UL 61058-1

STANDARD FOR SAFETY

Switches for Appliances – Part 1: General Requirements

UL Standard for Safety for Switches for Appliances – Part 1: General Requirements, UL 61058-1

Fifth Edition, Dated November 3, 2017

Summary of Topics

This revision of ANSI/UL 61058-1 dated June 30, 2021 includes a correction in Table 16 – Minimum requirements for capacitors, to correct the value of "X1" to "X2" in the column titled "Without overcurrent protection[1)]".

UL 61058-1 shall be used in conjunction with the First Edition of the Standard for Switches for Appliances – Part 1-1: Requirements for Mechanical Switches, UL 61058-1-1 and the First Edition of the Standard for Switches for Appliances – Part 1-2: Requirements for Electronic Switches, UL 61058-1-2. Please note that the National Difference document incorporates all of the U.S. national differences for UL 61058-1.

Text that has been changed in any manner or impacted by UL's electronic publishing system is marked with a vertical line in the margin.

The revised requirements are substantially in accordance with Proposal(s) on this subject dated March 12, 2021.

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CAN/CSA-C22.2 No. 61058-1:17
Third Edition
(IEC 61058-1:2016, MOD)

Underwriters Laboratories Inc.
UL 61058-1
Fifth Edition

Switches for Appliances – Part 1: General Requirements

November 3, 2017

(Title Page Reprinted: June 30, 2021)

This national standard is based on publication IEC 61058-1, Fourth Edition (2016).

Commitment for Amendments

This standard is issued jointly by the Canadian Standards Association (operating as “CSA Group”) and Underwriters Laboratories Inc. (UL). Comments or proposals for revisions on any part of the standard may be submitted to CSA Group or UL at anytime. Revisions to this standard will be made only after processing according to the standards development procedures of CSA Group and UL. CSA Group and UL will issue revisions to this standard by means of a new edition or revised or additional pages bearing their date of issue.

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This Standard is subject to review within five years from the date of publication, and suggestions for its improvement will be referred to the appropriate committee. The technical content of the IEC and ISO publications is kept under constant review by IEC and ISO. To submit a proposal for change, please send the following information to inquiries@csagroup.org and include "Proposal for change" in the subject line: Standard designation (number); relevant clause, table, and/or figure number; wording of the proposed change; and rationale for the change.

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This ANSI/UL Standard for Safety consists of the Fifth Edition including revisions through June 30, 2021. The most recent designation of ANSI/UL 61058-1 as an American National Standard (ANSI) occurred on May 3, 2021. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page (front and back), or the Preface. The National Difference Page and IEC Foreword are also excluded from the ANSI approval of IEC-based standards.

Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at https://csds.ul.com.

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PREFACE

This is the harmonized CSA Group and UL standard for Switches for Appliances – Part 1: General Requirements. It is the third edition of CAN/CSA-C22.2 No. 61058-1, and the fifth edition of UL 61058-1. This edition of CAN/CSA-C22.2 No. 61058-1 supersedes the previous edition published in 2009 as CAN/CSA-C22.2 No. 61058-1 (adopted IEC 61058-1:2000+A1:2001+A2:2007). This edition of UL 61058-1 supersedes the previous edition published on August 10, 2009. This harmonized standard has been jointly revised on June 30, 2021. For this purpose, CSA Group and UL are issuing revision pages dated June 30, 2021.

This harmonized standard is based on IEC Publication 61058-1: fourth edition Switches for Appliances – Part 1: General Requirements issued July 2016. IEC 61058-1 is copyrighted by the IEC.

This harmonized standard was prepared by CSA Group and Underwriters Laboratories Inc. (UL). The efforts and support of the International Harmonization Committee on Switches for Appliances are gratefully acknowledged.

This standard is considered suitable for use for conformity assessment within the stated scope of the standard.

This standard was reviewed by the CSA Integrated Committee on Wiring Devices, under the jurisdiction of the CSA Technical Committee on Wiring Products and the CSA Strategic Steering Committee on Requirements for Electrical Safety, and has been formally approved by the CSA Technical Committee. This standard has been developed in compliance with Standards Council of Canada requirements for National Standards of Canada. It has been published as a National Standard of Canada by CSA Group.

Application of Standard

Where reference is made to a specific number of samples to be tested, the specified number is to be considered a minimum quantity.

Note: Although the intended primary application of this standard is stated in its scope, it is important to note that it remains the responsibility of the users of the standard to judge its suitability for their particular purpose.

This CAN/CSA-C22.2 No. 61058-1 Part 1 is to be used in conjunction with the appropriate CAN/CSA-C22.2 No. 61058-1-1 – Part 1-1 or CAN/CSA-C22.2 No. 61058-1-2 – Part 1-2, which contains clauses to supplement or modify the corresponding clauses in the Part 1, to provide relevant requirements for each type of product. This is the UL Standard for Safety for Switches for Appliances – Part 1: General Requirements. This UL Part 1 is to be used in conjunction with the appropriate UL 61058-1-1 Part 1-1 or UL 61058-1-2 Part 1-2, which contains clauses to supplement or modify the corresponding clauses in the Part 1, to provide relevant requirements for each type of product.

Level of Harmonization

This standard adopts the IEC text with national differences.

This standard is published as an identical standard for CSA Group and UL.

An identical standard is a standard that is exactly the same in technical content except for national differences resulting from conflicts in codes and governmental regulations and basic safety principles and requirements. Presentation is word for word except for editorial changes.

All national differences from the IEC text are included in the CSA Group and UL versions of the standard. While the technical content is the same in each organization's version, the format and presentation may differ.

Reasons for Differences From IEC

National differences from the IEC are being added in order to address safety and regulatory situations present in the US and Canada.

Interpretations

The interpretation by the standards development organization of an identical or equivalent standard is based on the literal text to determine compliance with the standard in accordance with the procedural rules of the standards development organization. If more than one interpretation of the literal text has been identified, a revision is to be proposed as soon as possible to each of the standards development organizations to more accurately reflect the intent.

IEC Copyright

For CSA Group, the text, figures, and tables of International Electrotechnical Commission Publication 61058-1, Switches for Appliances – Part 1: General Requirements, copyright 2016, are used in this standard with the consent of the International Electrotechnical Commission. The IEC Foreword is not a part of the requirements of this standard but is included for information purposes only.

NATIONAL DIFFERENCES

National Differences from the text of International Electrotechnical Commission (IEC) Publication 61058-1, Switches for Appliances – Part 1: General Requirements, copyright 2016, are indicated by notations (differences) and are presented in bold text. The national difference type is included in the body.

There are five types of National Differences as noted below. The difference type is noted on the first line of the National Difference in the standard. The standard may not include all types of these National Differences.

DR – These are National Differences based on the **national regulatory requirements**.

D1 – These are National Differences which are based on **basic safety principles and requirements**, elimination of which would compromise safety for consumers and users of products.

D2 – These are National Differences from IEC requirements based on existing **safety practices**. These requirements reflect national safety practices, where empirical substantiation (for the IEC or national requirement) is not available or the text has not been included in the IEC standard.

DC – These are National Differences based on the **component standards** and will not be deleted until a particular component standard is harmonized with the IEC component standard.

DE – These are National Differences based on **editorial comments or corrections**.

Each national difference contains a description of what the national difference entails. Typically one of the following words is used to explain how the text of the national difference is to be applied to the base IEC text:

Addition / Add - An addition entails adding a complete new numbered clause, subclause, table, figure, or annex. Addition is not meant to include adding select words to the base IEC text.

Modification / Modify - A modification is an altering of the existing base IEC text such as the addition, replacement or deletion of certain words or the replacement of an entire clause, subclause, table, figure, or annex of the base IEC text.

Deletion / Delete - A deletion entails complete deletion of an entire numbered clause, subclause, table, figure, or annex without any replacement text.

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FOREWORD

INTERNATIONAL ELECTROTECHNICAL COMMISSION

SWITCHES FOR APPLIANCES – PART 1: GENERAL REQUIREMENTS

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.

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6) All users should ensure that they have the latest edition of this publication.

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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.

DV.1 D2 *Addition of the following:*

This nationally adopted Part 1 standard shall be used in conjunction with the nationally adopted IEC 61058-1-x Part 1 standards and any nationally adopted IEC 61058-2-x Part 2 standards. For references to IEC 61058, IEC 61058-1, IEC 61058-1-1, or IEC 61058-1-2, replace the reference with CAN/CSA-C22.2 No. 61058 / UL 61058, CAN/CSA-C22.2 No. 61058-1 / UL 61058-1, CAN/CSA-C22.2 No. 61058-1-1 / UL 61058-1-1, or CAN/CSA-C22.2 No. 61058-1-2 / UL 61058-1-2 accordingly.

DV.2 DE *Addition of the following:*

The numbering system in the standard uses a space instead of a comma to indicate thousands and uses a comma instead of a period to indicate a decimal point. For example, 1 000 means 1,000 and 1,01 means 1.01.

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".

1DV.1 D2 *Modification of Clause 1 to add the following to indicate which switches do not apply:*

These requirements do not cover switches that are covered by an existing standard such as those constructed so that they can be installed readily in a flush-device box intended to be used in a wiring system that complies with CSA C22.1 and NFPA 70. This part does not apply to switches intended to be covered within the scope of CSA C22.2 No. 111, UL 20, CSA C22.2 No. 4, UL 98, CSA C22.2 No. 205, or UL 773A.

1DV.2 D2 *Modification of Clause 1 to add the following note:*

NOTE 4 The term "earthing" as used in this standard relates to "bonding."

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

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

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

2DV DE *Modification of Clause 2 to add the following:*

CSA Group

C22.1
Canadian Electrical Code, Part I

C22.2 No. 4
Enclosed and Dead-Front Switches

C22.2 No. 111
General-Use Snap Switches

C22.2 No. 205
Signal Equipment

CAN/CSA-C22.2 No. 61058-1-1
Switches for Appliances – Part 1-1: Requirements for Mechanical Switches

CAN/CSA-C22.2 No. 61058-1-2
Switches for Appliances – Part 1-2: Requirements for Electronic Switches

NFPA (National Fire Protection Association)

NFPA 70
National Electrical Code

UL (Underwriters Laboratories Inc.)

UL 20
General-Use Snap Switches

UL 98
Enclosed and Dead-Front Switches

UL 773A
Nonindustrial Photoelectric Switches for Lighting Control

UL 61058-1-1
Switches for Appliances – Part 1-1: Requirements for Mechanical Switches

UL 61058-1-2
Switches for Appliances – Part 1-2: Requirements for Electronic Switches

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 Figure 1 through Figure 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.*

5.1.10DV D2 *Addition of Clauses 5.1.10DV.1 – 5.1.10DV.3:*

5.1.10DV.1 During the endurance test of Clause 17 (Clause 17 in CAN/CSA-C22.2 No. 61058-1-1 / UL 61058-1-1 and CAN/CSA-C22.2 No. 61058-1-2 / UL 61058-1-2), all exposed dead metal parts shall be connected through a fuse to earth. Dead metal parts can include frame, enclosures, and actuators. The potential between live parts and dead metal parts shall be the full test potential. The purpose of the fuse is to detect hazardous earth arcs shorting from live parts to exposed dead metal.

5.1.10DV.2 The fuse amperage rating shall not be greater than 15 A, but shall be less than the available output amperage of the electrical supply source. The fuse voltage rating shall be equal to or greater than the maximum potential to earth.

5.1.10DV.3 *Compliance is checked by inspection of the fuse. During the test, the fuse shall remain intact and not open.*

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,

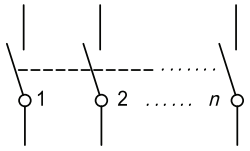
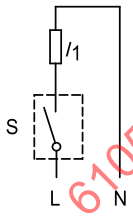
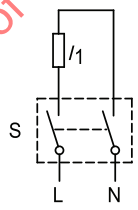
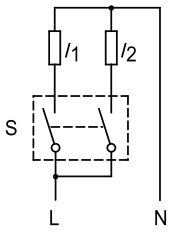
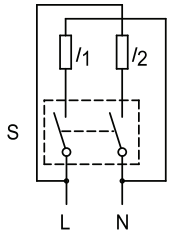
7.23.5 Capacitor class Y4.

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

NOTE 2 Explanations of capacitor requirements are given in 24.3.

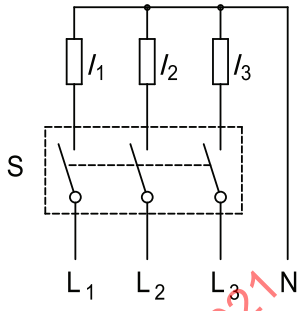
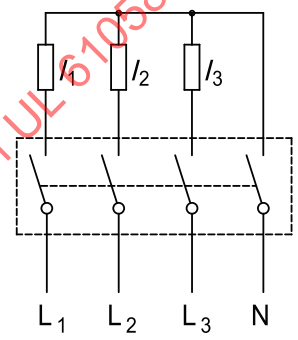
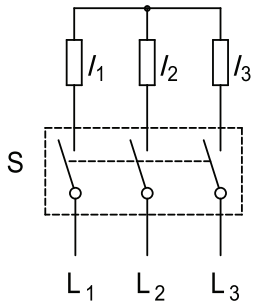
Table 2

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
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

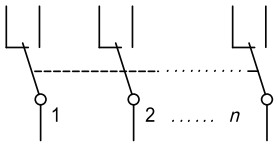
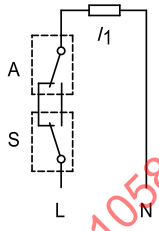
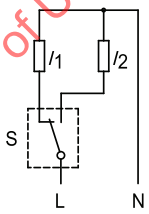
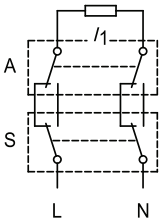
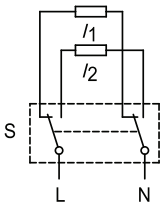
s4748a

Table 2 *(2 of 8)*

Code [1]	Type of switch	Type of connection	Test circuit [2]
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 lods (three-pole disconnection)	 S = Specimen

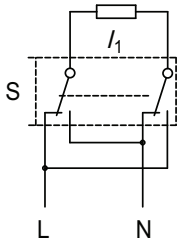
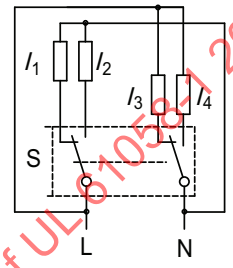
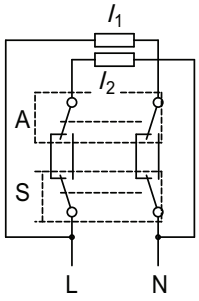
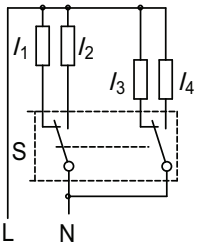
s4749a

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
2.5	Double pole	Double load (all-pole disconnection)	 S = Specimen

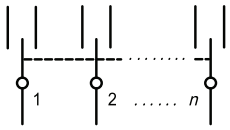
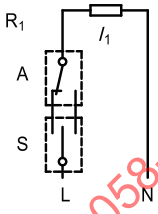
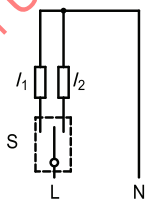
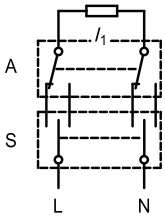
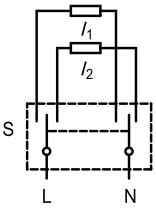
s4750a

Table 2 *(4 of 8)*

Code [1]	Type of switch	Type of connection	Test circuit [2]
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

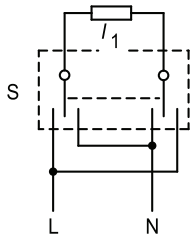
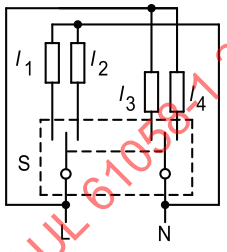
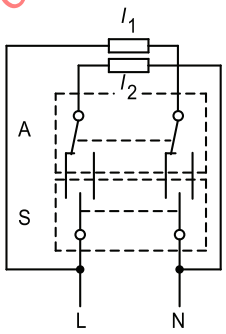
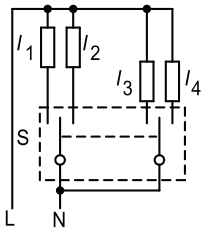
s4751a

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

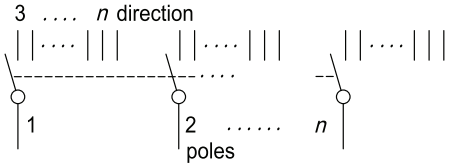
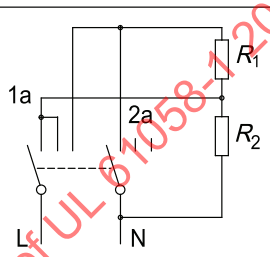
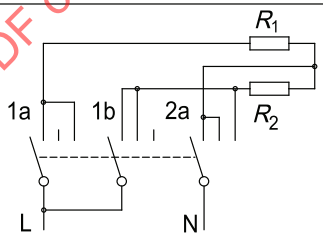
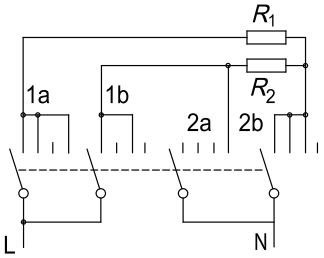
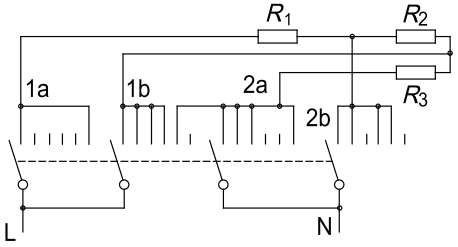
s4752a

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

su0180a

Table 2 *(7 of 8)*

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

s4754a

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 considered 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
5.2	Terminals for the connection of earthing conductors shall be marked with the protective earth symbol	8.2	Marking	Marking

Table 3 Continued on Next Page

Table 3 Continued

No	Characteristic	Subclause	Means of information	
			Common type reference CT (7.10.2)	Unique type reference UT (7.10.1)
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
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

Table 3 Continued on Next Page

Table 3 Continued

No	Characteristic	Subclause	Means of information	
			Common type reference CT (7.10.2)	Unique type reference UT (7.10.1)
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	
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	

Symbol for the "ON" position or the direction of actuation of 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 ~

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

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 ~

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

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 ~

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

Figure 8, Figure 9 and Figure 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 ~

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

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 ~

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.

10.10DV D2 *Addition of the following clause to provide requirements for push-in type terminals:*

A push-in (screwless) terminal shall not be used for connection of an earthing conductor or in the earthing path.

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			
A		Cross-sectional areas mm²			
Over	Up to and including	Minimum	Medium	Maximum	Terminal size
–	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			
A		Cross-sectional areas mm²			
Over	Up to and including	Minimum	Medium	Maximum	Terminal size
–	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
NOTE 1 "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 overvoltages as 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 Figure 2 and Figure 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	Force N	
A	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		Torque				
mm		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			3		
	1[3)]	2[4)]		Material group			Material group		
V	mm	mm	mm	I mm	II mm	III[5)] mm	I mm	II mm	III[5)] 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

Table 14 Continued on Next Page

Table 14 Continued

Working voltage r.m.s.[1]	Printed board assemblies		Pollution degree [2] [6]						
	Pollution degree		1[3]	2			3		
	1[3]	2[4]		Material group			Material group		
				I	II	III[5]	I	II	III[5]
V	mm	mm	mm	mm	mm	mm	mm	mm	mm
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 I_n (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 I_n (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.

NOTE 2 "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)		
		130 V < U_n ≤ 480 V	
	U_n ≤ 130 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.

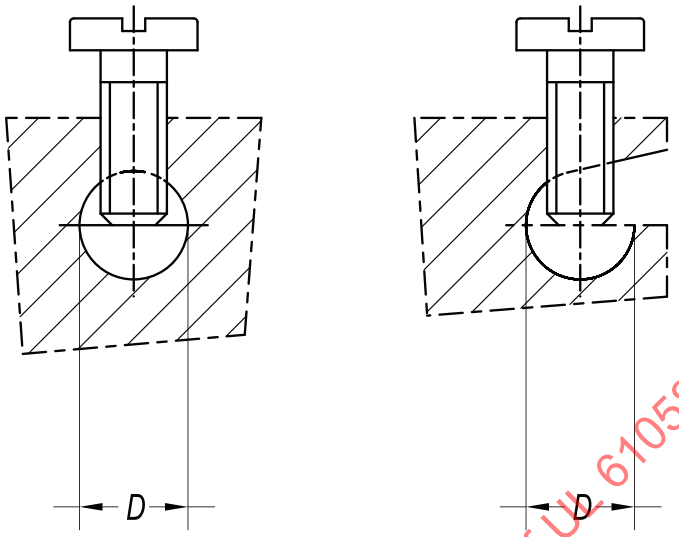
b) At the load and/or control terminals (8.1.4.2 of CISPR 15:2013).

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:

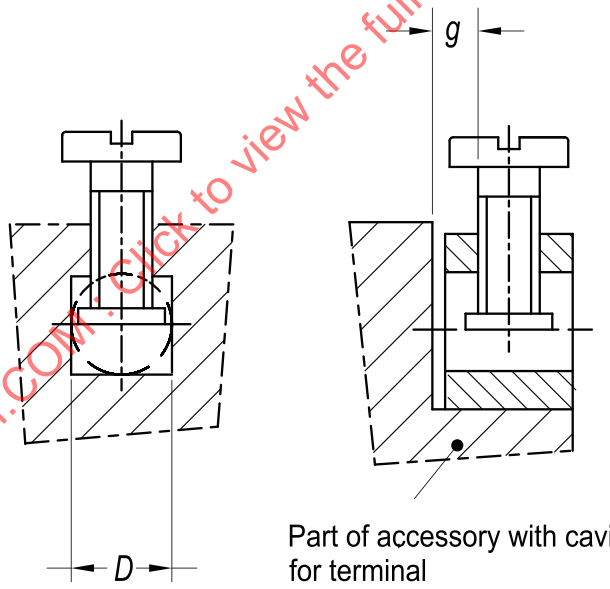
150 kHz, 240 kHz, 550 kHz, 1 MHz, 1,4 MHz, 2 MHz, 3,5 MHz, 6 MHz, 10 MHz, 22 MHz and 30 MHz.

Figure 1

Examples of pillar terminals



Terminals without pressure plates



Part of accessory with cavity for terminal

Terminals with pressure plates

IEC

s5000d

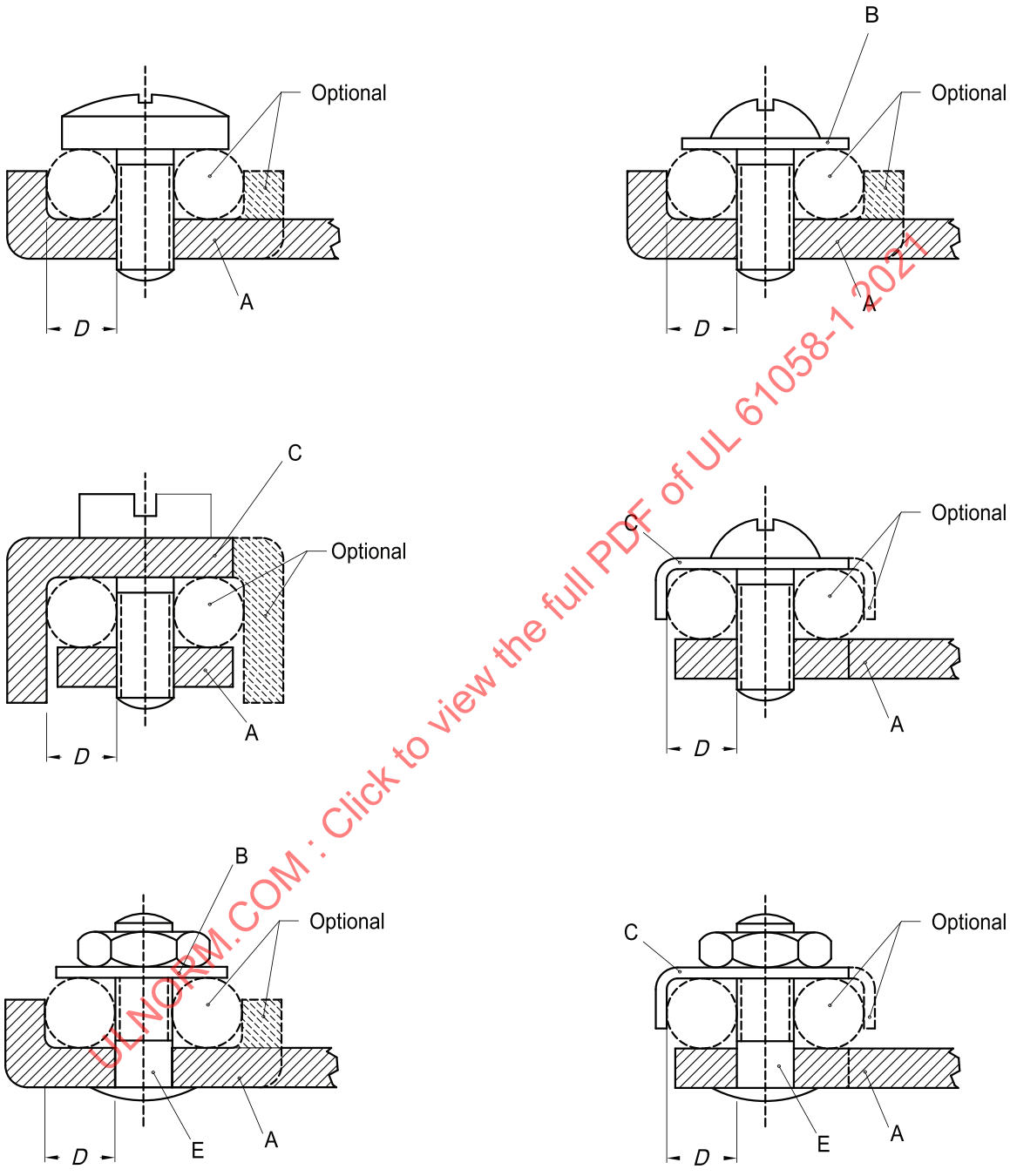
Key

D conductor space (not specified)

g distance between clamping screw and end-stop (not specified)

Figure 2

Examples of screw terminals and stud terminals



sm474e

Key

A fixed part

B washer or clamping plate

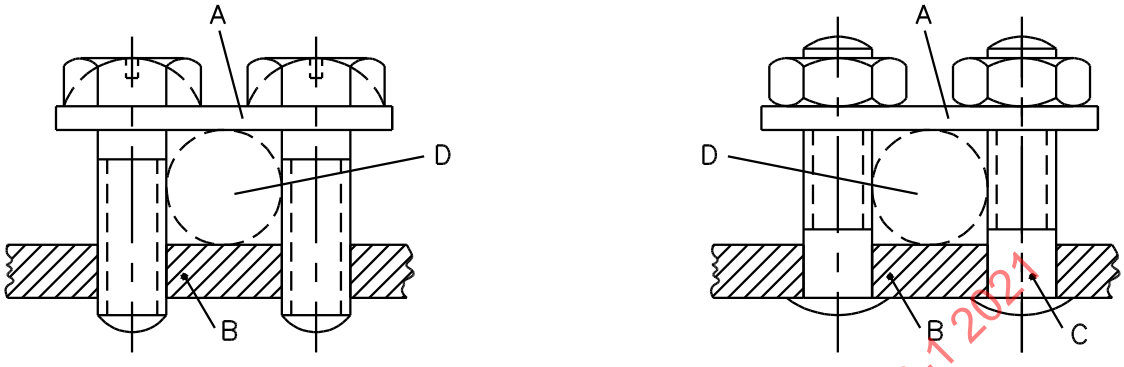
C anti-spred device

D conductor space (not specified)

E stud

Figure 3

Examples of saddle terminals



SM464A

Key

A saddle

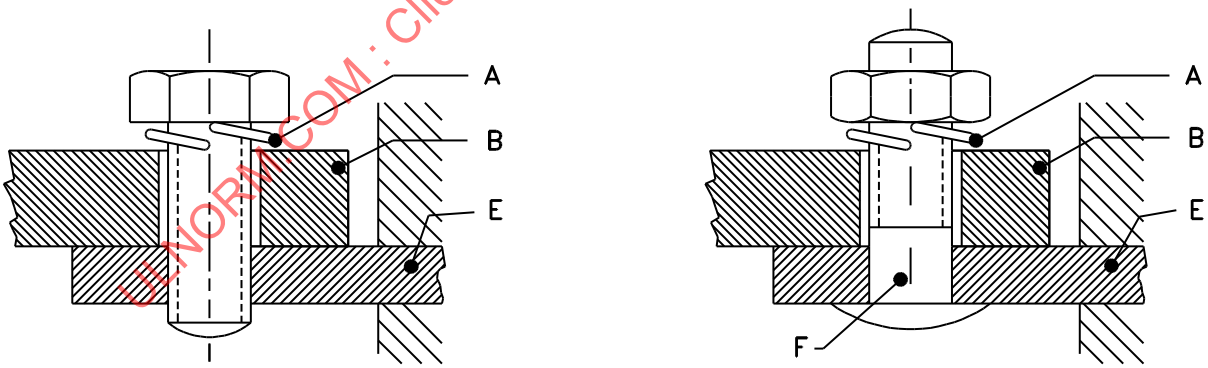
B cable lug or bar

C stud

D conductor space (not specified)

Figure 4

Examples of lug terminals



SM465A

Key

A locking means

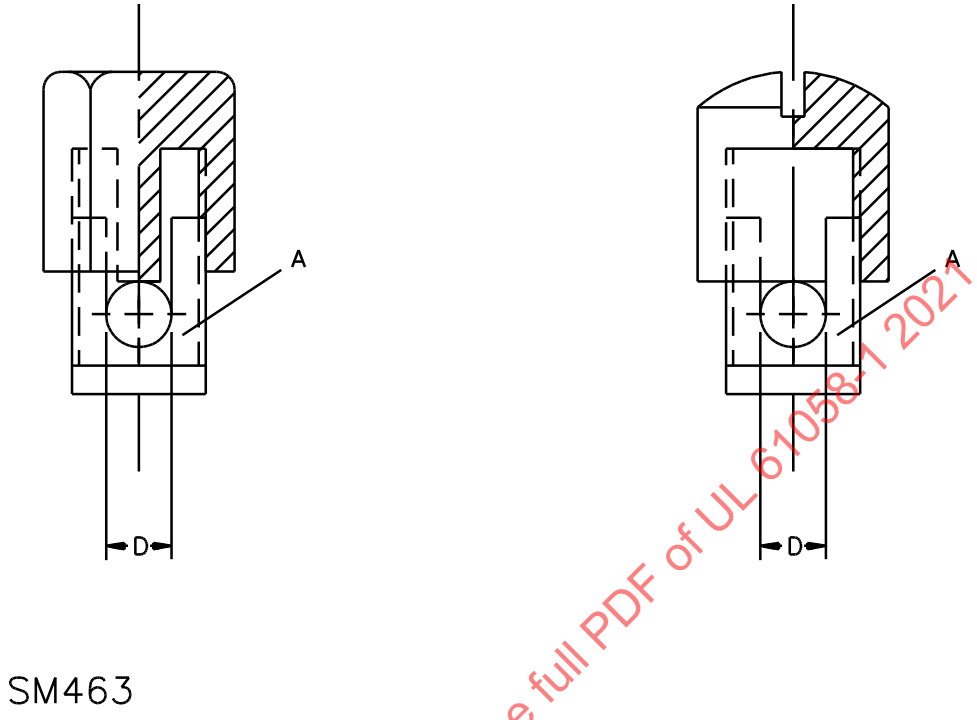
B cable lug or bar

E fixed part

F stud

Figure 5

Examples of mantle terminals



Key

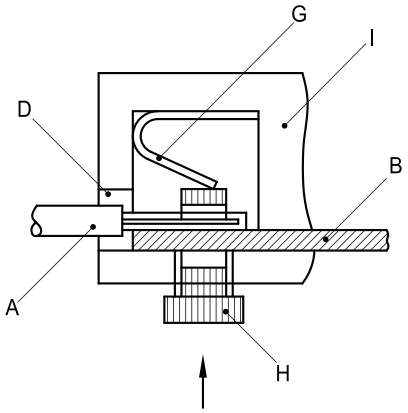
A fixed part

D conductor space (not specified)

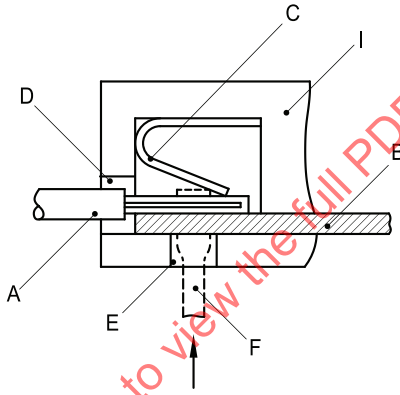
The bottom of the conductor space shall be slightly rounded in order to obtain a reliable connection.

Figure 6

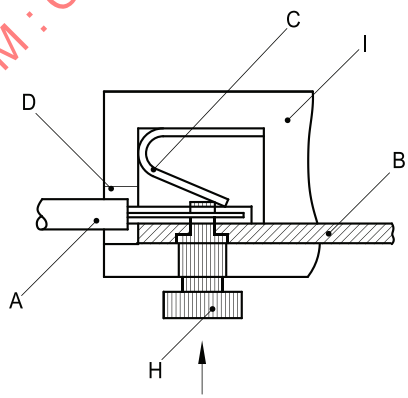
Examples of screwless terminals



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

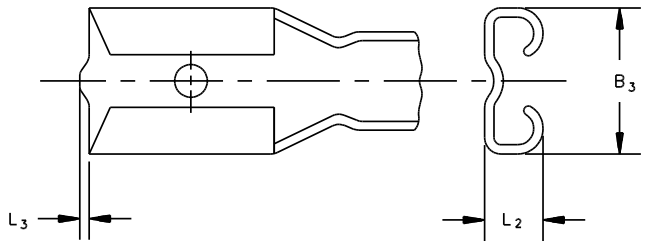
s5001b

Key

A conductor
B current-carrying part
C clamping spring
D conductor opening
E tool opening
F tool (screwdriver)
G pressure-spring
H actuating element
I part at the switch

Figure 7

Example of female (test) connector of flat quick-connect terminations



S5003

Dimensions of female connectors

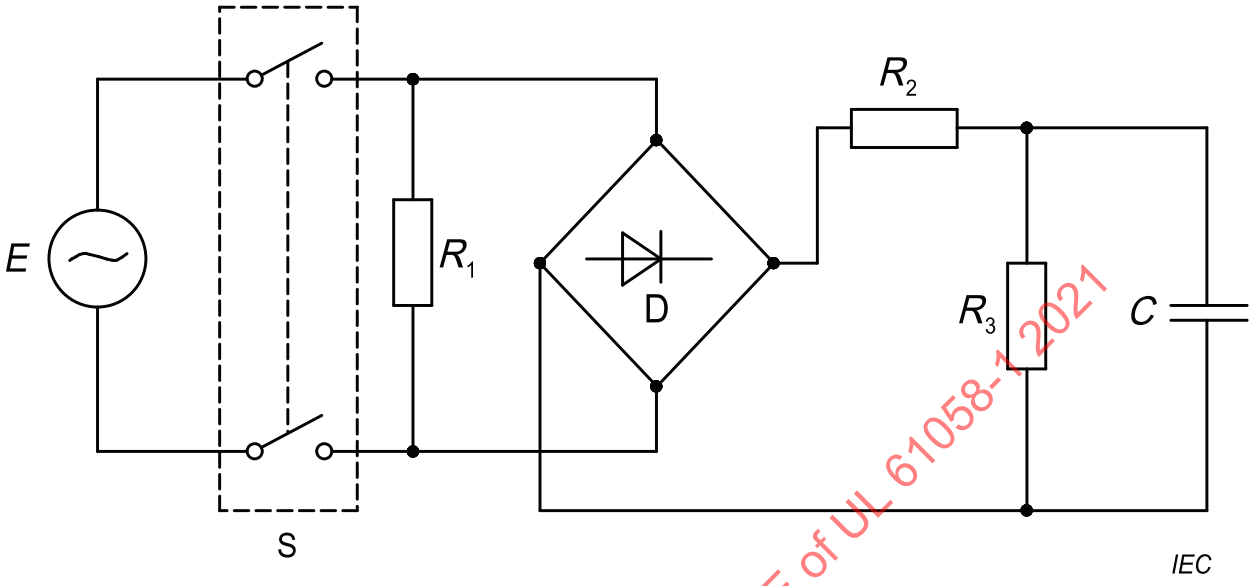
Dimensions in millimeters

Connector for tab size	B_3	L_2	L_3
	Max.	Max.	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 8

Circuit for capacitive load test and simulated tungsten filament lamp load test for AC circuits



s4081c

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;

$R_3 = (800/X) \times R_1$

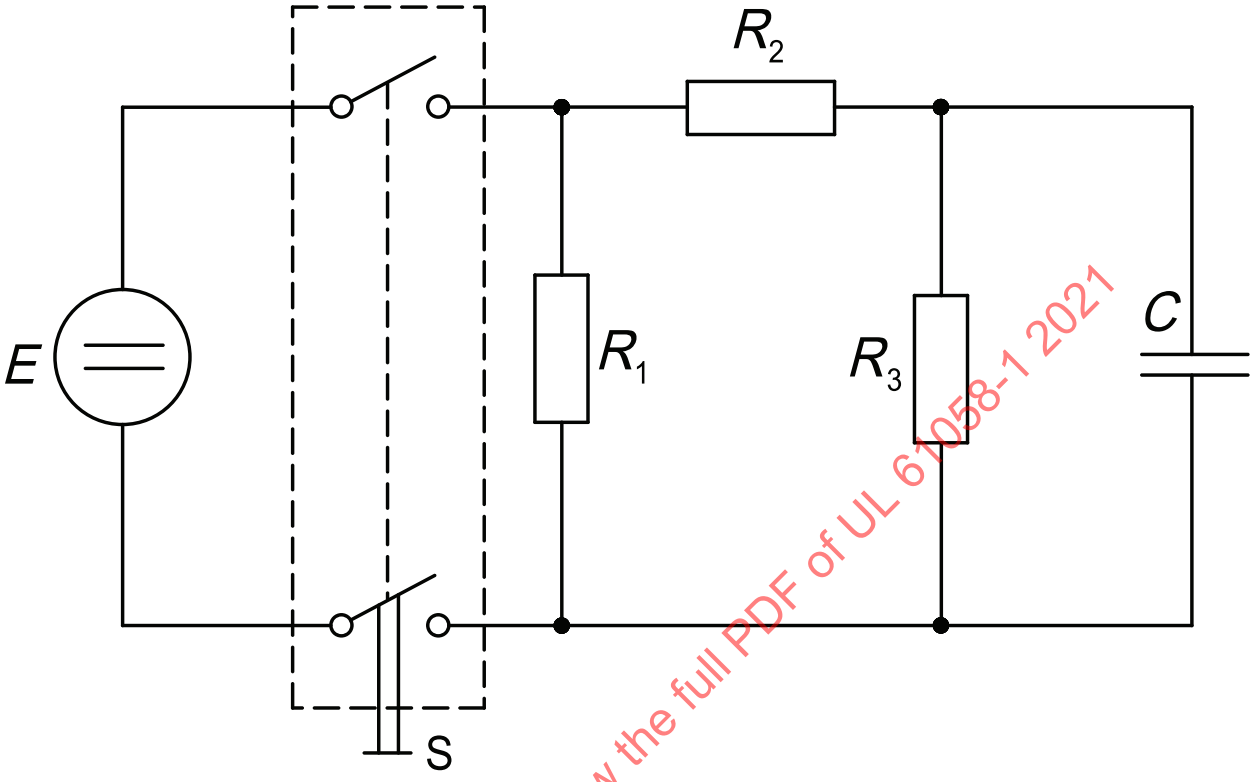
$C \times R_2 = 2\,500$ µs

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 9

Circuit for capacitive load test and simulated lamp load test for DC circuits



s4081d

$R_1 = E / \mathbf{I}$ 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;

$R_3 = (800/X) \times R_1$

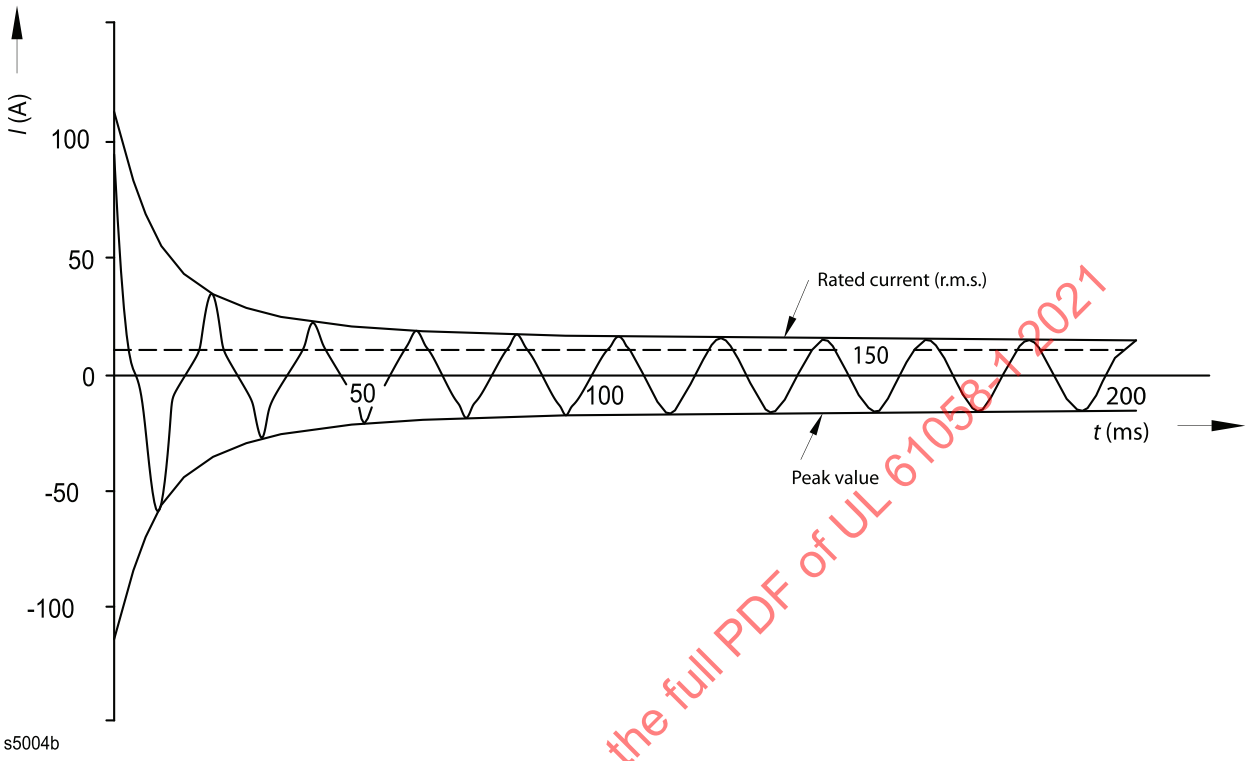
$C \times R_2 = 2\ 500$ µs

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 10

Values of the capacitive load test circuit for test of switches rated 10/100 A 250 V ~



List of values

R_1 = 25 Ω

R_2 = 3,93 Ω

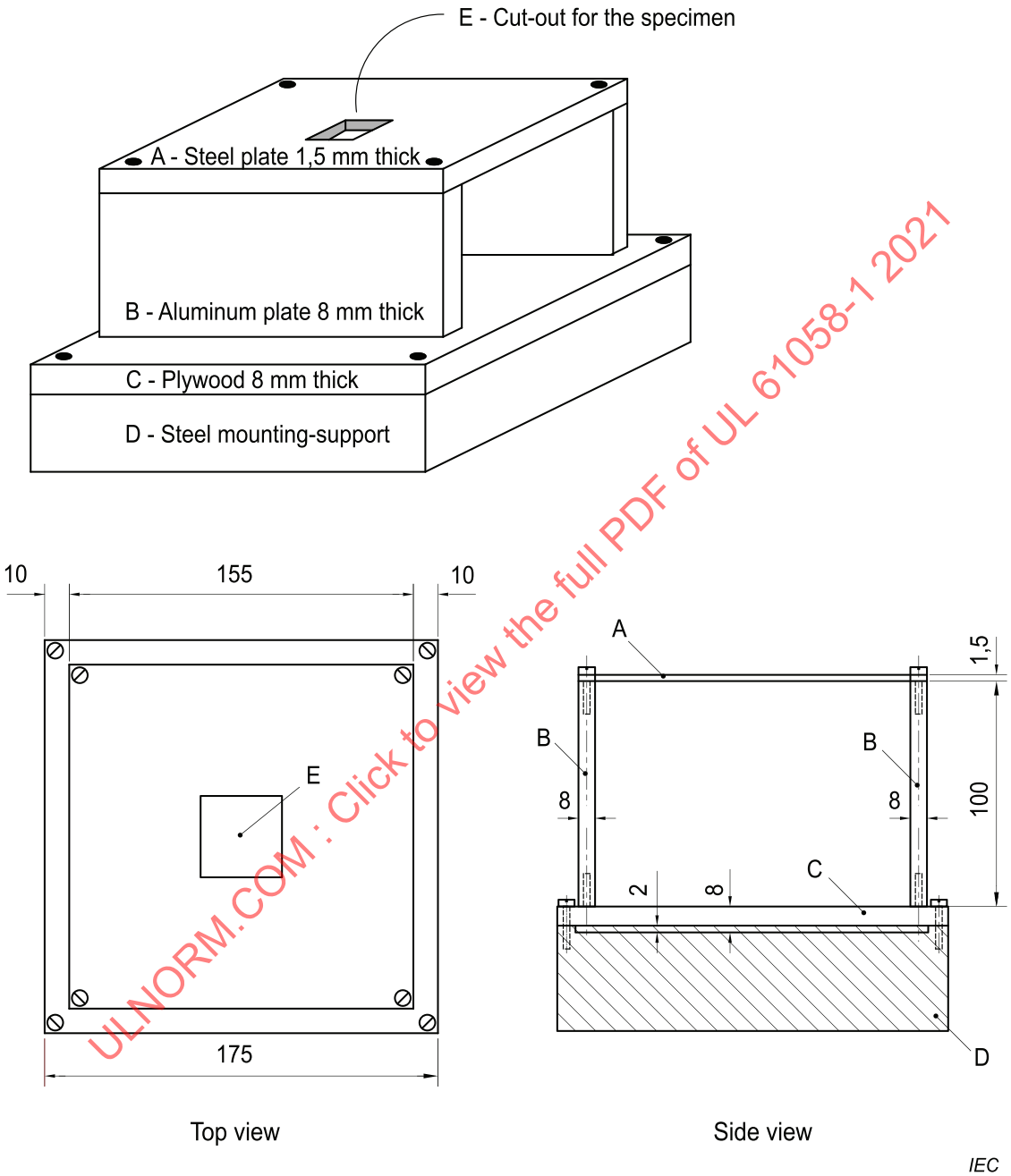
R_3 = 2 000 Ω

C = 636 µF

Figure 11

Mounting device for the impact tests

Dimensions in millimeters



Key

A interchangeable steel plate with a thickness of 1,5 mm

B aluminum plate with a thickness of 8 mm

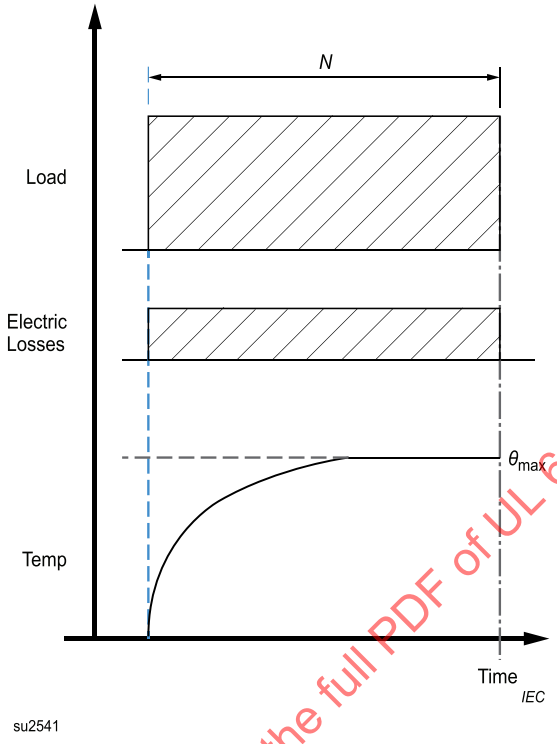
C sheet of plywood with a thickness of 8 mm

D mounting-support of steel with a minimum mass of 10 kg

E cut-out in the steel plate for the specimen

Figure 12

Continuous duty – Duty type S1 (see 7.18.1)



Key

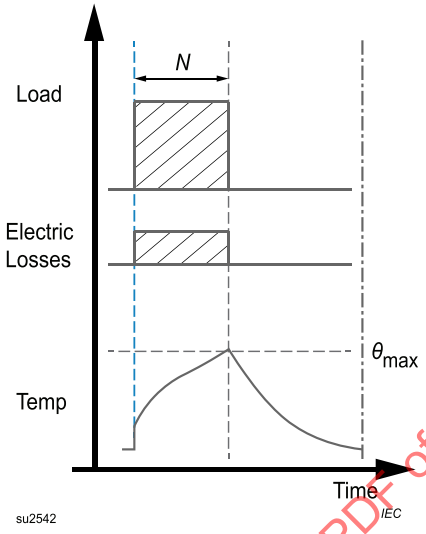
N Operation at constant load

θ_{max} Maximum temperature attained

R At rest and de-energized

Figure 13

Short-time duty – Duty type S2 (see 7.18.2)



Key

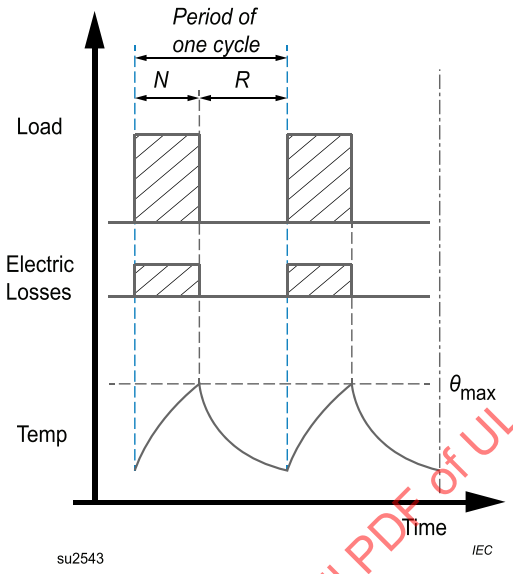
N Operation at constant load

θ_{max} Maximum temperature attained

R At rest and de-energized

Figure 14

Intermittent periodic duty – Duty-type S3 (see 7.18.3)



Key

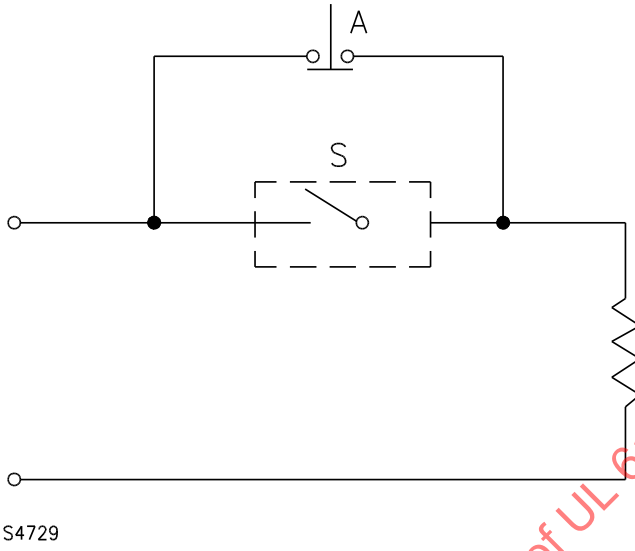
N Operation at constant load

θ_{max} Maximum temperature attained

R At rest and de-energized

Figure 15

Diagram for heating test



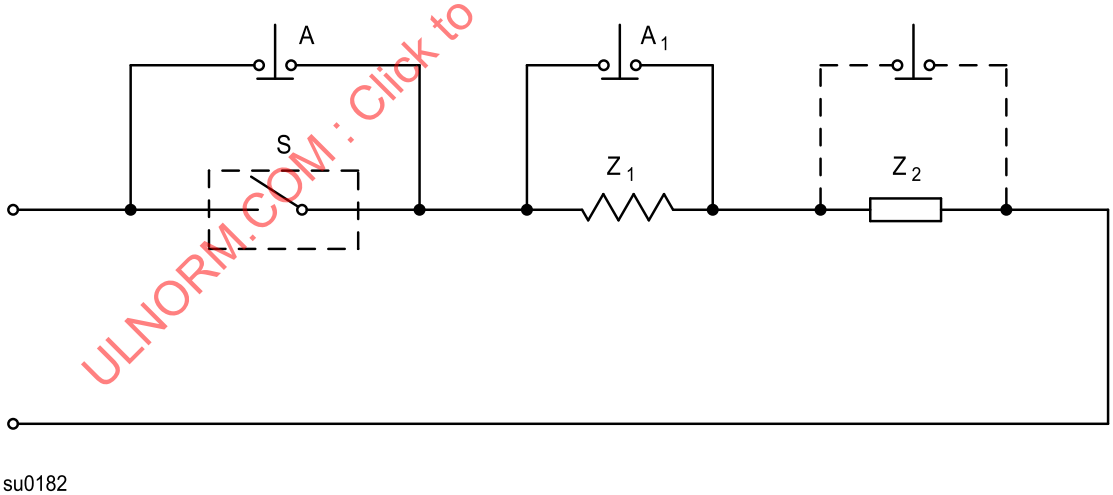
A Auxiliary switch to set switch load

R Resistive load to attain current

S Test specimen

Figure 16

Diagram for endurance 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 A1 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, A1 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.