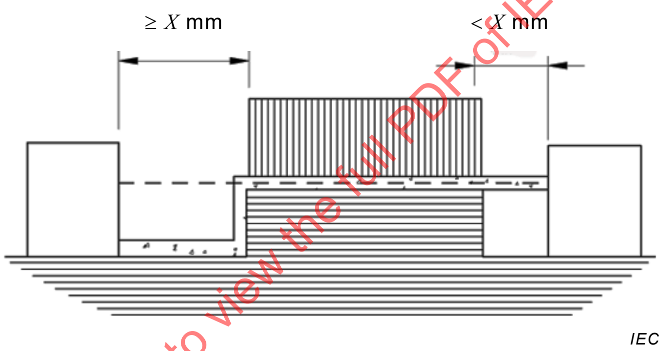
Rule: Creepage and clearance path is the "line of sight" distance shown.



Example 6

Condition: Path under consideration includes an uncemented joint with grooves equal to or more than X mm wide on each side.

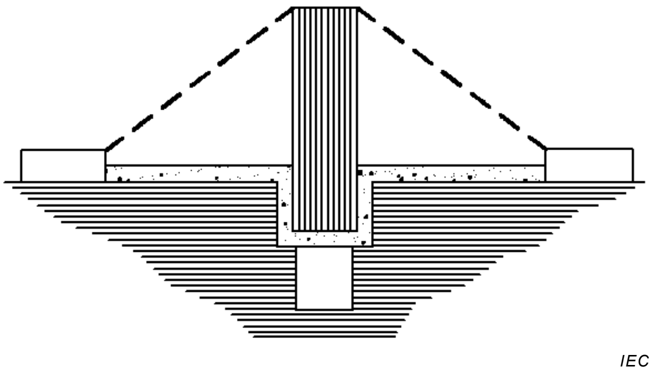
Rule: Clearance is the "line of sight" distance. Creepage path follows the contour of the grooves.



Example 7

Condition: Path under consideration includes an uncemented joint with a groove on one side less than X mm wide and the groove on the other side equal to or more than X mm wide.

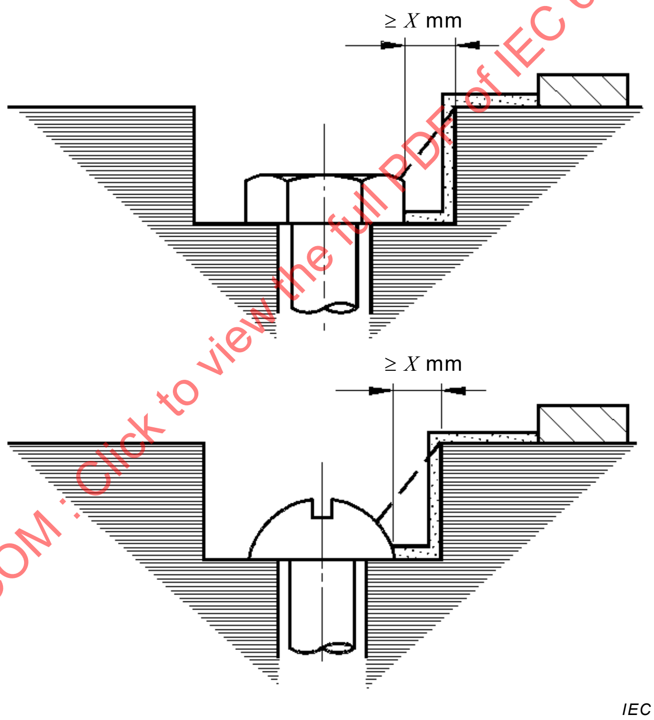
Rule: Clearance and creepage paths are as shown.



Example 8

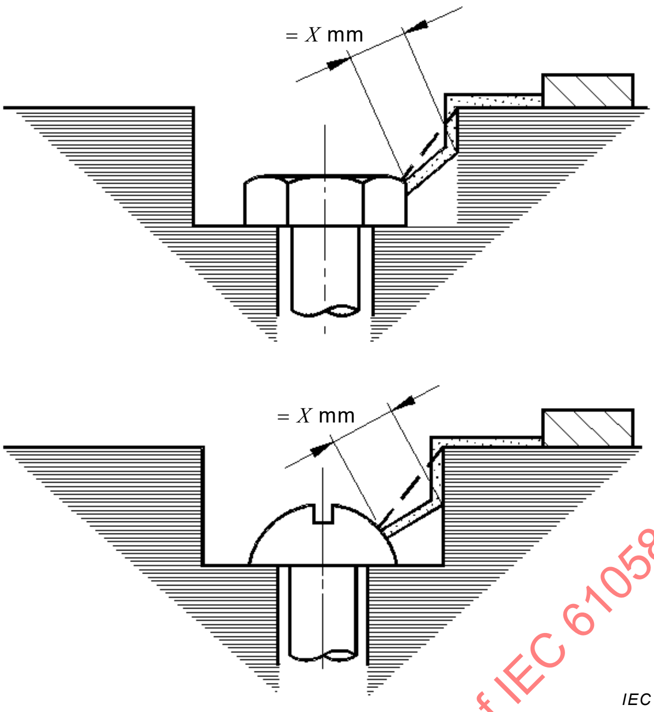
Condition: Creepage distance through an uncemented joint is less than creepage distance over a barrier.

Rule: Clearance is the shortest direct air path over the top of the barrier.



Example 9

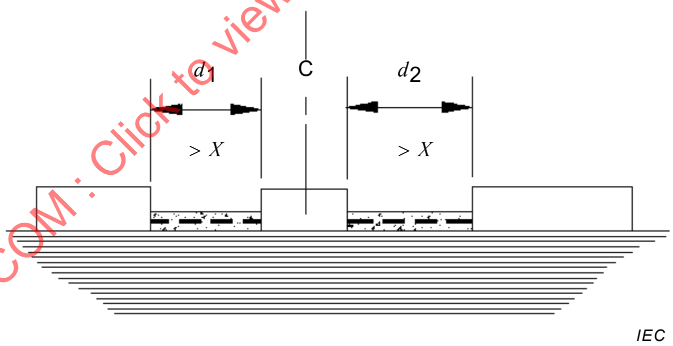
Gap between head of screw and wall of recess wide enough to be taken into account.



Example 10

Gap between head of screw and wall of recess too narrow to be taken into account.

Measurement of creepage distance is from screw to wall when the distance is equal to X mm.



Example 11

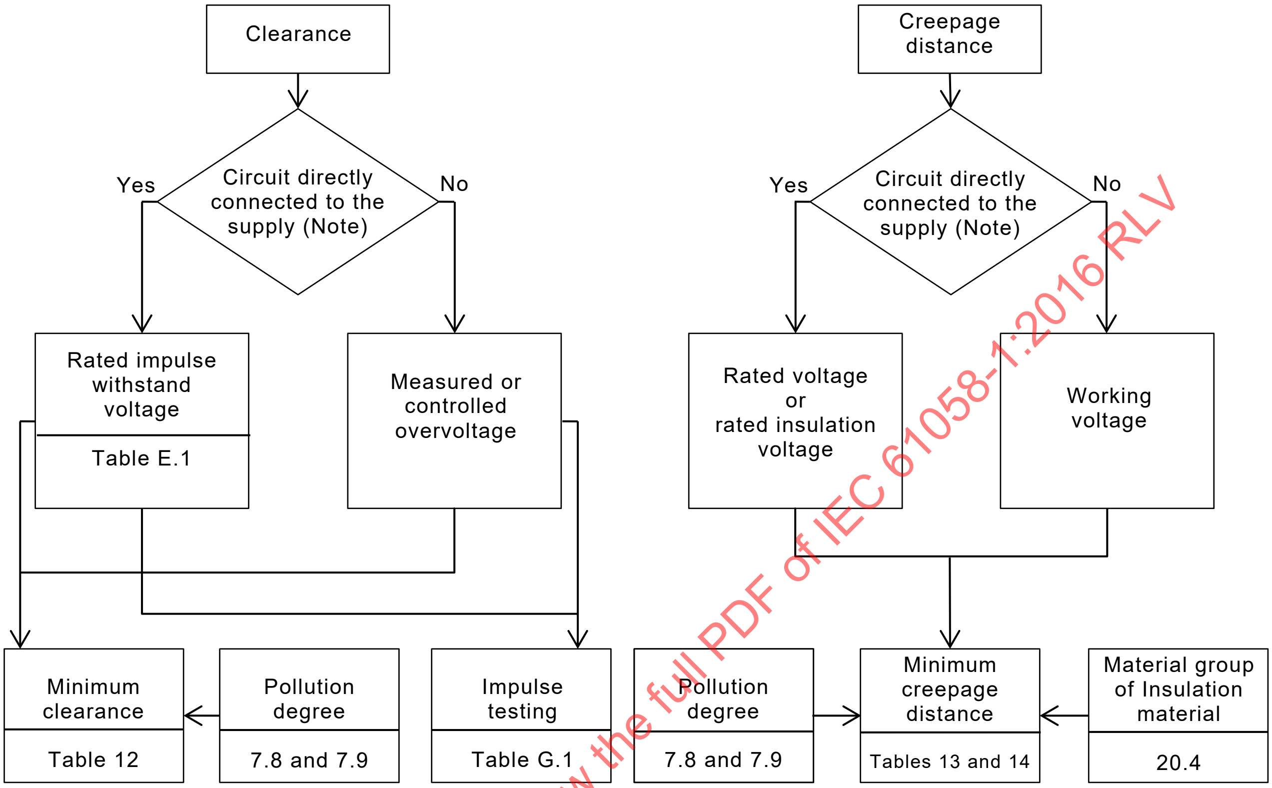
C floating part

Clearance is the distance $d_1 + d_2$.

Creepage distance is also $d_1 + d_2$.

Annex B
(informative)

Diagram for the dimensioning of clearances and creepage distances



Note Includes all circuits significantly affected by transient overvoltages.

Annex C
(normative)

Proof tracking test

The proof tracking test (PTI) is carried out in accordance with IEC 60112.

For the purpose of this standard, the following details apply:

a) 60112:2003, 7.3 – Only the test solution "A" described in 7.3 shall be used.

b) 60112:2003, Clause 8, Basic test procedure

c) 60112:2003, 8.2 "Set the test voltage to the required value". The required test voltage value is the PTI voltage of the material group according to IEC 61058-1:2016, 20.2 (typically the minimum value of the range).

Annex D
(informative)

Switch application guide

D.1 General

In actual applications switches control many different types of circuits throughout a broad range of currents. It is not economically feasible to test every switch on every application load. For the purpose of testing for certification, standard test circuit conditions have been established which are representative of typical circuits in the application. The electrical ratings of the switch are then verified using the standard circuit conditions. The following guidelines may be used for determining whether a particular switch rating is suitable for controlling the circuit in the actual application.

D.2 Resistive load current ratings

D.2.1 The resistive load current rating is established using a substantially resistive load with a power factor not less than 0,9.

D.2.2 Switches with resistive load rating may be used to control a motor load provided

– the power factor is not less than 0,8 and the motor load current does not exceed 60 % of the resistive load current rating of the switch and the inrush current value does not exceed the resistive load value, or

– the power factor is not less than 0,6 and the motor load current does not exceed 16 % of the resistive load current rating of the switch.

D.2.3 Switches with resistive load rating may be used to control a tungsten filament lamp load, provided the steady-state current of the tungsten filament lamp load does not exceed 10 % of the resistive load current rating of the switch.

D.3 Resistive and/or motor load current ratings

D.3.1 The motor load current rating is established using a load with a power factor of 0,6 for making the circuit and a power factor of 0,9 for breaking the circuit.

D.3.2 Switches having both resistive and motor load ratings are not suitable for switching a combined load of the full resistive load plus the full motor load. Such switches can be used for switching a combined resistive load plus a motor load, provided the vector sum of the resistive current and six times the steady-state motor current does not exceed either the resistive current rating or six times the motor current rating, whichever is greater, and depending upon the power factor of the combined load. The vector sum of the resistive current and the steady-state current of the motor shall not exceed the resistive current rating.

NOTE An example is a switch in which the same set of contacts is used to control a circuit in a fan heater which incorporates both a heating element and a motor.

D.3.3 Switches having both resistive and motor load ratings may be used for tungsten filament lamp loads and capacitive load, provided that the steady-state current does not exceed either 10 % of the resistive current rating or 60 % of the motor current rating, whichever is greater.

D.3.4 Switches with motor current ratings only may either be classified

– according to 7.2.2 by declaring the resistive load to be equal to the motor load, or

– according to 7.2.5 for a declared specific load.

D.4 Combination capacitive and resistive load ratings

NOTE An example is a circuit in a radio-receiving apparatus for sound and television.

D.5 Declared specific load ratings

NOTE 1 Examples are fluorescent lamp loads and inductive loads with a power factor less than 0,6.

NOTE 2 Switches submitted in an appliance may be tested using the circuit in the appliance and classified according to 7.2.5 as a declared specific load.

D.6 Current ratings not exceeding 20 mA

NOTE Examples are switches which control discharge lamp indicators and other signal lamps.

D.7 General purpose load

D.7.1 The general purpose load current rating is established using an inductive load with a power factor within 0,75 to 0,8.

D.7.2 It is for inductive or general use but not representing motor or lamp load.

Annex E
(normative)

Relation between rated impulse withstand voltage, rated voltage and overvoltage category

See Table E.1.

Table E.1 – Rated impulse withstand voltage for switches energized directly from the low voltage mains

Nominal voltage of the supply system based on IEC 60038[1)]		Voltage line to neutral derived from nominal voltages AC or DC up to including	Rated impulse withstand voltage [2)3)]		
V			kV		
Three-phase	**Single-phase**	V	**Overvoltage category**		
			I	II	III
		50	0,33	0,5	0,8
		100	0,5	0,8	1,5
	125	150	0,8	1,5	2,5
230/400; 277/480	250	300	1,5	2,5	4,0

NOTE 1 For more detailed information, see IEC 60664-1:2007. For example, for the overvoltage category, see 2.2.2.1.1.

NOTE 2 In general, switches for appliances are considered to fall within overvoltage category II. Overvoltage category I is applicable if special precautions against transient overvoltage are built into the appliance.

1) The / mark indicates a four-wire three-phase distribution system. The lower value is the voltage line-to-neutral, while the higher value is the voltage line-to-line.

2) Switches with these rated impulse withstand voltages can be used in installations in accordance with IEC 61140.

3) For switches capable of generating an overvoltage at the switch terminals, the rated impulse withstand voltage implies that the switch shall not generate overvoltage in excess of this value when used in accordance with the relevant appliance standard and instructions of the manufacturer.

Annex F
(normative)

Pollution degree

The environment determines the effect of pollution on the insulation. The macro-environment, however, has to be taken into account when considering the micro-environment.

In general, the macro-environment is the outside of the switch, and the micro-environment is the inside of the switch.

Within a switch, designed for a particular pollution degree, enclosures or sealing may be provided to allow the use of clearances and creepage distances appropriate for a lower pollution degree. Such means to reduce pollution may not be effective when the switch is subject to condensation.

Small clearances can be bridged completely by solid particles, dust and water and therefore minimum clearances are specified where pollution may be present in the environment.

NOTE Pollution will become conductive in the presence of humidity. Pollution caused by contaminated water, soot, metal or carbon dust is inherently conductive.

For the purpose of evaluating creepage distances and clearances, the following three degrees of pollution in the environment are established.

– 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.

Conductive pollution by ionized gases and metallic depositions may occur in arc chambers of switches. For this type of pollution, no pollution degree is specified.

Safety aspects are checked during the tests of Clause 17.

Annex G
(normative)

Impulse voltage test

The purpose of this test is to verify that clearances will withstand specified transient overvoltage. The impulse withstand voltage test is carried out with a voltage having a 1,2/50 μs wave form as specified in IEC 60060-1 and is intended to simulate overvoltage of atmospheric origin. It also covers overvoltages due to switching of low-voltage equipment.

The test shall be conducted for a minimum of three impulses of each polarity with an interval of at least 1 s between pulses.

The output impedance of the impulse generator should not be higher than 500 Ω. When testing specimens incorporating components across the test circuit, a much lower output impedance may be used.

When surge suppression is provided inside the specimen, the impulse shall have the following characteristics:

– the waveform 1, 2/50 μs for the no-load voltage with amplitudes equal to the values in Table G.1;
– the waveform 8/20 μs for an appropriate surge current.

The voltage waveform of the test voltage source is applicable whether or not the specimen is equipped with surge suppression. If the specimen is provided with surge suppression, the impulse voltage wave may be chopped but the specimen should be in a condition to operate normally again after the test.

If the specimen is not provided with surge suppression and it withstands the impulse voltage, the waveform will not be noticeably distorted.

Table G.1 – Test voltages for verifying clearances at sea-level

Rated impulse withstand voltage $\hat{U}$ kV	Impulse test voltage at sea-level $\hat{U}$ kV
0,33	0,35
0,5	0,55
0,8	0,91
1,5	1,75
2,5	2,95
4,0	4,8
6,0	7,3

NOTE 1 When testing clearances, associated solid insulation will be subjected to the test voltage. As the impulse test voltage of Table G.1 is increased with respect to the rated impulse withstand voltage, solid insulation will have to be designed accordingly. This results in an increased impulse withstand capability of the solid insulation.

NOTE 2 The test may be made with the pressure adjusted to the value corresponding to the altitude of 2 000 m (80 kPa) and 20 °C with the test voltage corresponding to the rated impulse withstand voltage. In this case, solid insulation will not be subjected to the same withstand requirements as when testing at sea-level.

NOTE 3 Explanations concerning the influencing factors (air pressure, altitude, temperature, humidity) with respect to dielectric strength of clearances are given in 4.1.1.2.1.2 of IEC 60664-1:2007.

Annex H
(normative)

Altitude correction factors

As the dimensions given in Table 12 are valid for altitudes up to and including 2 000 m above sea-level, clearances for altitudes above 2 000 m shall be multiplied by the altitude correction factor as specified in Table H.1

Table H.1 – Altitude correction factors

Altitude m	**Normal barometric pressure** kPa	**Multiplication factor for clearances**
2 000	80,0	1,00
3 000	70,0	1,14
4 000	62,0	1,29
5 000	54,0	1,48
6 000	47,0	1,70
7 000	41,0	1,95
8 000	35,5	2,25
9 000	30,5	2,62
10 000	26,5	3,02
15 000	12,0	6,67
20 000	5,5	14,50

Annex I
(normative)

Types of coatings for rigid printed board assemblies

Type 1 coating: Provides only protection against pollution by improving the environment for spacings between printed wiring conductors under the coating to pollution degree 1. The clearance and creepage distance requirements of 20.1, 20.2 and 20.4 apply to the rigid printed board assembly under the coating.

Type 2 coating: Provides protection against pollution and insulation by enclosing the conductors in solid insulation so that the clearance and creepage distance requirements of 20.1, 20.2 and 20.4 are not applicable between conductors under the coating.

NOTE 1 Coating can be effective between two conducting parts if it covers either one or both conductive parts, together with at least 80 % of the creepage distance between them. As a result, some coated rigid printed board assemblies can be used with higher voltage or reduced clearances and creepage distances between conductive parts compared to the same rigid printed board assembly when uncoated.

NOTE 2 Clearance and creepage distance requirements according to 20.1, 20.2 and 20.4 apply to all uncoated parts of the rigid printed board assembly and between conductive parts over the coating.

Annex J
(normative)

Measuring the insulation distance of a coated printed board with type 1 coating

See Figure J.1.

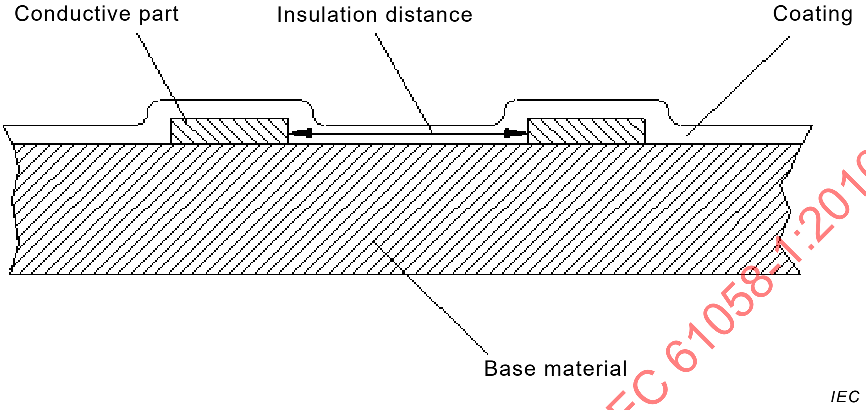


Figure J.1 – Measurement of the insulation distance

The insulation distance is measured under the coating on the base material.

Annex K
(normative)

Routine tests

Routine tests are prescribed in those situations where detection on a sampling basis is considered to be essential for safety.

Clearances for basic or functional insulation which are less than the values given in Table 12 shall be confirmed by routine test, using the test of Annex G.

In cases where the switch does not pass the relevant tests, corrective actions shall be made.

Annex L
(informative)

Sampling tests

L.1 General

Annex L is provided for guidance as a means to confirm that products manufactured after type testing to this standard continue to perform in the declared manner. Test plans other than as described in Annex L may be used if determined to satisfy the same purpose.

L.2 General considerations

Tests specified in Annex L may be considered as part of a product examination test plan. The product examination is applied during ongoing production of the switch.

In cases where the switch does not pass the relevant tests, corrective action should be taken.

Tests according to Clause L.3 are conducted on samples taken randomly from the production line, in accordance with written procedures. The need, nature and frequency of the tests and the sampling rates used for these tests may be influenced by:

- the construction of the product;
- the quality control system used, and;
- the quantity of products manufactured.

Tests may be carried out with different test methods than those applied in conjunction with the type tests if the alternate test methods can be shown to be equivalent.

The quality control system used should include the elements of an ISO 9000 quality control system which apply to manufacturing and production systems. The requirements of the quality control system may be met by other means.

L.3 Tests

L.3.1 The following tests apply as part of a sampling plan on all production, independently of switch types or switch groupings.

- Check of content of marking according to Clause 8, legibility and durability of marking according to 8.8.

NOTE 1 The test may be omitted when ongoing conformity is found (e.g., by use of moulding, etching or similar processes).

- Dielectric strength test according to Clause 15 without humidity treatment.

NOTE 2 The test may be omitted when ongoing conformity is found (e.g. by design).

L.3.2 Within a time period specified in written procedures, the following tests should be conducted in the order given:

- dielectric strength test according to Clause 15;
- heating test on contacts and terminals according to Clause 16;
- endurance test according to Clause 17.

The tests should be conducted on individual switch types, which may be selected from switch families, according to Annex M. The number of test samples is according to Table 101 of IEC 61058-1-1:2016 or Table 101 of IEC 61058-1-2:2016. They may be grouped into switch families according to Annex M, and the tests may then be carried out with samples selected according to Annex M. Annex M gives an example system for grouping switch types into switch families for this purpose. Other grouping systems may also be appropriate for this purpose.

L.3.3 Within a time period specified in written procedures, glow wire tests and ball pressure tests according to Clause 21, and proof tracking tests according to Annex C, should be conducted on samples of material representing the different switch constructions and materials in production. However, these tests do not apply if it is otherwise verified that the same raw materials, moulds and processes are used as for the type test. This may be accomplished as part of a moulder's verification program. These tests may be part of incoming inspection rather than as part of production testing.

Annex M
(normative)

Switch families

M.1 Overview

Annex M gives an example system for grouping switch types into switch families, as relates to tests specified in L.3.2. Other grouping systems may be appropriate for this purpose. As used in Annex M, a "switch family" refers to a single grouping of different switch types that are representative of one another in construction and performance.

M.2 General

Switch types may be grouped into switch families in such a way that the most severe case for the switch family can be represented by the tests each time the tests are conducted.

Alternatively, when switch families include switch types with different ratings, the switches should be selected for test in proportion to production volume, and, the severest rating of the selected switch type should be tested each time.

A switch family may include the following variations:

a) different electrical ratings for switches that employ
   1) the same basic contact construction, except for the diameter, thickness or material of the contacts;
   2) the same configuration of internal contacts, base and actuator; and
   3) the same number of poles;
b) different external parts such as terminals and actuating members;
c) one-way, two-way, and multiway types;
d) normally open and normally closed biased types of switches;
e) different contact constructions under the following conditions: switches with the same or with different electrical ratings that employ the same basic contact construction, except for the diameter, thickness, or material of the contacts, may be included in the same switch family, provided the switches have the same configuration of internal contacts, base and actuator, and the same number of poles;
f) single-pole, double-pole, and multiple-pole types when the electrical rating is the same and there is a similar configuration of internal contacts, base and actuator;
g) different combinations of electrical rating, temperature and number of operating cycles within identical constructions.

M.3 Guidelines for selection of switches in switch families for testing

M.3.1 One-way / two-way; or biased switches in same switch family: selection should be made on an as-available basis.

M.3.2 Different number of poles in same switch family: selection should be rotated in proportion to production volume.

M.3.3 Different operating cycle ratings for the same electrical rating within identical constructions and different combinations of electrical, temperature and operating cycle ratings: rotate selection in proportion to relative production volume of each type.

M.3.4 Same contacts but different electrical ratings in same switch family: if the switch family includes various ratings, rotate selection in proportion to relative production volume of each type. The endurance test should be conducted at the maximum volt-ampere rating at the highest voltage applicable to the selected switch type and the heating test should be conducted at the highest current rating applicable to the selected switch type.

M.3.5 Different contacts and different ratings in same switch family: selection of switch types for test should be rotated based on production volume of each contact type used. The endurance test should be conducted at the maximum volt-ampere rating at the highest applicable voltage applicable to the selected contact each time. The heating test should be conducted at the highest applicable current rating applicable to the selected contact type each time.

M.3.6 Co-ordinated electrical ratings (i.e., same volt-ampere ratings with different voltage and ampere ratings) in same switch family: selection should be rotated on the basis of production volume, considering maximum ratings in the switch family as specified in M.3.4.

Annex N
(informative)

Dimensions of tabs forming part of a switch

Refer to IEC 61210.

Annex O
(informative)

Common end product standards

Switches complying with this standard may be used in end products with additional requirements.

End product standards of interest include the following.

- IEC 60065: *Audio, video and similar electronic apparatus – Safety requirements*
- IEC 60335 (all parts): *Household and similar electrical appliances – Safety*
- IEC 60745(all parts): *Hand-held motor-operated electric tools –Safety*
- IEC 60950 (all parts): *Information technology equipment – Safety*

Bibliography

IEC 60034-1:2010, *Rotating electrical machines – Part 1: Rating and performance*

IEC 60050-151:2001, *International Electrotechnical Vocabulary – Part 151: Electrical and magnetic devices*

IEC 60050-411:1996, *International Electrotechnical Vocabulary – Chapter 411: Rotating machinery*

IEC 60050-441:1984, *International Electrotechnical Vocabulary – Chapter 441: Switchgear, controlgear and fuses*
Amendment 1:2000

IEC 60050-826:2004, *International Electrotechnical Vocabulary – Part 826: Electrical installations*

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

IEC 60085:2007, *Electrical insulation – Thermal evaluation and designation*

IEC 60228:2004, *Conductors of insulated cables*

IEC 60335-1, *Household and similar electrical appliances – Safety – Part 1: General requirements*

IEC 60335-2 (all parts), *Household and similar electrical appliances – Safety*

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

IEC 60893-1:2004, *Insulating materials – Industrial rigid laminated sheets based on thermosetting resins for electrical purposes – Part 1: Definitions, designations and general requirements*

IEC 60998-2-3:2002, *Connecting devices for low-voltage circuits for household and similar purposes – Part 2-3: Particular requirements for connecting devices as separate entities with insulation-piercing clamping units*

IEC 61000 (all parts), *Electromagnetic compatibility (EMC)*

IEC 61140, *Protection against electric shock – Common aspects for installation and equipment*

____

SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

____

INTERRUPTEURS POUR APPAREILS –

Partie 1: Exigences générales

AVANT-PROPOS

1) La Commission Electrotechnique Internationale (IEC) est une organisation mondiale de normalisation composée de l'ensemble des comités électrotechniques nationaux (Comités nationaux de l'IEC). L'IEC a pour objet de favoriser la coopération internationale pour toutes les questions de normalisation dans les domaines de l'électricité et de l'électronique. A cet effet, l'IEC – entre autres activités – publie des Normes internationales, des Spécifications techniques, des Rapports techniques, des Spécifications accessibles au public (PAS) et des Guides (ci-après dénommés "Publication(s) de l'IEC"). Leur élaboration est confiée à des comités d'études, aux travaux desquels tout Comité national intéressé par le sujet traité peut participer. Les organisations internationales, gouvernementales et non gouvernementales, en liaison avec l'IEC, participent également aux travaux. L'IEC collabore étroitement avec l'Organisation Internationale de Normalisation (ISO), selon des conditions fixées par accord entre les deux organisations.
2) Les décisions ou accords officiels de l'IEC concernant les questions techniques représentent, dans la mesure du possible, un accord international sur les sujets étudiés, étant donné que les Comités nationaux de l'IEC intéressés sont représentés dans chaque comité d'études.
3) Les Publications de l'IEC se présentent sous la forme de recommandations internationales et sont agréées comme telles par les Comités nationaux de l'IEC. Tous les efforts raisonnables sont entrepris afin que l'IEC s'assure de l'exactitude du contenu technique de ses publications; l'IEC ne peut pas être tenue responsable de l'éventuelle mauvaise utilisation ou interprétation qui en est faite par un quelconque utilisateur final.
4) Dans le but d'encourager l'uniformité internationale, les Comités nationaux de l'IEC s'engagent, dans toute la mesure possible, à appliquer de façon transparente les Publications de l'IEC dans leurs publications nationales et régionales. Toutes divergences entre toutes Publications de l'IEC et toutes publications nationales ou régionales correspondantes doivent être indiquées en termes clairs dans ces dernières.
5) L'IEC elle-même ne fournit aucune attestation de conformité. Des organismes de certification indépendants fournissent des services d'évaluation de conformité et, dans certains secteurs, accèdent aux marques de conformité de l'IEC. L'IEC n'est responsable d'aucun des services effectués par les organismes de certification indépendants.
6) Tous les utilisateurs doivent s'assurer qu'ils sont en possession de la dernière édition de cette publication.
7) Aucune responsabilité ne doit être imputée à l'IEC, à ses administrateurs, employés, auxiliaires ou mandataires, y compris ses experts particuliers et les membres de ses comités d'études et des Comités nationaux de l'IEC, pour tout préjudice causé en cas de dommages corporels et matériels, ou de tout autre dommage de quelque nature que ce soit, directe ou indirecte, ou pour supporter les coûts (y compris les frais de justice) et les dépenses découlant de la publication ou de l'utilisation de cette Publication de l'IEC ou de toute autre Publication de l'IEC, ou au crédit qui lui est accordé.
8) L'attention est attirée sur les références normatives citées dans cette publication. L'utilisation de publications référencées est obligatoire pour une application correcte de la présente publication.
9) L'attention est attirée sur le fait que certains des éléments de la présente Publication de l'IEC peuvent faire l'objet de droits de brevet. L'IEC ne saurait être tenue pour responsable de ne pas avoir identifié de tels droits de brevets et de ne pas avoir signalé leur existence.

La Norme internationale IEC 61058-1 a été établie par le sous-comité 23J: Interrupteurs pour appareils, du comité d'études 23 de l'IEC: Petit appareillage.

Cette quatrième édition annule et remplace la troisième édition parue en 2000, l'Amendement 1:2001 et l'Amendement 2:2007. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) les exigences relatives aux constructions d'interrupteurs mécaniques sont maintenant incluses dans l'IEC 61058-1-1;
b) les exigences relatives aux constructions d'interrupteurs électroniques sont maintenant incluses dans l'IEC 61058-1-2.

Le texte de cette norme est issu des documents suivants:

FDIS	Rapport de vote
23J/401/FDIS	23J/405/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette norme.

Cette publication a été rédigée selon les Directives ISO/IEC, Partie 2.

Une liste de toutes les parties de la série IEC 61058, publiées sous le titre général *Interrupteurs pour appareils*, peut être consultée sur le site web de l'IEC.

Dans la présente partie, les caractères d'imprimerie suivants sont employés:

- exigences proprement dites: caractères romains;
- modalités d'essai: *caractères italiques*;
- notes: petits caractères romains.

Le comité a décidé que le contenu de cette publication ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous "http://webstore.iec.ch" dans les données relatives à la publication recherchée. A cette date, la publication sera

- reconduite,
- supprimée,
- remplacée par une édition révisée, ou
- amendée.

INTERRUPTEURS POUR APPAREILS –

Partie 1: Exigences générales

1 Domaine d'application

La présente partie de l'IEC 61058 s'applique d'une manière générale aux interrupteurs pour appareils. Les interrupteurs permettent de commander des appareils électriques et autres matériels pour usage domestique et analogue dont la tension assignée ne dépasse pas 480 V et le courant assigné ne dépasse pas 63 A.

Les interrupteurs pour appareils sont prévus pour être manœuvrés par:

– une personne par l'intermédiaire d'un organe de manœuvre,
– une manœuvre indirecte,
– une unité sensible de manœuvre.

La transmission d'un signal entre l'organe de manœuvre ou l'unité sensible et l'interrupteur peut être associée à une liaison optique, acoustique, thermique, électrique ou toute autre liaison appropriée et peut comporter des unités télécommandées.

La présente partie de l'IEC 61058 s'applique aux interrupteurs pour appareils comportant des fonctions de commande additionnelles gérées par l'interrupteur, qui comporte lui-même des circuits électroniques ainsi que des dispositifs nécessaires au fonctionnement prévu et/ou correct de l'interrupteur.

La présente partie de l'IEC 61058 s'applique aux circuits lorsqu'ils sont évalués avec l'interrupteur, car nécessaires à sa fonction de coupure.

La présente partie de l'IEC 61058 s'applique d'une manière générale aux interrupteurs pour appareils conjointement avec les parties suivantes:

– *Partie 1-1: Exigences relatives aux interrupteurs mécaniques*, et/ou
– *Partie 1-2: Exigences relatives aux interrupteurs électroniques*.

La présente partie de l'IEC 61058 ne s'applique pas aux produits couverts par les normes suivantes:

– l'IEC 60669 (toutes les parties), *Interrupteurs pour installations électriques fixes domestiques et analogues*, et
– l'IEC 60730 (toutes les parties), *Dispositifs de commande électrique automatiques*;

La présente partie de l'IEC 61058 ne comporte aucune exigence relative aux interrupteurs sectionneurs (IEC 60050-811:1991, 811-29-17).

NOTE 1 Pour les interrupteurs utilisés dans des climats tropicaux, des exigences supplémentaires peuvent être nécessaires.

NOTE 2 L'attention est attirée sur le fait que les normes des produits finaux pour appareils peuvent contenir des exigences supplémentaires ou différentes pour les interrupteurs.

NOTE 3 Dans la présente partie de l'IEC 61058, le terme "appareil" signifie "appareil ou équipement".

2 Références normatives

Les documents suivants sont cités en référence de manière normative, en intégralité ou en partie, dans le présent document et sont indispensables pour son application. 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 60038, *Tensions normales de l'IEC*

IEC 60060-1, *Technique des essais à haute tension – Partie 1: Définitions et exigences générales*

IEC 60065:2014, *Appareils audio, vidéo et appareils électroniques analogues – Exigences de sécurité*

IEC 60068-2-75, *Essais d'environnement – Partie 2-75: Essais – Essai Eh: Essais au marteau*

IEC 60112:2003, *Méthode de détermination des indices de résistance et de tenue au cheminement des matériaux isolants solides*
Amendement 1:2009

IEC 60127, *Coupe-circuit miniatures*

IEC 60269-3, *Fusibles basse tension – Partie 3: Exigences supplémentaires pour les fusibles destinés à être utilisés par des personnes non qualifiées (fusibles pour usages essentiellement domestiques et analogues) – Exemples de systèmes de fusibles normalisés A à F*

IEC 60384-14, *Condensateurs fixes utilisés dans les équipements électroniques – Partie 14: Spécification intermédiaire: Condensateurs fixes d'antiparasitage et raccordement à l'alimentation*

IEC 60417, *Symboles graphiques utilisables sur le matériel* (disponible sous: http://www.graphical-symbols.info/equipment)

IEC 60529:1989, *Degrés de protection procurés par les enveloppes (Code IP)*
Amendement 1:1999
Amendement 2:2013

IEC 60617, *Symboles graphiques pour schémas* (disponible sous: http://std.iec.ch/iec60617)

IEC 60664-3:2003, *Coordination de l'isolement des matériels dans les systèmes (réseaux) à basse tension – Partie 3: Utilisation de revêtement, d'empotage ou de moulage pour la protection contre la pollution*
Amendement 1:2010

IEC 60691, *Protecteurs thermiques – Exigences et guide d'application*

IEC 60695-2-11, *Essais relatifs aux risques du feu – Partie 2-11: Essais au fil incandescent/chauffant – Méthode d'essai d'inflammabilité pour produits finis*

IEC 60695-10-2, *Essais relatifs aux risques du feu – Partie 10-2: Chaleurs anormales – Essai à la bille*

IEC 60695-11-10, *Essais relatifs aux risques du feu – Partie 11-10: Flammes d'essai – Méthodes d'essai horizontal et vertical à la flamme de 50 W*

IEC 60695-11-20, *Essais relatifs aux risques du feu – Partie 11-20: Flammes d'essai – Méthode d'essai à la flamme de 500 W*

IEC 60730 (toutes les parties), *Dispositifs de commande électrique automatiques*

IEC 60730-1:2013, *Dispositifs de commande électrique automatiques – Partie 1: Exigences générales*

IEC 60730-2-9, *Automatic electrical controls – Part 2-9: Particular requirements for temperature sensing control* (disponible en anglais uniquement)

IEC 60738-1, *Thermistances – Coefficient de température positif à chauffage direct – Partie 1: Spécification générique*

IEC 61000-3-2, *Compatibilité électromagnétique (CEM) – Partie 3-2: Limites – Limites pour les émissions de courant harmonique (courant appelé par les appareils ≤ à 16 A par phase)*

IEC 61000-3-3, *Compatibilité électromagnétique (CEM) – Partie 3-3: Limites – Limitation des variations de tension, des fluctuations de tension et du papillotement dans les réseaux publics d'alimentation basse tension pour l'équipement ayant un courant assigné ≤ à 16 A par phase et non soumis à un raccordement conditionnel*

IEC TS 61000-3-5, *Compatibilité électromagnétique (CEM) – Partie 3-5: Limites – Limitation des fluctuations de tension et du flicker dans les réseaux basse tension pour les équipements ayant un courant assigné supérieur à 75 A*

IEC 61000-4-2, *Compatibilité électromagnétique (CEM) – Partie 4-2: Techniques d'essai et de mesure – Essai d'immunité aux décharges électrostatiques*

IEC 61000-4-3, *Compatibilité électromagnétique (CEM) – Partie 4-3: Techniques d'essai et de mesure – Essai d'immunité aux champs électromagnétiques rayonnés aux fréquences radioélectriques*

IEC 61000-4-4, *Compatibilité électromagnétique (CEM) – Partie 4-4: Techniques d'essai et de mesure – Essais d'immunité aux transitoires électriques rapides en salves*

IEC 61000-4-5, *Compatibilité électromagnétique (CEM) – Partie 4-5: Techniques d'essai et de mesure – Essai d'immunité aux ondes de choc*

IEC 61000-4-8, *Compatibilité électromagnétique (CEM) – Partie 4-8: Techniques d'essai et de mesure – Essai d'immunité au champ magnétique à la fréquence du réseau*

IEC 61000-4-11, *Compatibilité électromagnétique (CEM) – Partie 4-11: Techniques d'essai et de mesure – Essais d'immunité aux creux de tension, coupures brèves et variations de tension*

IEC 61032:1997, *Protection des personnes et des matériels par les enveloppes – Calibres d'essais pour la vérification*

IEC 61058-1-1, *Interrupteurs pour appareils – Partie 1-1: Exigences relatives aux interrupteurs mécaniques*

IEC 61058-1-2, *Interrupteurs pour appareils – Partie 1-2: Exigences relatives aux interrupteurs électroniques*

IEC 61210:2010, *Dispositifs de connexion – Bornes plates à connexion rapide pour conducteurs électriques en cuivre – Exigences de sécurité*

CISPR 14-1, *Compatibilité électromagnétique – Exigences pour les appareils électrodomestiques, outillages électriques et appareils analogues – Partie 1: Emission*

CISPR 15:2013, *Limites et méthodes de mesure des perturbations radioélectriques produites par les appareils électriques d'éclairage et les appareils analogues*

3 Termes et définitions

Pour les besoins du présent document, les termes et définitions suivants s'appliquent.

3.1 Termes et définitions généraux

3.1.1
interrupteur mécanique
dispositif de coupure destiné à fermer et à ouvrir un ou plusieurs circuits électriques au moyen de contacts séparables

Note 1 à l'article: Dans la série IEC 61058, les termes "interrupteur mécanique" et "interrupteur" sont employés indifféremment.

[SOURCE: IEC 60050-441:1984, 441-14-02]

3.1.2
partie conductrice
partie capable de conduire du courant, bien qu'elle ne soit pas nécessairement utilisée pour conduire du courant en service normal

[SOURCE: IEC 60050-441:1984, 441-11-09]

3.1.3
partie active
conducteur ou partie conductrice destiné(e) à être sous tension en service normal, y compris le conducteur de neutre, mais par convention, excepté le conducteur PEN, le conducteur PEM ou le conducteur PEL

Note 1 à l'article: Pour les interrupteurs d'appareils, une "partie active" implique un risque de choc électrique.

Note 2 à l'article: Sauf spécification contraire, les parties raccordées à une alimentation en TBTS ou inférieures ou égales à 24 V ne sont pas considérées comme des parties actives.

3.1.4
pôle d'un interrupteur
partie d'un interrupteur associée exclusivement à un chemin conducteur électriquement séparé des autres chemins de son circuit principal, les éléments constitutifs de la fixation et du fonctionnement d'ensemble de tous les pôles étant exclus

Note 1 à l'article: Un interrupteur est appelé "unipolaire" s'il n'a qu'un pôle. S'il a plus d'un pôle, il peut être appelé "multipolaire" (bipolaire, tripolaire, etc.) à condition que les pôles soient liés de manière à fonctionner ensemble.

[SOURCE: IEC 60050-441:1984, 441-15-01, modifié – Pôle d'un appareil de connexion remplacé par pôle d'un interrupteur]

3.1.5
partie amovible
partie qui peut être enlevée sans l'aide d'un outil, l'interrupteur étant monté comme en usage normal

3.1.6
outil
tournevis, pièce de monnaie ou autre objet pouvant être utilisé pour manœuvrer un écrou, une vis ou un élément analogue

3.1.7
usage normal
usage de l'interrupteur dans le but pour lequel il a été fabriqué et déclaré

3.1.8
référence unique de type
UT
identification de marquage sur un interrupteur qui, par son libellé complet, permet au fabricant d'identifier un modèle d'interrupteur unique

Note 1 à l'article: L'abréviation "UT" est dérivée du terme anglais développé correspondant "unique type reference".

3.1.9
référence commune de type
CT
identification de marquage sur un interrupteur ne nécessitant pas d'autres informations spécifiques que celles qui sont fournies par les exigences de marquage de la présente partie de l'IEC 61058 pour le choix, l'installation et l'utilisation conformément à la présente partie de l'IEC 61058

Note 1 à l'article: L'abréviation "CT" est dérivée du terme anglais développé correspondant "common type reference".

3.1.10
capot
plaque de recouvrement
protecteur de contact
enveloppe en matériaux isolants recouvrant des parties actives afin d'éviter un contact électrique accidentel et qui est accessible lorsque l'interrupteur est monté comme en usage normal, et pouvant être enlevée à l'aide d'un outil

3.1.11
indicateur de signalisation
dispositif associé à un interrupteur pour visualiser l'état des circuits

Note 1 à l'article: Le dispositif peut être ou ne pas être commandé par l'interrupteur.

3.1.12
conducteur non préparé
conducteur dont l'extrémité coupée a été dénudée pour être insérée dans une borne

[SOURCE: IEC 60050-442:1998, 442-01-26]

3.1.13
conducteur préparé
conducteur dont l'extrémité dénudée est munie d'un accessoire tel que manchon ou cosse ou raccord de câbles

[SOURCE: IEC 60050-442:1998, 442-01-27]

3.1.14
inversion de polarité
changement de polarité des bornes raccordées à la charge par l'action d'un interrupteur

3.1.15
dispositif à semiconducteurs
DCSC
dispositif dont les caractéristiques essentielles sont dues au flux de porteurs de charges à l'intérieur d'un semiconducteur

Note 1 à l'article: Les éditions antérieures de l'IEC 61058-1 désignent le dispositif à semiconducteurs sous le nom de "dispositif de coupure à semiconducteurs (DCSC)" ou "dispositif statique".

[SOURCE: IEC 60050-521:2002, 521-04-01]

3.1.16
circuit à semiconducteur
circuit comportant plusieurs composants dont au moins un est un dispositif à semiconducteurs

3.1.17
interrupteur électronique
interrupteur pour appareils comportant un dispositif à semiconducteurs ou un circuit à semiconducteurs dans son circuit de coupure

Note 1 à l'article: L'interrupteur électronique peut comporter des contacts mécaniques en série et/ou en parallèle. Se reporter aux exemples du Tableau 15 de l'IEC 61058-1-2:2016.

3.1.18
service
déclaration de la charge à laquelle l'interrupteur est soumis, y compris, le cas échéant, la fermeture, la commande et la coupure, ainsi que leurs durées et leur ordre de succession dans le temps

3.1.19
service type
service continu, temporaire ou périodique comprenant une ou plusieurs charges qui restent constantes pendant la durée spécifiée ou service non périodique pendant lequel généralement la charge varie dans la plage de fonctionnement admissible

[SOURCE: IEC 60050-411:1996, 411-51-13, modifié – "vitesse" est supprimé]

3.1.20
impédance de protection
composant ou ensemble de composants dont l'impédance et la conception sont telles qu'elles assurent la limitation du courant de contact en régime établi et de la charge électrique à des niveaux non dangereux

3.2 Termes et définitions relatifs à la tension et au courant

3.2.1
tension assignée
tension attribuée par le fabricant pour le fonctionnement spécifié

Note 1 à l'article: Elle est mesurée en valeur efficace sauf indication contraire.

Note 2 à l'article: Cette valeur correspond à la valeur maximale et couvre l'ensemble des valeurs inférieures.

3.2.2
très basse tension de sécurité
TBTS
tension ne dépassant pas 50 V efficace en courant alternatif ou 120 V en courant continu entre conducteurs ou entre un conducteur et la terre dans un circuit isolé de l'alimentation principale

Note 1 à l'article: La TBTS est une très basse tension non reliée à la terre (voir IEC 61140).

3.2.3
courant assigné
courant attribué par le fabricant pour le fonctionnement spécifié

Note 1 à l'article: Il est mesuré en valeur efficace sauf indication contraire.

Note 2 à l'article: Cette valeur correspond à la valeur maximale et couvre l'ensemble des valeurs inférieures

3.2.4
charge assignée
type de charge attribuée par le fabricant, selon les classifications

3.2.5
surintensité
courant supérieur au courant assigné

[SOURCE: IEC 60050-441:1984, 441-11-06]

3.2.6
surcharge
conditions de fonctionnement d'un circuit électriquement sain, qui provoquent une surintensité

[SOURCE: IEC 60050-441:1984, 441-11-08]

3.2.7
tension locale
valeur efficace la plus élevée de la tension en courant alternatif ou continu qui peut apparaître à travers n'importe quelle isolation lorsque l'interrupteur est alimenté sous la tension assignée

Note 1 à l'article: Les surtensions transitoires sont négligées.

Note 2 à l'article: Il est tenu compte à la fois des conditions à vide et des conditions normales de fonctionnement.

3.2.8
surtension
tension dont la valeur de crête dépasse la valeur de crête correspondant à la tension maximale en régime établi dans les conditions normales de fonctionnement

3.2.9
catégorie de surtension
chiffre définissant une condition de surtension transitoire

Note 1 à l'article: Voir Annexe E.

3.2.10
tension de tenue aux chocs
valeur de crête la plus élevée d'une tension de choc, de forme et de polarité prescrites, qui ne provoque pas de claquage dans des conditions d'essai spécifiées

3.2.11
charge minimale
charge à laquelle, lorsqu'elle est déclarée, l'interrupteur électronique continue de fonctionner correctement

3.2.12
courant thermique
courant résistif continu qui, dans les conditions d'essai déclarées par le fabricant (pouvant inclure la température ambiante), génère, sans refroidissement forcé, le même échauffement que lorsque l'interrupteur électronique est en fonctionnement dans des conditions ambiantes

spécifiées dans l'appareil à la charge assignée, avec un refroidissement forcé présent, s'il y a lieu

Note 1 à l'article: Le concept "courant thermique" permet un essai simplifié des interrupteurs électroniques, dont les conditions de refroidissement sont complexes dans une application normale. Le courant thermique sera toujours déterminé par des essais d'un interrupteur positionné sur une table ou sur une simple plateforme d'essai, et des essais comparatifs dans l'appareil en question. Par conséquent, le courant thermique sera normalement inférieur au courant assigné. Cela implique des essais supplémentaires des bornes, contacts, etc., afin de s'assurer qu'ils seront ensuite en mesure de supporter le courant assigné, une fois l'interrupteur électronique monté dans l'appareil. Ces essais complémentaires sont spécifiés aux Articles 16 et 17 de l'IEC 61058-1-1:2016 ou de l'IEC 61058-1-2:2016.

3.3 Termes et définitions relatifs aux différents types d'interrupteurs

3.3.1
interrupteur incorporé
interrupteur destiné à être incorporé dans ou monté sur un appareil d'utilisation, mais qui peut être essayé indépendamment de ce dernier

[SOURCE: VEI 442-04-01]

3.3.2
interrupteur intégré
interrupteur dont la fonction dépend de son montage et de sa fixation correctes dans un appareil d'utilisation et qui ne peut être essayé qu'avec les parties correspondantes de cet appareil

[SOURCE: VEI 442-04-02]

3.3.3
interrupteur rotatif
interrupteur dont l'organe de manœuvre est un axe ou une tige qui doit être tourné vers une ou plusieurs positions indexées afin d'obtenir un changement de l'état des contacts

Note 1 à l'article: La rotation de l'organe de manœuvre peut être illimitée ou limitée dans un sens ou dans l'autre.

3.3.4
interrupteur à levier
interrupteur dont l'organe de manœuvre est un levier qui doit être déplacé (basculé) vers une ou plusieurs positions indexées afin d'obtenir un changement de l'état des contacts

3.3.5
interrupteur à touche basculante
interrupteur dont l'organe de manœuvre est un levier de forme aplatie (touche basculante) qui doit être basculé vers une ou plusieurs positions indexées afin d'obtenir un changement de l'état des contacts

3.3.6
interrupteur à bouton-poussoir
interrupteur dont l'organe de manœuvre est un bouton qui doit être poussé afin d'obtenir un changement de l'état des contacts

Note 1 à l'article: L'interrupteur peut être équipé d'un ou de plusieurs organes de manœuvre.

3.3.7
interrupteur à tirage
interrupteur dont l'organe de manœuvre est un cordon de traction qui doit être tiré pour changer l'état des contacts

[SOURCE: IEC 60050-442:1998, 442-04-08, modifié – "dispositif de manoeuvre" modifié en "organe de manoeuvre"]

3.3.8
interrupteur poussez-tirez
interrupteur dont l'organe de manœuvre est une tige qui doit être tirée ou poussée vers une ou plusieurs positions indexées afin d'obtenir un changement de l'état des contacts

3.3.9
interrupteur prépositionné
interrupteur dont les contacts et l'organe de manœuvre reviennent à une position prédéterminée lorsque l'organe de manœuvre est relâché de sa position de commande

3.4 Termes et définitions relatifs au fonctionnement de l'interrupteur

3.4.1
manœuvre
déplacement de l'organe de manœuvre de l'interrupteur effectué à la main, au pied ou de toute autre manière par l'utilisateur

3.4.2
manœuvre indirecte
déplacement de l'organe de manœuvre de l'interrupteur provoqué indirectement par une partie d'un appareil dans lequel l'interrupteur est incorporé ou intégré

Note 1 à l'article: Par exemple, l'interrupteur peut être incorporé ou intégré dans la porte d'un appareil.

3.4.3
organe de manœuvre
partie qui est tirée, poussée, tournée ou influencée d'une quelconque façon pour provoquer le fonctionnement de l'interrupteur

3.4.4
liaison de manœuvre
partie qui peut être interposée entre l'organe de manœuvre et le mécanisme de contact dans le but de permettre son fonctionnement

3.4.5
coupure
interruption d'un circuit électrique dans un pôle de façon à procurer l'isolation entre l'alimentation et les parties à déconnecter de l'alimentation

3.4.6
microcoupure
coupure qui procure un fonctionnement correct par séparation des contacts dans le cas d'une surtension temporaire de longue durée

3.4.7
coupure électronique
coupure qui procure un fonctionnement non cyclique satisfaisant par un dispositif à semiconducteurs (SD) dans le cas d'une surtension temporaire de longue durée

3.4.8
coupure totale
coupure qui procure un fonctionnement correct par séparation des contacts dans le cas d'une surtension temporaire de courte et de longue durée et d'une tension de tenue aux chocs équivalente à l'isolation principale

3.4.9
coupure omnipolaire monophasée
coupure simultanée de tous les conducteurs d'alimentation, excepté le conducteur de terre, par une seule manœuvre pour les appareils à courant alternatif et à courant continu

3.4.10
cycle de manœuvres
suite de manœuvres d'une position à une autre avec retour à la première position en passant par toutes les autres positions, s'il en existe

[SOURCE: IEC 60050-441:1984, 441-16-02]

3.4.11
organe de manœuvre électronique
partie, composant ou groupe de composants qui commande la liaison de manœuvre ou le dispositif de coupure

Note 1 à l'article: Une unité sensible optique ou acoustique est un exemple d'un groupe de composants.

3.4.12
liaison de manœuvre électronique
partie, composant ou groupe de composants qui commande électroniquement le dispositif de coupure

3.4.13
conditions anormales
conditions entraînant une réduction de la sécurité, qui peuvent se présenter dans l'appareil ou dans l'interrupteur durant une manœuvre normale

Note 1 à l'article: Ces conditions (p. ex.: échauffement, protection insuffisante contre les chocs) peuvent être la conséquence de défauts de l'interrupteur ou des conditions ambiantes associées, qui sont prévisibles dans le cas d'avaries ou d'un fonctionnement dégradé d'autres composants de l'application. Les cas de mauvais usage/emploi (volontaire) ne sont pas couverts.

3.4.14
unité sensible
unité réglable par des moyens autres que mécaniques et constituée de composants électroniques qui commande la grandeur de sortie au moyen de composants électroniques ou unité qui est activée par tout phénomène physique ou par une combinaison de ceux-ci

3.4.15
conditions de défaut
conditions anormales causées par une défaillance à l'intérieur de l'interrupteur, qui peuvent être simulées par des modifications de l'interrupteur

3.5 Termes et définitions relatifs au raccordement de l'interrupteur

3.5.1
conducteur externe
câble, cordon ou conducteur qui est extérieur à l'interrupteur

3.5.2
conducteur intégré
conducteur qui se trouve à l'intérieur d'un interrupteur, ou qui est utilisé pour le raccordement permanent des bornes ou des terminaisons d'un interrupteur

3.6 Termes et définitions relatifs aux bornes et aux terminaisons

3.6.1
borne
partie conductrice d'un interrupteur, destinée à le connecter à un ou plusieurs conducteurs externes

3.6.2
borne à vis
borne permettant le raccordement et/ou l'interconnexion et la déconnexion ultérieure d'un ou de plusieurs conducteurs, le raccordement étant réalisé, directement ou indirectement, au moyen de vis ou d'écrous de tout type

Note 1 à l'article: Des exemples de bornes à vis sont donnés aux Figures 1 à 5.

3.6.3
borne sans vis
borne permettant le raccordement et/ou l'interconnexion et la déconnexion ultérieure d'un ou de plusieurs conducteurs, la connexion étant réalisée directement ou indirectement par des moyens autres que des vis

Note 1 à l'article: Des exemples de bornes sans vis sont donnés à la Figure 6.

Note 2 à l'article: Les bornes pousse-fil, qui sont des bornes de fil permettant de maintenir en place un conducteur dénudé introduit dans la borne, sont couvertes par la définition des bornes sans vis.

3.6.4
terminaison
dispositif servant à la connexion non démontable d'un interrupteur aux conducteurs externes

3.6.5
bornes plates à connexion rapide
raccordement électrique comprenant une languette et un clip pouvant être accouplés et désaccouplés avec ou sans l'utilisation d'un outil

[SOURCE: IEC 60050-442:1998, 442-06-07]

3.6.6
languette
partie d'une borne plate à connexion rapide qui reçoit le clip et qui fait partie intégrante de l'interrupteur

Note 1 à l'article: Des exemples de languettes sont donnés dans l'IEC 61210.

3.6.7
clip
partie d'une borne plate à connexion rapide qui est enfichée sur la languette

Note 1 à l'article: Un exemple de clip est donné à la Figure 7.

3.6.8
borne à souder
partie conductrice d'un interrupteur prévue pour permettre de réaliser une terminaison par soudure

3.7 Termes et définitions relatifs à l'isolation

3.7.1
isolation principale
isolation des parties actives destinée à assurer la protection principale contre les chocs électriques

3.7.2
isolation supplémentaire
isolation indépendante prévue en plus de l'isolation principale en vue d'assurer la protection contre les chocs électriques en cas de défaut de l'isolation principale

3.7.3
double isolation
isolation comprenant à la fois une isolation principale et une isolation supplémentaire

3.7.4
isolation renforcée
isolation unique des parties actives assurant un degré de protection contre les chocs électriques équivalant à une double isolation

Note 1 à l'article: Le terme "isolation unique" n'implique pas que l'isolation soit homogène. Elle peut comporter plusieurs couches qui ne peuvent pas être soumises à l'essai séparément en tant qu'isolation principale ou isolation supplémentaire.

3.7.5
isolation fonctionnelle
isolation entre parties actives, uniquement nécessaire pour le bon fonctionnement de l'interrupteur

3.7.6
revêtement
matériau isolant solide posé sur l'une ou les deux faces de la carte imprimée

Note 1 à l'article: Ce revêtement peut être un vernis ou un film sec posé sur la carte imprimée, ou peut être obtenu par dépôt thermique.

Note 2 à l'article: Le revêtement et le matériau de base forment un système isolant qui peut avoir des propriétés similaires à l'isolation solide.

3.7.7
isolation solide
matériau isolant interposé entre deux parties conductrices

Note 1 à l'article: Dans le cas d'une carte imprimée à revêtement, l'isolation solide est constituée de la carte elle-même ainsi que du revêtement. Dans d'autres cas, l'isolation solide est constituée du matériau d'encapsulation.

3.7.8
appareil de classe 0
appareil dans lequel la protection contre les chocs électriques repose sur l'isolation principale, ce qui implique qu'aucune mesure n'existe pour le raccordement des parties conductrices accessibles éventuelles à un conducteur de protection des canalisations fixes de l'installation, la protection en cas de défaut de l'isolation principale reposant sur l'environnement

3.7.9
appareil de classe I
appareil dans lequel la protection contre les chocs électriques ne repose pas uniquement sur l'isolation principale, mais dans lequel a été prise une mesure de sécurité supplémentaire sous la forme de moyens de raccordement des parties conductrices accessibles (qui ne sont pas des parties actives) à un conducteur de protection (conducteur de terre) faisant partie du câblage fixe de manière telle que ces parties conductrices accessibles ne puissent pas devenir dangereuses en cas de défaut de l'isolation principale

3.7.10
appareil de classe II
appareil dans lequel la protection contre les chocs électriques ne repose pas uniquement sur l'isolation principale, mais dans lequel ont été prises des mesures supplémentaires de sécurité, telles que la double isolation ou l'isolation renforcée, ces mesures ne comportant pas de dispositif de mise à la terre de protection et ne dépendant pas des conditions d'installation

Note 1 à l'article: Un appareil de classe II peut être équipé de moyens permettant d'assurer la continuité du circuit de protection, à condition que de tels moyens soient placés à l'intérieur de l'appareil et isolés des surfaces accessibles selon les exigences de classe II.

3.7.11
appareil de classe III
appareil dans lequel la protection contre les chocs électriques repose sur l'alimentation sous TBTS et dans lequel ne sont pas engendrées de tensions supérieures à la TBTS

3.7.12
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

[SOURCE: IEC 60050-212:2010, 212-11-59]

3.8 Termes et définitions relatifs à la pollution

3.8.1
pollution
apport de matériau étranger solide, liquide ou gazeux qui peut entraîner une réduction de la rigidité diélectrique ou de la résistivité de la surface de l'isolation

3.8.2
micro-environnement
environnement immédiat de l'isolation qui influence en particulier le dimensionnement des lignes de fuite

Note 1 à l'article: Pour la pollution produite dans le tube à décharge des interrupteurs, se reporter à l'Annexe F.

3.8.3
macro-environnement
environnement de la pièce ou de tout autre endroit dans lequel l'interrupteur est installé ou utilisé

3.8.4
degré de pollution
nombre caractérisant la pollution prévue du micro-environnement

Note 1 à l'article: Les degrés de pollution 1, 2 et 3 sont utilisés (voir 7.8, 7.9 et l'Annexe F).

3.9 Termes et définitions relatifs aux essais du fabricant

3.9.1
essai individuel de série
essai auquel est soumis chaque interrupteur d'appareil en cours de fabrication et/ou en fin de fabrication pour vérifier qu'il satisfait aux exigences applicables de la présente partie de l'IEC 61058 (voir Annexe K).

3.9.2
essai sur prélèvement
essai effectué sur un certain nombre d'interrupteurs prélevés au hasard dans un lot

Note 1 à l'article: Les essais sur prélèvement sont spécifiés à l'Annexe L.

[SOURCE: IEC 60050-811:1991, 811-10-06, modifié – "dispositifs" remplacé par "interrupteurs"]

3.9.3
essai de type
essai effectué sur un ou plusieurs interrupteurs réalisés selon une conception donnée pour vérifier que cette conception répond à certaines spécifications

[SOURCE: IEC 60050-811:1991, 811-10-04, modifié – "dispositifs" remplacé par "interrupteurs"]

4 Exigences générales

Les interrupteurs doivent être conçus et construits de telle manière que, en usage normal, ils fonctionnent sans risque afin de ne pas mettre en danger les personnes ni l'environnement, même en cas d'usage négligent pouvant survenir en usage normal, comme spécifié dans la série IEC 61058-1.

La conformité est vérifiée en effectuant tous les essais appropriés.

5 Informations générales sur les essais

5.1 Les essais doivent être réalisés conformément aux directives générales données à l'Article 5

5.1.1 *En général, les conditions d'essais applicables aux caractéristiques supérieures d'un interrupteur peuvent être représentatives des caractéristiques d'essai applicables aux caractéristiques inférieures. Voir 5.2.*

5.1.2 *Dans tous les essais, les instruments ou moyens de mesure doivent être tels qu'ils n'affectent pas de façon appréciable les grandeurs à mesurer.*

5.1.3 *Si un seul spécimen ne satisfait pas aux exigences d'un essai aux Articles 14, 15, 16 et 17 (Article 17 de l'IEC 61058-1-1:2016 ou de l'IEC 61058-1-2:2016), cet essai ainsi que les essais précédents pouvant avoir influencé les résultats de l'essai doivent être répétés et les essais ultérieurs doivent aussi être réalisés dans le même ordre prévu avec de nouveaux spécimens, l'intégralité devant alors satisfaire aux exigences.*

5.1.4 *Sauf spécification contraire dans la présente norme, les spécimens sont soumis à l'essai dans l'état où ils sont livrés à une température ambiante de 25 °C ± 10 °C.*

5.1.5 *Les spécimens sont montés selon les indications du fabricant, mais en utilisant, le cas échéant, la méthode la plus défavorable si plus d'une méthode est déclarée.*

5.1.6 *Pour les essais de la présente norme, la manœuvre peut être réalisée par l'équipement d'essai. La manœuvre peut être appliquée à l'organe de manœuvre ou à la liaison de manœuvre. Il n'est pas nécessaire qu'un interrupteur soit muni de l'organe de manœuvre s'il est déclaré comme étant amovible.*

5.1.7 *Les interrupteurs à utiliser avec un conducteur fixé à demeure sont soumis à l'essai, le conducteur approprié étant raccordé.*

5.1.8 *Si les interrupteurs sont équipés de languettes, des clips neufs doivent être utilisés pour les essais selon l'Article 16 (dans l'IEC 61058-1) et l'Article 17 (dans l'IEC 61058-1-1:2016 ou l'IEC 61058-1-2:2016). Les clips doivent être d'un type compatible avec la température ambiante assignée de l'interrupteur, et les conducteurs sertis doivent être soudés ou brasés sur la partie à sertir du clip, s'il y a lieu.*

5.1.9 *Si, dans les interrupteurs pour les appareils de classe 0 ou de classe I, il est nécessaire d'avoir des parties avec double isolation ou avec isolation renforcée, ces parties sont soumises à un contrôle afin de vérifier qu'elles satisfont aux exigences spécifiées pour les interrupteurs pour appareils de classe II. De la même façon, si dans les interrupteurs, il est nécessaire d'avoir des parties fonctionnant en TBTS, ces parties sont également soumises à un contrôle afin de vérifier qu'elles satisfont aux exigences spécifiées pour les interrupteurs pour appareils de classe III.*

5.2 Informations électriques

5.2.1 *Lorsque plusieurs caractéristiques assignées sont combinées ou représentées par les essais décrits ci-après, les informations suivantes s'appliquent à l'ensemble des essais.*

Essai de rigidité diélectrique (Article 15 et TE3) – basé sur la tension la plus élevée.

Essai d'échauffement (Article 16 et TE2) – basé sur le courant assigné le plus élevé.

5.2.2 *Il est admis de réaliser des essais d'endurance représentatifs pour le même type de charge classifié (voir 7.2) dans les conditions suivantes:*

a) *Tension – L'essai exigé au titre des caractéristiques assignées à une tension supérieure constitue l'essai exigé au titre des caractéristiques assignées à une tension inférieure.*

   NOTE Par exemple, les interrupteurs de 5 A/125 V en courant alternatif et de 5 A/250 V en courant alternatif sont soumis à l'essai à 5 A/250 V en courant alternatif.

b) *Courant – L'essai à un courant supérieur constitue l'essai à un courant inférieur.*

   NOTE Par exemple, les interrupteurs de 10 A/250 V en courant alternatif et de 5 A/250 V en courant alternatif sont soumis à l'essai à 10 A/250 V en courant alternatif.

5.2.3 *Les interrupteurs comportant au moins deux caractéristiques assignées sont soumis à l'essai d'endurance pour chaque caractéristique assignée sur un lot de 3 spécimens supplémentaires, sauf s'il est admis de réaliser un essai représentatif.*

5.2.4 *Les interrupteurs pour courant continu sans marquage des polarités sont soumis à l'essai d'endurance sur 3 spécimens avec une polarité et sur un lot de 3 spécimens supplémentaires avec la polarité inverse.*

5.2.5 *Les interrupteurs pour courant continu et alternatif sont soumis à l'essai d'endurance à une tension continue pour représenter la tension alternative si les caractéristiques assignées de tension/courant continus pour le type de charge classifié (voir 7.2) sont supérieures ou égales aux caractéristiques assignées alternatives.*

NOTE Par exemple, les interrupteurs à courant assigné alternatif et continu de 4 A/48 V en courant alternatif et de 4 A/48 V en courant continu sont soumis à l'essai d'endurance à 4 A/48 V en courant continu.

5.2.6 *Les interrupteurs pour courant alternatif seulement pour chaque type de charge avec 2 valeurs assignées de courant ou plus, à un courant nominal assigné 100 – 480 V c.a., à la même puissance, sont soumis à l'essai à la tension la plus élevée.*

NOTE *Par exemple, les interrupteurs à courant assigné alternatif de 10 A/125 V en courant alternatif, de 5 A/250 V en courant alternatif et de 4,5 A/277 V en courant alternatif sont soumis à l'essai à 4,5 A/277 V en courant alternatif.*

5.2.7 *Les interrupteurs pour courant alternatif seulement pour chaque type de charge, avec 2 valeurs assignées de courant ou plus, à un courant nominal assigné 20 – 100 V c.a., à la même puissance, sont soumis à l'essai d'endurance au courant le plus élevé.*

NOTE *Par exemple, les interrupteurs à courant assigné alternatif de 10 A/24 V en courant alternatif et de 5 A/48 V en courant alternatif sont soumis à l'essai d'endurance à 10 A/24 V en courant alternatif.*

5.2.8 *Les interrupteurs ayant une fréquence assignée sont soumis à l'essai d'endurance à cette fréquence. Les interrupteurs sans fréquence assignée sont soumis à l'essai à la fréquence de 50 Hz. Les interrupteurs ayant une plage de fréquences assignées sont soumis à l'essai à la fréquence la plus défavorable de cette plage.*

NOTE Par exemple, un interrupteur classifié de 50 Hz à 60 Hz est soumis à l'essai à la fréquence de 50 Hz.

5.2.9 *Les interrupteurs destinés à fonctionner avec une alimentation spécifique sont soumis à l'essai avec cette alimentation spécifique.*

5.3 Charges d'essai appliquées aux interrupteurs à directions multiples

Les interrupteurs à directions multiples sont chargés selon le Tableau 1. La charge pour les autres positions de l'interrupteur résulte des charges nécessaires pour accomplir les conditions spécifiées ci-dessus.

Tableau 1 – Essais de charge des interrupteurs à directions multiples

Cycle de manœuvres	Interrupteur en position de	Charge
Première moitié	Plus forte charge	I_R
	Charge immédiatement inférieure	0,8 × I_R
	Charge inférieure suivante	0,533 × I_R
Deuxième moitié	Plus forte charge	I_R
	Charge immédiatement inférieure	0,5 × I_R
	Charge inférieure suivante	0,333 × I_R

5.4 Eprouvettes d'essai

Le nombre minimal de spécimens d'essai doit être conforme à l'IEC 61058-1-1 ou à l'IEC 61058-1-2. Sauf spécification contraire, les essais peuvent être effectués dans n'importe quel ordre.

6 Caractéristiques assignées

6.1 La tension assignée maximale est 480 V.

6.2 Le courant assigné maximal est 63 A.

6.3 Les interrupteurs avec indicateurs de signalisation peuvent avoir différentes tensions assignées pour les indicateurs de signalisation.

La conformité aux exigences de 6.1 à 6.3 est vérifiée par examen conjointement avec l'Article 8.

6.4 Un interrupteur ayant plus d'un circuit peut ne pas avoir la même classification pour chaque circuit. L'Annexe D peut être utilisée pour déterminer si la caractéristique assignée particulière d'un interrupteur convient pour la commande du circuit dans l'utilisation réelle.

7 Classification

7.1 Selon la nature de l'alimentation

7.1.1 interrupteurs pour courant alternatif seulement;

7.1.2 interrupteurs pour courant continu seulement;

7.1.3 interrupteurs pour courant alternatif et continu.

7.2 Selon le type de charge à commander par chaque circuit de l'interrupteur

7.2.1 circuit convenant à une charge pratiquement résistive avec un facteur de puissance au moins égal à 0,9;

7.2.2 circuit convenant à une charge résistive, une charge de moteur avec un facteur de puissance au moins égal à 0,6 ou une combinaison des deux;

7.2.3 circuit convenant à une combinaison associant des charges capacitives et résistives;

7.2.4 circuit convenant à une charge de lampe à filament de tungstène ordinaire;

7.2.5 circuit convenant à une charge spécifique déclarée;

7.2.6 circuit convenant à un courant n'excédant pas 20 mA;

7.2.7 circuit convenant à une charge de lampe spécifique;

7.2.8 circuit convenant à une charge inductive avec un facteur de puissance au moins égal à 0,6;

7.2.9 circuit convenant à une charge de moteur spécifique avec un rotor bloqué et un facteur de puissance au moins égal à 0,6;

7.2.10 circuit convenant à une charge d'usage général avec un facteur de puissance au moins égal à 0,75.

7.3 Selon la température ambiante

7.3.1 interrupteurs dont toutes les parties sont destinées à être utilisées à $0\ °C \leq T \leq 55\ °C$;

7.3.2 interrupteurs non classifiés en 7.3.1 et en 7.3.3;

7.3.3 interrupteurs comportant des parties accessibles à une température ambiante et des parties non accessibles à une température ambiante différente:

– organe et parties accessibles à $0\ °C \leq T \leq 55\ °C$, et
– autres parties de l'interrupteur non classifiées pour la plage $0°C \leq T \leq 55\ °C$.

7.4 Selon le nombre de cycles de manœuvres

7.4.1 100 000 cycles de manœuvres;

7.4.2 50 000 cycles de manœuvres;

7.4.3 25 000 cycles de manœuvres;

7.4.4 10 000 cycles de manœuvres;

7.4.5 6 000 cycles de manœuvres;

7.4.6 3 000 cycles de manœuvres;

7.4.7 1 000 cycles de manœuvres;

7.4.8 300 cycles de manœuvres;

7.4.9 cycles de manœuvres – selon le nombre déclaré pour une utilisation spécifique.

7.5 Selon le degré de protection contre les corps solides étrangers

NOTE Déterminé selon l'IEC 60529, l'interrupteur étant monté selon les indications déclarées.

7.5.1 en l'absence de déclaration, l'interrupteur n'est pas protégé contre les corps solides étrangers (IP0X);

7.5.2 protégé contre les corps solides étrangers de diamètre supérieur ou égal à 50 mm (IP1X);

7.5.3 protégé contre les corps solides étrangers de diamètre supérieur ou égal à 12,5 mm (IP2X);

7.5.4 protégé contre les corps solides étrangers de diamètre supérieur ou égal à 2,5 mm (IP3X);

7.5.5 protégé contre les corps solides étrangers de diamètre supérieur ou égal à 1 mm (IP4X);

7.5.6 protégé contre la poussière (IP5X);

7.5.7 totalement protégé contre la poussière (IP6X).

7.6 Selon le degré de protection contre la pénétration de l'eau

NOTE Déterminé selon l'IEC 60529, l'interrupteur étant monté selon les indications déclarées.

7.6.1 en l'absence de déclaration, l'interrupteur n'est pas protégé contre la pénétration de l'eau (IPX0);

7.6.2 protégé contre les chutes verticales de gouttes d'eau (IPX1);

7.6.3 protégé contre les chutes verticales de gouttes d'eau lorsque l'enveloppe est inclinée jusqu'à 15° (IPX2);

7.6.4 protégé contre les gouttes d'eau (IPX3);

7.6.5 protégé contre les projections d'eau (IPX4);

7.6.6 protégé contre les jets d'eau (IPX5);

7.6.7 protégé contre les jets d'eau puissants (IPX6);

7.6.8 protégé contre les effets d'une immersion temporaire jusqu'à 1 m de profondeur (IPX7);

7.6.9 protégé contre les effets d'une immersion prolongée au-delà de 1 m de profondeur (IPX8);

7.6.10 protégé contre les effets du nettoyage à haute pression (IPX9).

7.7 Selon le degré de protection contre les chocs électriques de l'appareil équipé d'un interrupteur

7.7.1 appareil de classe 0;

7.7.2 appareil de classe I;

7.7.3 appareil de classe II;

7.7.4 appareil de classe III.

NOTE Les classes sont expliquées en 3.7.8, en 3.7.9, en 3.7.10 et en 3.7.11.

7.8 Selon le degré de pollution à l'intérieur de l'interrupteur

7.8.1 degré de pollution 1 du micro-environnement;

7.8.2 degré de pollution 2 du micro-environnement;

7.8.3 degré de pollution 3 du micro-environnement.

7.9 Selon le degré de pollution à l'extérieur de l'interrupteur

7.9.1 degré de pollution 1 du macro-environnement;

7.9.2 degré de pollution 2 du macro-environnement;

7.9.3 degré de pollution 3 du macro-environnement.

NOTE Les degrés de micropollution et de macropollution sont spécifiés en 3.8 et à l'Annexe F.

7.10 Selon le marquage

7.10.1 Interrupteur avec marquage limité UT (référence unique de type, UT);

7.10.2 Interrupteur avec marquage complet CT (référence commune de type, CT).

NOTE Les références de type sont expliquées en 3.1.8 et en 3.1.9.

7.11 Selon la résistance à l'inflammabilité à la température du fil incandescent

7.11.1 650 °C;

7.11.2 750 °C;

7.11.3 850 °C;

7.11.4 960 °C.

La résistance à la chaleur anormale de l'interrupteur représente la température minimale du fil incandescent pour les matériaux des parties qui sont en contact avec des connexions électriques, qui les maintiennent ou qui les retiennent en position, y compris les pièces qui maintiennent une connexion électrique sous la pression d'un ressort.

7.12 Selon la tension de tenue aux chocs assignée

7.12.1 330 V;

7.12.2 500 V;

7.12.3 800 V;

7.12.4 1 500 V;

7.12.5 2 500 V;

7.12.6 4 000 V.

NOTE La relation entre la tension de tenue aux chocs assignée, la tension assignée et la catégorie de surtension est donnée à l'Annexe E.

7.13 Selon la catégorie de surtension assignée

7.13.1 catégorie I;

7.13.2 catégorie II;

7.13.3 catégorie III.

NOTE La relation entre la tension de tenue aux chocs assignée, la tension assignée et la catégorie de surtension est donnée à l'Annexe E.

7.14 Selon le type de coupure

7.14.1 coupure électronique;

7.14.2 microcoupure;

7.14.3 coupure totale;

7.14.4 les commutateurs présentant une combinaison de coupures doivent être déclarés de manière spécifique selon leur construction.

NOTE Les coupures sont expliquées en 3.4.6, en 3.4.7 et en 3.4.8.

7.15 Selon le type de revêtement pour les cartes imprimées rigides équipées

7.15.1 revêtement de type 1;

7.15.2 revêtement de type 2.

NOTE Les explications concernant les revêtements de types 1 et 2 sont données à l'Annexe I.

7.16 Selon le type et/ou le raccordement des interrupteurs

7.16.1 nombre de pôles;

7.16.2 nombre de directions;

7.16.3 inversion de polarité;

7.16.4 coupure omnipolaire;

7.16.5 nombre de connexions transversales non commutables;

7.16.6 selon le code de type d'interrupteur donné au Tableau 2.

NOTE Des détails concernant les types d'interrupteurs et de connexions sont donnés au Tableau 2.

7.17 Selon la configuration du dispositif de coupure

7.17.1 interrupteur électronique avec un SD sans interrupteur mécanique;

7.17.2 interrupteur électronique avec un SD et un interrupteur mécanique monté en série;

7.17.3 interrupteur électronique avec un SD et un interrupteur mécanique monté en parallèle;

7.17.4 interrupteur électronique avec un SD et un interrupteur mécanique monté en série et en parallèle;

7.17.5 interrupteur électronique comportant seulement un interrupteur mécanique sans SD (le SD doit être fourni dans l'application finale);

7.17.6 interrupteur mécanique avec ou sans fonction électronique qui n'impacte pas la sécurité de l'interrupteur;

7.17.7 interrupteur mécanique avec fonction électronique qui impacte la sécurité de l'interrupteur.

7.18 Selon le service type

7.18.1 service continu – Service type S1 (voir Figure 12);

7.18.2 service temporaire – Service type S2 avec temps à l'état FERME et à l'état OUVERT déterminés (voir Figure 13);

7.18.3 service périodique intermittent. Service type S3 avec temps à l'état FERME et à l'état OUVERT déterminés (voir Figure 14);

7.18.4 selon le type déclaré pour une utilisation spécifique.

NOTE Le concept de service type est tiré de l'IEC 60034-1.

7.19 Selon la liaison entre le contact et la vitesse de l'actionneur

7.19.1 la vitesse de fermeture ou d'ouverture du contact dépend de la vitesse de l'actionneur.

7.19.2 la vitesse de fermeture et d'ouverture du contact ne dépend pas de la vitesse de l'actionneur.

7.20 Selon le type des bornes

7.20.1 bornes destinées au raccordement de conducteurs non préparés;

7.20.2 bornes destinées au raccordement de conducteurs préparés;

NOTE Le torsadage d'un conducteur à âme câblée pour en consolider l'extrémité n'est pas considéré comme une préparation spéciale.

7.20.3 bornes destinées au raccordement de conducteurs à âmes câblées souples;

7.20.4 bornes destinées au raccordement de conducteurs à âmes câblées rigides;

7.20.5 bornes destinées au raccordement de conducteurs rigides;

7.20.6 bornes destinées aux plages de tailles de conducteurs selon le Tableau 4;

7.20.7 bornes destinées à une plage limitée déclarée de tailles de conducteurs;

7.20.8 bornes destinées au raccordement d'un seul conducteur;

7.20.9 bornes destinées au raccordement de deux conducteurs ou plus;

7.20.10 bornes destinées à être assemblées une seule fois;

7.20.11 bornes destinées à être assemblées et désassemblées plus d'une fois.

NOTE Une borne pousse-fil destinée seulement à être insérée (pas de liaison de coupure) est considérée comme une borne destinée à être assemblée une seule fois. Une borne pousse-fil comportant une liaison de coupure ou une borne à vis est considérée comme une borne destinée à être assemblée et désassemblée plus d'une fois.

7.20.12 bornes à vis et connexions;

7.20.13 bornes pousse-fil et connexions;

7.20.14 borne plate à connexion rapide;

NOTE Les dimensions normalisées pour les terminaisons sont définies dans l'IEC 61210.

7.20.15 bornes à souder;

7.20.16 bornes à soudure ou à moulure;

7.20.17 fils pour connexions;

7.20.18 bornes pour perçage de conducteurs;

7.20.19 bornes déclarées par le fabricant.

NOTE Les bornes peuvent présenter différentes caractéristiques.

7.21 Selon le type de protection intégrée

7.21.1 protection intégrée fournie;

7.21.2 aucune protection fournie.

NOTE Les détails de l'essai des protections intégrées sont donnés à l'Article 23.

7.22 Selon le type de refroidissement forcé

7.22.1 aucun refroidissement forcé nécessaire;

7.22.2 refroidissement forcé exigé (description du refroidissement forcé).

NOTE Les détails de l'essai du refroidissement forcé sont donnés à l'Article 23.

7.23 Selon le condensateur fourni avec l'interrupteur

7.23.1 condensateur de classe X1;

7.23.2 condensateur de classe X2;

7.23.3 condensateur de classe X3;

7.23.4 condensateur de classe Y2;

7.23.5 condensateur de classe Y4.

NOTE 1 Les définitions de classes de condensateurs sont données dans l'IEC 60384-14.

NOTE 2 Les exigences relatives aux condensateurs sont données en 24.3.

Tableau 2 – Nature et raccordement des interrupteurs *(1 de 7)*

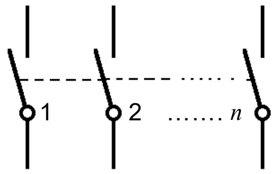
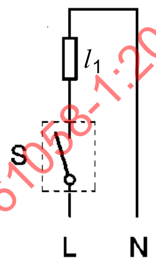
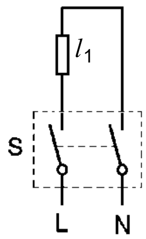
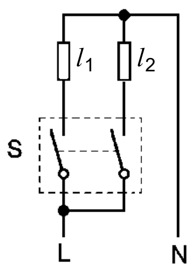
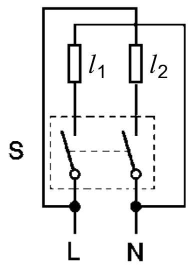
Code[1)]	Type d'interrupteur	Type de raccordement	Circuit d'essai[2)]
	Interrupteurs à une direction		
	Principe applicable aux interrupteurs à une direction comptant un à *n* pôles		
1.1	Nombre de pôles, type de raccordement et charges conformes aux indications déclarées		
1.2	Un pôle	Une charge (coupure unipolaire)	 S = spécimen
1.3	Deux pôles	Une charge (coupure sur tous les pôles)	 S = spécimen
1.4 [1.2]	Deux pôles	Deux charges (coupure unipolaire)	 S = spécimen
1.5 [1.2] [1.4]	Deux pôles	Deux charges (coupure unipolaire, charge connectée à la polarité opposée)	 S = spécimen

Tableau 2 *(2 de 7)*

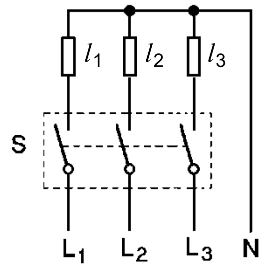
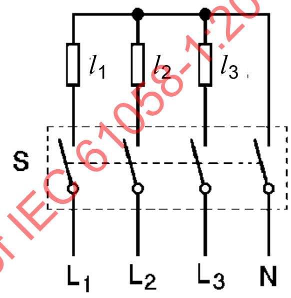
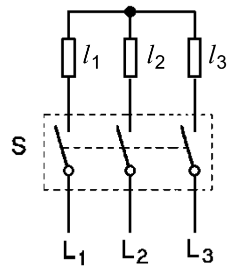
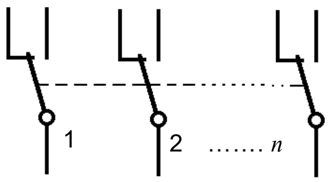
Code1)	Type d'interrupteur	Type de raccordement	Circuit d'essai2)
1.6	Trois pôles	Trois charges avec neutre non coupé (coupure tripolaire)	 S = spécimen
1.7	Quatre pôles	Trois charges avec neutre coupé (coupure quadripolaire)	 S = spécimen
1.8	Trois pôles	Trois charges (coupure tripolaire)	 S = spécimen
Interrupteurs à une direction			
	Principe applicable aux interrupteurs à une direction comptant un à *n* pôles		

Tableau 2 *(3 de 7)*

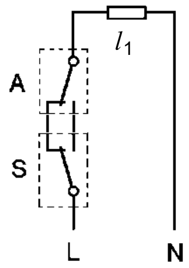
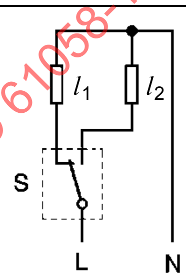
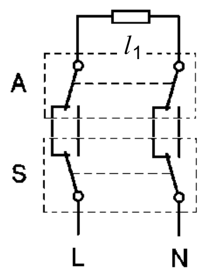
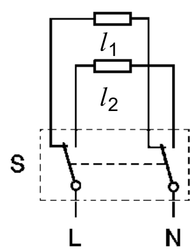
Code[1)]	**Type d'interrupteur**	**Type de raccordement**	**Circuit d'essai[2)]**
2.1	Nombre de pôles, type de raccordement et charges conformes aux indications déclarées		
2.2 [1.2]	Un pôle	Une charge (coupure unipolaire)	 S = spécimen A = interrupteur auxiliaire
2.3	Un pôle	Deux charges (coupure unipolaire)	 S = spécimen
2.4 [1.3]	Deux pôles	Une charge (coupure sur tous les pôles)	 S = spécimen A = interrupteur auxiliaire
2.5	Deux pôles	Deux charges (coupure sur tous les pôles)	 S = spécimen

Tableau 2 *(4 de 7)*

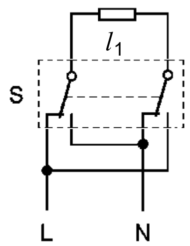
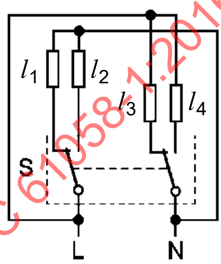
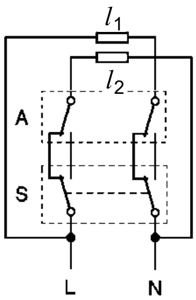
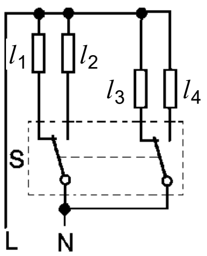
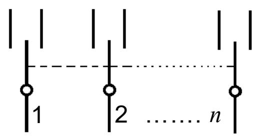
Code[1)]	Type d'interrupteur	Type de raccordement	Circuit d'essai[2)]
2.6	Deux pôles	Une charge avec inversion de polarité	 S = spécimen
2.7	Deux pôles	Quatre charges (coupure unipolaire, charge connectée à la polarité opposée)	 S = spécimen
2.8	Deux pôles	Deux charges (coupure unipolaire, charge connectée à la polarité opposée)	 S = spécimen A = interrupteur auxiliaire
2.9	Deux pôles	Quatre charges (coupure unipolaire)	 S = spécimen
Interrupteurs à deux directions avec position de coupure centrale			
	Principe applicable aux interrupteurs à deux directions avec position centrale comptant un à *n* pôles		

Tableau 2 *(5 de 7)*

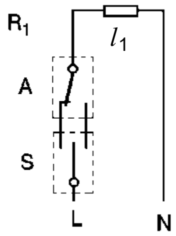
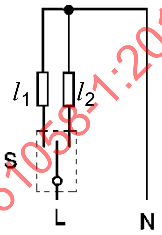
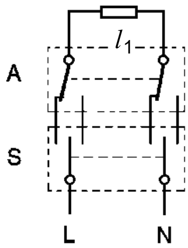
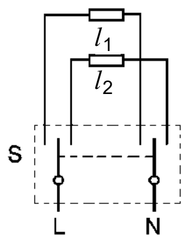
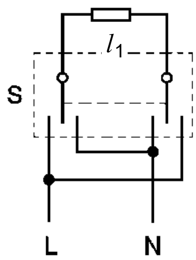
Code[1)]	Type d'interrupteur	Type de raccordement	Circuit d'essai[2)]
3.1	Nombre de pôles, type de raccordement et charges conformes aux indications déclarées		
3.2	Un pôle	Une charge (coupure unipolaire)	 S = spécimen A = interrupteur auxiliaire
3.3	Un pôle	Deux charges (coupure unipolaire)	 S = spécimen
3.4	Deux pôles	Une charge (coupure sur tous les pôles)	 S = spécimen A = interrupteur auxiliaire
3.5	Deux pôles	Deux charges (coupure sur tous les pôles)	 S = spécimen
3.6	Deux pôles	Une charge avec inversion de polarité (coupure sur tous les pôles)	 S = spécimen

Tableau 2 *(6 de 7)*

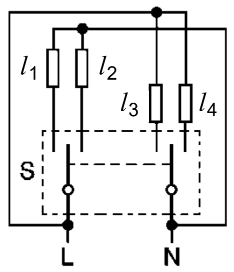
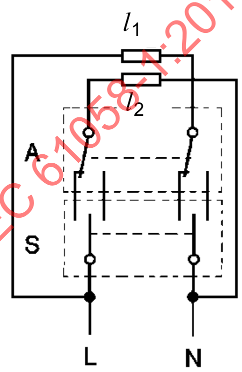
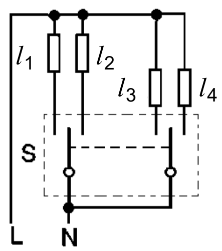
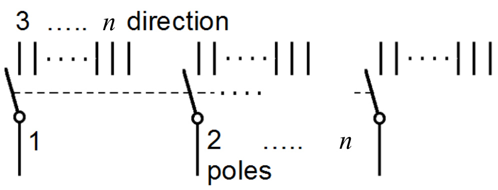
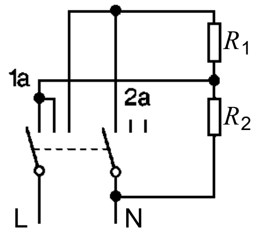
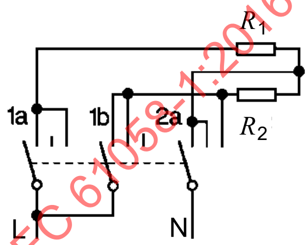
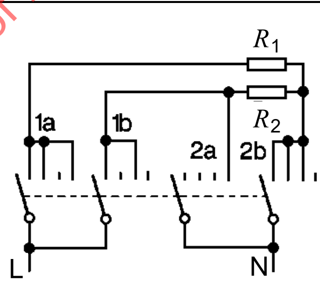
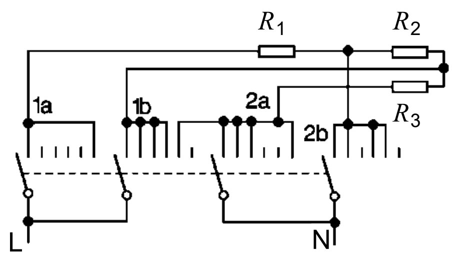
Code[1)]	Type d'interrupteur	Type de raccordement	Circuit d'essai[2)]
3.7 [3.3]	Deux pôles	Quatre charges (coupure unipolaire, charge connectée à la polarité opposée)	 S = spécimen
3.8	Deux pôles	Deux charges (coupure unipolaire, charge connectée à la polarité opposée)	 S = spécimen A = interrupteur auxiliaire
3.9 [3.3]	Deux pôles	Quatre charges (coupure unipolaire)	 S = spécimen
Interrupteurs à directions multiples			
	Principe applicable aux interrupteurs à directions multiples comptant 3 à *n* directions et 1 à *n* pôles		

Tableau 2 *(7 de 7)*

Code[1)]	Type d'interrupteur	Type de raccordement
4.1	Nombre de pôles, type de raccordement et charges conformes aux indications déclarées	
4.2	Un pôle Quatre positions avec inversion de polarité (coupure unipolaire)	
4.3	Deux pôles Quatre positions avec inversion de polarité (coupure sur tous les pôles)	
4.4	Deux pôles Cinq positions avec inversion de polarité (coupure sur tous les pôles)	
4.5	Deux pôles Sept positions avec inversion de polarité (coupure sur tous les pôles)	

1) Pour les interrupteurs offrant une conception de base identique, l'essai est considéré comme englobant les essais applicables au code d'interrupteur indiqué entre crochets.

Les interrupteurs sont réputés présenter une conception de base identique lorsque:

– l'ensemble des composants sont identiques, hormis ceux utilisés en raison d'un nombre différent de pôles et de chemins de contact;

– les dimensions de base et les constructions mécaniques sont identiques;

– les interrupteurs multipolaires sont constitués d'interrupteurs unipolaires ou intègrent les mêmes composants que les interrupteurs unipolaires et offrent des dimensions globales par pôles identiques.

Il n'est pas nécessaire de procéder à un essai séparé sur un interrupteur à action momentanée (interrupteur monostable) s'il peut être démontré que la fonction de contact est équivalente à celle d'un interrupteur bistable de construction équivalente.

2) Les symboles L et N représentent la connexion au réseau d'alimentation principal.

8 Marquage et documentation

8.1 Informations sur les interrupteurs

8.1.1 Généralités

Le fabricant d'interrupteurs doit fournir les informations appropriées pour que:

– le fabricant d'appareils puisse choisir et installer un interrupteur;
– l'utilisateur final puisse utiliser un interrupteur comme prévu par le fabricant d'interrupteurs;
– les essais correspondants puissent être effectués selon la présente norme.

Les informations doivent être indiquées de manière claire et non ambiguë:

Ces informations doivent être fournies par un ou plusieurs des moyens suivants par marquage de l'interrupteur et/ou par le biais de la documentation, de la manière décrite au Tableau 3.

8.1.2 Marquage de l'interrupteur

Les informations doivent être fournies par un marquage sur l'interrupteur lui-même.

8.1.3 Documentation

Les informations doivent être fournies dans une documentation distincte, laquelle peut désigner une feuille de spécification ou un dessin, par exemple.

Le contenu de la documentation doit être tenu à la disposition du fabricant de l'appareil ou de l'utilisateur final selon le cas, dans tout format approprié.

NOTE 1 La mention Marquage/Documentation signifie que les informations peuvent être fournies par marquage ou par le biais de la documentation.

NOTE 2 Le format dans lequel ces informations sont présentées ne relève pas du domaine d'application de la présente norme.

Tableau 3 – Informations relatives aux interrupteurs et aux charges placées dans les groupes

N°	Caractéristique	Paragraphe	Moyen d'information	
			Référence commune de type CT (7.10.2)	Référence unique de type UT (7.10.1)
1	**IDENTIFICATION DE L'INTERRUPTEUR**			
1.1	Marque d'identification du fabricant ou du vendeur responsable (nom ou marque commerciale)	8.1	Marquage	Marquage
1.2	Identificateur de l'interrupteur (référence du modèle, par exemple)	8.1	Marquage	Marquage
2	**ENVIRONNEMENT DE L'INTERRUPTEUR/MONTAGE**			
2.1	Degré de protection fourni pour l'interrupteur lorsqu'il est monté conformément à la documentation (Code IP de l'IEC 60529)	7.5 et 7.6	Documentation	Documentation
2.2	Degré de protection contre les chocs électriques de l'extérieur d'un appareil	7.7	Documentation	Documentation
2.3	Méthode de montage et de manœuvre de l'interrupteur et méthode de mise à la terre selon le cas. La ou les méthodes prévues de montage, et les orientations prévues doivent être déclarées. Sauf spécification contraire, les méthodes déclarées de montage avec les bornes de terre sont supposées être les méthodes de mise à la terre des parties conductrices.	7.1.7 et 7.1.7.7	Documentation	Documentation
2.4	Degré de micropollution	7.8	Documentation	Documentation
2.5	Degré de macropollution	7.9	Documentation	Documentation
3	**TEMPERATURE**			
3.1	Limites de température de l'air ambiant si différentes de 0 °C à 55 °C	7.3	Marquage	Documentation
4	**CHARGE ELECTRIQUE**			
4.1	Tension assignée ou plage des tensions assignées	6.1	Marquage	Documentation
4.2	Nature de l'alimentation si l'interrupteur n'est pas destiné à être utilisé à la fois en courant alternatif et en courant continu ou si les valeurs assignées sont différentes en alternatif et en continu	7.1	Marquage	Documentation
4.3	Fréquence ou plage de fréquences si elles sont différentes de 50 Hz ou 50 Hz à 60 Hz	5.2.8	Marquage	Documentation
4.4	Courant assigné et type de charge électrique	7.2	Marquage	Documentation
4.5	Pour les interrupteurs pour plus d'un circuit, le courant applicable à chaque circuit et à chaque borne. Si ceux-ci sont différents les uns des autres, il doit être clairement indiqué à quel circuit ou borne s'applique l'information.	7.16 et 5.2 le cas échéant	Marquage/Documentation	Documentation
4.6	Tension de tenue aux chocs assignée NOTE Non exigée lorsque 4.7 est déclaré.	7.12	Documentation	Documentation
4.7	Catégorie de surtension	7.13	Documentation	Documentation
4.8	Service type et informations applicables (temps à l'état FERME/OUVERT)	7.18	Documentation	Documentation
4.9	Type et/ou raccordement de l'interrupteur	7.16	Documentation	Documentation

N°	Caractéristique	Paragraphe	Moyen d'information	
			Référence commune de type CT (7.10.2)	Référence unique de type UT (7.10.1)
4.10	Configuration du dispositif de coupure	7.17	Documentation	Documentation
5	**BORNES/CONDUCTEURS**			
5.1	Toutes les bornes doivent être clairement identifiées, ou leur usage doit être évident, ou les circuits de l'interrupteur doivent être visibles. Pour les bornes prévues pour la connexion des conducteurs, d'alimentation, l'identification peut être faite sous la forme d'une lettre L, d'un nombre ou d'une flèche.	8.1	Marquage	Marquage
5.2	Les bornes destinées au raccordement des conducteurs de terre doivent être marquées du symbole terre de protection	8.2	Marquage	Marquage
5.3	Méthode de connexion et de déconnexion des bornes pousse-fil	11.2.2	Documentation	Documentation
5.4	Type de conducteur à raccorder à la borne (rigide ou à âme câblée)	7.20	Documentation	Documentation
5.5	Aptitude de la borne au raccordement des conducteurs indiqués (diamètre minimal et maximal de conducteur)	7.20	Documentation	Documentation
5.6	Aptitude de la borne au raccordement de deux conducteurs ou plus	7.20	Documentation	Documentation
5.7	Type de fixation mécanique de la borne à souder avant soudure (acier, bain, etc.)	7.20	Documentation	Documentation
5.8	Pour les bornes employant une méthode de connexion spécifique, les informations telles que la température ou le procédé de soudure doivent être déclarées.	7.20	Documentation	Documentation
5.9	Pour les bornes destinées aux conducteurs préparés, préciser la méthode utilisée pour la préparation des conducteurs (soudage par bain, connecteur à sertir, etc.).	7.20	Documentation	Documentation
5.10	Pour les languettes de dimensions autres que celles de l'IEC 61210, clip approprié (dimension, matériau ou isolant le cas échéant, par exemple).	7.20	Documentation	Documentation
6	**CYCLES/SEQUENCE DE MANŒUVRES**			
6.1	Nombre de cycles de manœuvres	7.4	Marquage	Documentation
6.2	Séquence de manœuvres pour les interrupteurs avec plus d'un circuit, si important. Pour les interrupteurs avec plusieurs circuits, les séquences de manœuvres des paires de contacts doivent être déclarées si cela est important pour la sécurité de l'utilisateur. Les contacts qui "se ferment avant de s'ouvrir" ou "s'ouvrent avant de se fermer" sont des exemples	13.5 et 5	Documentation	Documentation
6.3	Forces appliquées aux butées ou en course totale de l'organe de manœuvre	17.4 IEC 61058-1-1 ou IEC 61058-1-2	Documentation	Documentation
7	**INDICATEURS DE SIGNALISATION**			

N°	Caractéristique	Paragraphe	Moyen d'information	
			Référence commune de type CT (7.10.2)	Référence unique de type UT (7.10.1)
7.1	Puissance maximale pour les lampes à filament de tungstène. Le marquage doit être visible lors du remplacement de la lampe	6.3	Marquage	Marquage
7.2	Destination de la fonction ou de l'opération de l'indicateur de signalisation	8.1 et 12.2.5	Documentation	Documentation
8	**COUPURE DU CIRCUIT**			
8.1	Coupure électronique	7.14.1	Marquage	Documentation
8.2	Microcoupure	7.14.2	Marquage	Documentation
8.3	Coupure totale	7.14.3	Documentation	Documentation
8.4	A protection combinée	7.14.4	Documentation	Documentation
9	**MATERIAUX ISOLANTS**			
9.1	Suivi de l'ITC ou de l'IRC	20.4	Documentation	Documentation
9.2	Températures du fil incandescent	7.11	Documentation	Documentation
9.3	Type de revêtement pour les cartes imprimées rigides équipées	7.15	Documentation	Documentation
10	**CONDITION DE REFROIDISSEMENT**			
10.1	Aucun refroidissement forcé nécessaire	7.22	Documentation	Documentation
10.2	Avec refroidissement forcé	7.22	Documentation	Documentation
10.3	Direction de l'air de refroidissement	7.22	Documentation	Documentation
10.4	Vitesse de l'air de refroidissement	7.22	Documentation	Documentation
10.5	Résistance thermique du radiateur	7.22	Documentation	Documentation
10.6	Température, densité et autres détails du flux d'air pénétrant	7.22	Documentation	Documentation
11	**DISPOSITIF DE PROTECTION**			
11.1	Courant assigné/caractéristiques de fonctionnement / pouvoir de coupure de la protection remplaçable incorporée	7.21	Marquage	Documentation
11.2	Type / fonction de la protection non remplaçable incorporée	7.21	Documentation	Documentation
11.3	Pouvoir de coupure du dispositif de protection externe, courant assigné/caractéristiques de fonctionnement	24.2	Documentation	Documentation
12	**CONDITIONS D'ESSAI**			
12.1	Condition d'essai pour les interrupteurs disposant d'une vitesse de fermeture et d'ouverture de contact indépendante de la vitesse de manœuvre	7.19	Documentation	Documentation
12.2	Exigences spéciales pour les essais telles que la charge électrique minimale définie en 3.2.11 ou encore le courant thermique (3.2.12)		Documentation	Documentation

8.2 Symboles

Lorsque des symboles sont utilisés, ils doivent être conformes aux normes IEC 60417, IEC 60529 et IEC 60617. Les exemples incluent ce qui suit: