IEC 60669-2-3

Edition 4.0 2024-03
EXTENDED VERSION

INTERNATIONAL STANDARD

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This extended version of IEC 60669-2-3:2024 includes the content of the references made to IEC 60669-1:2017

Switches for household and similar fixed electrical installations – Part 2-3: Particular requirements – Time-delay switches (TDS)

IEC 60669-2-3:2024-03 EXV(en)

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

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

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Switches for household and similar fixed electrical installations – Part 2-3: Particular requirements – Time-delay switches (TDS)

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CONTENTS

FOREWORD 7
1 Scope 10
2 Normative references 11
3 Terms and definitions 13
4 General requirements 18
5 General remarks on tests 18
5.101 Incorporated hand-operated device 21
5.102 Operated by hand 21
5.103 Control and switching circuits without common point 21
6 Ratings 21
6.1 Rated voltage 21
6.2 Rated current 21
6.3 Preferred combinations of number of poles and ratings 22
6.101 Rated control voltage 22
7 Classification 23
8 Marking 24
8.1 General 24
8.2 Symbols 25
8.3 Visibility of markings 27
8.4 Marking on terminals for phase conductors 27
8.5 Marking on terminals for neutral and earth conductors 28
8.6 Marking of the switch position 28
8.7 Additional requirements for marking 29
8.8 Durability 29
9 Checking of dimensions 29
10 Protection against electric shock 29
10.1 Prevention of access to live parts 29
10.2 Requirements for operating parts 30
10.3 Requirements for accessible metal parts 30
10.4 Requirements for insulation of the mechanism 31
10.5 Requirements for insulation of the mechanism with respect to the surrounding environment 31
10.6 Requirements for switches operated indirectly 31
10.7 Requirements for switches with replaceable pull cord 32
11 Provision for earthing 32
11.1 General 32
11.2 Earthing terminals 32
11.3 Requirements for surface-type switches 32
11.4 Test for earthing connection 32
12 Terminals 33
12.1 General 33
12.2 Terminals with screw clamping for external copper conductors 33
12.3 Screwless terminals for external copper conductors 39
13 Constructional requirements 44
13.1 Mechanical requirements for insulating means 44
13.2 Installation requirements 45

Documents
Document Sharing Hub
Full document details: IEC 60669-2-3 2024 EXV

13.3 Fixing of covers, cover plates and actuating members 46
13.4 Openings in normal use 47
13.5 Attachment of knobs 47
13.6 Mounting means 48
13.7 Combination of switches 48
13.8 Accessories combined with switches 48
13.9 Surface-type switches having an IP code higher than IP20 48
13.10 Installation in a box 49
13.11 Connection of a second current-carrying conductor 49
13.12 Inlet openings 49
13.13 Provision for back entry from a conduit 50
13.14 Switch provided with membranes or the like for inlet openings 51
13.15 Requirements for membranes in inlet openings 51
13.16 Pilot light units 52
13.101 Reset function 52
13.102 Transformers intended for SELV circuits 52
14 Mechanism 52
14.1 Indication of the position 52
14.2 Rest and intermediate position 52
14.3 Undue arcing 52
14.4 Making and breaking 52
14.5 Action of the mechanism without cover or cover plate 53
14.6 Pull force for cord-operated switches 53
14.101 Hand-operated device with position indicator 53
15 Resistance to ageing, protection provided by enclosures of switches and resistance to humidity 53
15.1 Resistance to ageing 53
15.2 Protection provided by enclosures of switches 54
15.2.1 General 54
15.2.2 Protection against access to hazardous parts and against harmful effects due to ingress of solid foreign objects 54
15.2.3 Protection against harmful effects due to ingress of water 55
15.3 Resistance to humidity 56
16 Insulation resistance and electric strength 57
16.1 General 57
16.2 Test for measuring the insulation resistance 57
16.3 Electric strength test 59
17 Temperature rise 61
17.1 General 61
17.2 Switches incorporating pilot lights 62
18 Making and breaking capacity 63
18.1 General 63
18.2 Overload 63
18.3 Overload test with filament lamps 64
19 Normal operation 65
19.1 Test for switches intended for inductive loads 65
19.2 Test for switches intended for externally ballasted lamp loads 68
19.3 Test for switches intended for self ballasted lamp loads 70
19.101 TDS control voltage test 73

AVA Documents
Document Sharing Hub
Full document details: IEC 60669-2-3 2024 EXV

19.102 TDS delay time accuracy 73
19.103 TDS delay after revert operation 73
20 Mechanical strength 74
20.1 General 74
20.2 Pendulum hammer test 74
20.3 Test on the main parts of surface-type switches 77
20.4 Screwed glands 77
20.5 Covers, cover plates or actuating members – accessibility to live parts 77
20.5.1 General 77
20.5.2 Verification of the non-removal of covers, cover plates or actuating members 77
20.5.3 Verification of the removal of covers, cover plates or actuating members 78
20.6 Covers, cover plates or actuating members – accessibility to non-earthed metal parts separated from live parts 78
20.7 Covers, cover plates or actuating members – accessibility to insulating parts, earthed metal parts, the live parts of SELV ≤ 25 V AC and 60 V DC or metal parts separated from live parts 78
20.8 Covers, cover plates or actuating members – application of gauges 78
20.9 Grooves, holes and reverse tapers 79
20.10 Additional test for cord-operated switch 79
21 Resistance to heat 79
21.1 General 79
21.2 Basic heating test 80
21.3 Ball-pressure test on parts of insulating material necessary to retain current-carrying parts and parts of the earthing circuit in position 80
21.4 Ball-pressure test on parts of insulating material not necessary to retain current-carrying parts and parts of the earthing circuit in position 80
22 Screws, current-carrying parts and connections 81
22.1 General 81
22.2 Correct insertion of screws 81
22.3 Contact pressure of electrical connections 82
22.4 Screws and rivets used both as electrical and mechanical connections 82
22.5 Material of current-carrying parts 82
22.6 Contacts subjected to sliding actions 83
22.7 Thread-forming and thread-cutting screws 83
23 Creepage distances, clearances and distances through sealing compound 83
23.1 General 83
23.2 Insulating compound 87
23.101 Control circuits for connections to a SELV 87
23.102 Use of enamel wires 87
24 Resistance of insulating material to abnormal heat, to fire and to tracking 87
24.1 Resistance to abnormal heat and to fire 87
24.2 Resistance to tracking 88
25 Resistance to rusting 89
26 EMC requirements 89
26.1 Immunity 89
26.2 Emission 89
101 Abnormal operation of the control circuit 89

Documents
Document Sharing Hub
Full document details: IEC 60669-2-3 2024 EXV

Annex A (normative) Additional requirements for switches having facilities for the outlet and retention of flexible cables 110
Annex B (informative) Changes planned for the future in order to align IEC 60669-1 with the requirements of IEC 60998 (all parts), IEC 60999 (all parts) and IEC 60228 113
Annex C (informative) Circuit development (19.3) 114
C.1 Rationale 114
C.2 I_{peak} and I^2t for normal operation tests 114
C.2.1 General 114
C.2.2 Switching a single lamp 114
C.2.3 Switching multiple lamps 116
Annex D (informative) Additional requirements for insulation-piercing terminals 118
Annex E (informative) Additional requirements and tests for switches intended to be used at a temperature lower than −5 °C 128
Bibliography 130

Figure 1 – Pillar terminals 91
Figure 2 – Screw head terminals and stud terminals 93
Figure 3 – Saddle terminals 93
Figure 4 – Lug terminals 94
Figure 5 – Mantle terminals 95
Figure 6 – Thread-forming screw 95
Figure 7 – Thread-cutting screw 95
Figure 8 – Classification according to connections 96
Figure 9 – Test apparatus for checking damage to conductors 97
Figure 10 – Information for deflection test 98
Figure 11 – Circuit diagrams for making and breaking capacity and normal operation 99
Figure 12 – Circuit diagrams for testing switches 100
Figure 13 – Arrangement for test on cover-plates 100
Figure 14 – Gauge (thickness: about 2 mm) for the verification of the outline of covers, cover-plates or actuating members 101
Figure 15 – Example of application of the gauge of Figure 14 on covers fixed without screws on a mounting surface or supporting surface 102
Figure 16 – Examples of applications of the gauge of Figure 14 in accordance with the requirements of 20.8 103
Figure 17 – Gauge for verification of grooves, holes and reverse tapers 104
Figure 18 – Sketch showing the direction of application of the gauge of Figure 17 104
Figure 19 – Ball-pressure apparatus 105
Figure 20 – Determining parts of insulating material to be tested – Diagrammatic representation (see 24.1) 105
Figure 21 – Test wall in accordance with the requirements of 15.2.3 106
Figure 22 – Direction for the conductor pull of 30 N for 1 min 108
Figure 23 – Examples of membranes and grommets 109
Figure C.1 – 120 V 15 W (LT spice model) 115
Figure C.2 – 230 V 15 W (LT spice model) 116
Figure C.3 – Model for multiple lamp loads 117
Figure C.4 – I_{peak} and I^2t for multiple lamp loads 117

Documents
Document Sharing Hub
Full document details: IEC 60669-2-3 2024 EXV

Figure D.1 – Example of insulation-piercing terminals 126
Figure D.2 – Example of test-points 126
Figure D.3 – Temperature cycle for the voltage drop test of 12.4.11 127

Table 1 – Number of specimens needed for the tests 20
Table 2 – Relationship between rated current of the switch and rated power of the SBL circuit 22
Table 3 – Preferred combinations of numbers of poles and ratings 22
Table 4 – Relationship between rated currents and connectable cross-sectional areas of copper conductors 33
Table 5 – Tightening torque for the verification of the mechanical strength of screw-type terminals 35
Table 6 – Test values for flexion and pull out for copper conductors 36
Table 7 – Test values for pulling out test 37
Table 8 – Relationship between rated currents and connectable cross-sectional areas of copper conductors for screwless terminals 39
Table 9 – Test current for the verification of electrical and thermal stresses in normal use of screwless terminals 42
Table 10 – Cross-sectional areas of rigid copper conductors for deflection test of screwless terminals 44
Table 11 – Deflection test forces 44
Table 12 – Forces to be applied to covers, cover-plates or actuating members whose fixing is not dependent on screws 47
Table 13 – External cable diameter limits for surface type switches 50
Table 14 – Points of application of the test voltage for the verification of insulation resistance and electric strength 57
Table 15 – Test voltage, points of application and minimum values of insulating resistance for the verification of electric strength 60
Table 16 – Temperature-rise test currents and cross-sectional areas of copper conductors 61
Table 17 – Fractions of total number of operations 64
Table 18 – Number of operations for normal operation test 66
Table 19 – Values for I_{peak} and I^2t depending on the type of distribution system 71
Table 20 – Calculated circuit parameters 71
Table 21 – Height of fall for impact test 75
Table 22 – Torque for the verification of the mechanical strength of glands 77
Table 23 – Creepage distances, clearances and distances through insulating sealing compound 84
Table A.1 – Limits of external dimensions of flexible cables 111
Table C.1 – Lamp 114
Table D.1 – Specimens needed for Clause 12 for insulation-piercing terminals (IPTs) 119
Table D.2 – Relationship between rated currents and connectable cross-sectional areas of copper conductors for insulation-piercing terminals 121
Table D.3 – Test current for the verification of electrical and thermal stresses in normal use of insulation-piercing terminals 125

Documents
Document Sharing Hub
Full document details: IEC 60669-2-3 2024 EXV

INTERNATIONAL ELECTROTECHNICAL COMMISSION

SWITCHES FOR HOUSEHOLD AND SIMILAR FIXED ELECTRICAL INSTALLATIONS –

Part 2-3: Particular requirements – Time-delay switches (TDS)

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IEC 60669-2-3:2024 EXV includes the content of IEC 60669-2-3:2024, and the references made to IEC 60669-1:2017.

The specific content of IEC 60669-2-3:2024 is displayed on a blue background.

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IEC 60669-2-3 has been prepared by subcommittee 23B: Plugs, socket-outlets and switches, of IEC technical committee 23: Electrical accessories. It is an International Standard.

This fourth edition cancels and replaces the third edition published in 2006. This edition constitutes a technical revision.

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

a) Revision of the present edition with reference to IEC 60669-1:2017 (Edition 4);
b) Introduction of a revision to Annex E "Additional requirements and tests for switches intended to be used at a temperature lower than −5 °C".

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

Draft	Report on voting
23B/1487/FDIS	23B/1501/RVD

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

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

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

This part of IEC 60669-2 is to be used in conjunction with IEC 60669-1:2017. It lists the changes necessary to convert that standard into a specific standard for time-delay switches.

When a particular subclause of IEC 60669-1:2017 is not mentioned in this document, that subclause applies as far as reasonable.

In this document, the following print types are used:

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

Subclauses, figures or tables which are additional to those in IEC 60669-1:2017 are numbered starting from 101.

A list of all parts of IEC 60669 series, under the general title *Switches for household and similar fixed electrical installations*, can be found on the IEC website.

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SWITCHES FOR HOUSEHOLD AND SIMILAR FIXED ELECTRICAL INSTALLATIONS –

Part 2-3: Particular requirements – Time-delay switches (TDS)

1 Scope

This part of IEC 60669 applies to time-delay switches (hereinafter referred to as TDS) with a rated voltage not exceeding 440 V AC and a rated current not exceeding 63 A, intended for household and similar fixed electrical installations, either indoors or outdoors, operated by hand and/or by remote control. For the control circuit, the rated control voltage does not exceed 440 V AC or 220 V DC.

TDS are provided with a time-delay device operated by mechanical, thermal, pneumatic, hydraulic or electrical means or by a combination of them.

Electronic TDS are within the scope of IEC 60669-2-1 but not of this document.

TDS including only passive components such as resistors, capacitors, positive temperature coefficient (PTC) and negative temperature coefficient (NTC) components and printed circuit boards are not considered to be electronic TDS.

For switches provided with screwless terminals, the rated current is limited to 16 A.

NOTE 1 The rated current is limited to 16 A for switches provided with insulation piercing terminals (IPT's) according to Annex D.

Switches covered by this document are, where applicable, intended for the control in normal use of all of the following loads:

– a circuit for a tungsten filament lamp load;
– a circuit for an externally ballasted lamp load (for example LED, CFL, fluorescent lamp load);
– a circuit for a self ballasted lamp load (for example LEDi or CFLi);
– a circuit for a substantially resistive load with a power factor not less than 0,95;
– a single phase circuit for motor load with a rated current not exceeding 3 A at 250 V (750 VA) and 4,5 A at 120 V (540 VA) and a power factor not less than 0,6. This applies to both switches rated not less than 10 A that have not undergone additional tests and to momentary switches rated not less than 6 A that have not undergone additional tests.

NOTE 2 In the following country the suitability of a switch intended to control the inrush current of a motor shall be tested: AU.

This document also applies to boxes for switches, with the exception of mounting boxes for flush-type switches.

NOTE 3 General requirements for boxes for flush-type switches are given in IEC 60670-1.

It also applies to switches such as

– switches incorporating pilot lights;
– electromagnetic remote control switches (particular requirements are given in IEC 60669-2-2);

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– switches incorporating a time-delay device (particular requirements are given in IEC 60669-2-3);
– combinations of switches and other functions (with the exception of switches combined with fuses);
– electronic switches (particular requirements are given in IEC 60669-2-1);
– switches having facilities for the outlet and retention of flexible cables (see Annex A);
– isolating switches (particular requirements are given in IEC 60669-2-4);
– switches and related accessories for use in home and building electronic systems (particular requirements are given in IEC 60669-2-5);
– firemen's switches (particular requirements are given in IEC 60669-2-6).

Switches complying with this document are suitable for use at ambient temperatures not normally exceeding +40 °C, but their average over a period of 24 h does not exceed +35 °C, with a lower limit of the ambient air temperature of –5 °C.

NOTE 4 For lower temperatures see Annex E.

Switches complying with this document are suitable only for incorporation in equipment in such a way and in such a place that it is unlikely that the surrounding ambient temperature exceeds +35 °C.

In locations where special conditions prevail, such as in ships, vehicles and the like and in hazardous locations, for example where explosions are liable to occur, special construction and/or additional requirements may be required.

2 Normative references

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

IEC 60038:2009, *IEC standard voltages*

IEC 60068-2-75:2014, *Environmental testing – Part 2-75: Tests – Test Eh: Hammer tests*

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

IEC 60212:2010, *Standard conditions for use prior to and during the testing of solid electrical insulation materials*

IEC 60227-5:2011, *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V – Part 5: Flexible cables (cords)*

IEC 60228:2004, *Conductors of insulated cables*

IEC 60245-4:2011, *Rubber insulated cables – Rated voltages up to and including 450/750 V – Part 4: Cords and flexible cables*

IEC 60317 (all parts), *Specifications for particular types of winding wires*

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

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IEC 60445:2021, *Basic and safety principles for man-machine interface, marking and identification – Identification of equipment terminals, conductor terminations and conductors*

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

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

IEC 60664-3:2016, *Insulation coordination for equipment within low-voltage systems – Part 3: Use of coating, potting or moulding for protection against pollution*

IEC 60669-1:2017, *Switches for household and similar fixed electrical installations – Part 1: General requirements*

IEC 60669-2-1:2002, *Switches for household and similar fixed electrical installations – Part 2-1: Particular requirements – Electronic switches*
IEC 60669-2-1:2002/AMD1:2008
IEC 60669-2-1:2002/AMD2:2015

IEC 60695-2-10:2000, *Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure*

IEC 60695-2-11:2014, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products (GWEPT)*

IEC 60998-1:2002, *Connecting devices for low-voltage circuits for household and similar purposes – Part 1: General requirements*

IEC 60998-2-1, *Connecting devices for low-voltage circuits for household and similar purposes – Part 2-1: Particular requirements for connecting devices as separate entities with screw-type clamping units*

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

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

IEC 60998-2-4, *Connecting devices for low-voltage circuits for household and similar purposes – Part 2-4: Particular requirements for twist-on connecting devices*

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

IEC 61558-2-6:2021, *Safety of transformers, reactors, power supply units and combinations thereof – Part 2-6: Particular requirements and tests for safety isolating transformers and power supply units incorporating safety isolating transformers for general applications*

ISO 1456:2009, *Metallic and other inorganic coatings – Electrodeposited coatings of nickel, nickel plus chromium, copper plus nickel and of copper plus nickel plus chromium*

ISO 2081:2008, *Metallic and other inorganic coatings – Electroplated coatings of zinc with supplementary treatments on iron or steel*

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

3 Terms and definitions

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

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

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

NOTE Where the terms "voltage" and "current" are used, they are rms values unless otherwise specified.

3.1
switch
device designed to make or break the current in one or more electric circuits

3.1.1
on/off switch
switch for alternatively closing and opening one or more electric circuits.

[SOURCE: IEC 60050-151:2001, 151-12-23]

3.1.2
momentary contact switch
switch which returns its contacts automatically to the initial state after operation.

Note 1 to entry: Momentary contact switches are intended to operate, for example, bells, electromagnetic remote control switches, time-delay switches and electronic switches.

3.1.3
push-button switch
switch having a single actuator which moves with a single motion when operated by an external, manual force usually applied by the finger or palm of the hand and having stored energy return

3.1.4
cord-operated switch
switch the operating means of which is a cord which has to be pulled in order to change its contact state

3.1.5
switch of normal-gap construction
switch construction having a clearance between the contacts in the open position of not less than 3 mm

3.1.6
switch of mini-gap construction
switch construction having a clearance between the contacts which is less than 3 mm but is not less than 1,2 mm

3.1.7
switch of micro-gap construction
switch construction having a clearance between the contacts in the open position of less than 1,2 mm

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3.2
one operation
transfer of the moving contacts from one operating position to another

3.3
terminal
conductive part of one pole, composed of one or more clamping unit(s) and insulation if necessary

3.4
clamping unit
part or parts of a terminal necessary for the mechanical clamping and the electrical connection of the conductor(s)

3.5
screw-type terminal
terminal intended for the connection, by clamping only, of (an) external rigid or flexible conductor(s)

3.5.1
pillar terminal
screw-type terminal in which the conductor(s) is (are) inserted into a hole or cavity, where it is clamped under the shank of the screw or screws

Note 1 to entry: The clamping pressure can be applied directly by the shank of the screw or through an intermediate clamping part to which pressure is applied by the shank of the screw.

Note 2 to entry: Examples of pillar terminals are shown in Figure 1.

[SOURCE: IEC 60050-442:1998, 442-06-22, modified — “or screws” has been added because in some constructions there is more than one screw.]

3.5.2
screw head terminal
screw-type terminal in which the conductor is clamped under the head of the screw

Note 1 to entry: The clamping pressure can be applied directly by the head of the screw or through an intermediate part, such as a washer, clamping plate or anti-spread device.

Note 2 to entry: Examples of screw head terminals are shown in Figure 2.

3.5.3
stud terminal
screw-type terminal in which the conductor is clamped under a nut

Note 1 to entry: The clamping pressure can be applied directly by a suitably shaped nut or through an intermediate part, such as a washer, a clamping plate or an anti-spread device.

Note 2 to entry: Examples of stud terminals are shown in Figure 2.

[SOURCE: IEC 60050-442:1998, 442-06-23]

3.5.4
saddle terminal
screw-type terminal in which the conductor is clamped under a saddle by means of two or more screws or nuts

Note 1 to entry: Examples of saddle terminals are shown in Figure 3.

[SOURCE: IEC 60050-442:1998, 442-06-09, modified — "screw-type" has been added.]

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3.5.5
lug terminal
screw head terminal or stud terminal, designed for clamping a cable lug or bar by means of a screw or nut

Note 1 to entry: Examples of lug terminals are shown in Figure 4.

[SOURCE: IEC 60050-442:1998, 442-06-16, modified — "screw-type terminal" is replaced with "screw head terminal or stud terminal" and “directly and indirectly” has been deleted.]

3.5.6
mantle terminal
screw-type terminal in which the conductor is clamped against the base of a slot in a threaded stud by means of a nut

Note 1 to entry: The conductor is clamped against the base of the slot by a suitably shaped washer under the nut, by a central peg if the nut is a cap nut, or by equally effective means for transmitting the pressure from the nut to the conductor within the slot.

Note 2 to entry: Examples of mantle terminals are shown in Figure 5.

[SOURCE: IEC 60050-442:1998, 442-06-14, modified — “screw-type” has been added and the last part of the definition is included in a note.]

3.6
screwless-type terminal
terminal for the connection and subsequent disconnection of a rigid (solid or stranded) or flexible conductor or the interconnection of two conductors capable of being dismantled, the connection being made, directly or indirectly, by means of springs, parts of angled, eccentric or conical form, etc., without special preparation of the conductor concerned, other than removal of insulation

[SOURCE: IEC 60050-442:1998, 442-06-11 , modified]

3.7
thread-forming screw
screw having an uninterrupted thread which, by screwing in, forms a thread by displacing material in the cavity

Note 1 to entry: An example of a thread-forming screw is shown in Figure 6.

[SOURCE: IEC 60050-442:1998, 442-06-04]

3.8
thread-cutting screw
screw having an interrupted thread which, by screwing in, makes a thread by removing material from the cavity

Note 1 to entry: An example of a thread-cutting screw is shown in Figure 7.

Note 101 to entry: This definition is applicable to the switching circuit only.

[SOURCE: IEC 60050-442:1998, 442-06-03]

3.9
mechanical time-delay device
device which, through a mechanical auxiliary, operates some time after the instant at which the conditions which cause it to operate are established

Note 101 to entry: This definition is applicable to the switching circuit only.

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Full document details: IEC 60669-2-3 2024 EXV

3.10
base
part of the switch retaining current-carrying parts and which normally retains the mechanism in position

3.11
rated voltage
voltage assigned by the manufacturer for a specific operating condition of the switch

[SOURCE: IEC 60050-442:1998, 442-01-03, modified — "accessory" has been replaced with "switch".]

3.12
rated current
current assigned by the manufacturer for a specific operating condition of the switch

[SOURCE: IEC 60050-442:1998, 442-01-02, modified — "accessory" has been replaced with "switch".]

3.13
operating member
part of a cord-operated switch which connects the internal mechanism with a pull cord and is usually attached to the actuating member of the switch

3.14
pole of a switching device
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 switching device 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 the poles are or can be coupled in such a manner as to operate together.

[SOURCE: IEC 60050-441:2000, 441-15-01]

3.15
actuating member
part which is pulled, pushed, turned or otherwise moved to cause an operation of the switch

[SOURCE: IEC 60050-442:1998, 442-04-14]

3.16

pilot light
device incorporating a light source either integral or designed to be installed with the switch and intended to give for example an indication of the switch state or to indicate the switch location

3.17
main part
assembly consisting of the base and other parts which is not intended to be dismantled at any time after manufacture

3.18
grommet
component used to support and protect the wires or cable or conduit at the point of entry

Note 1 to entry: A grommet may also prevent the ingress of moisture or contaminants.

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Full document details: IEC 60669-2-3 2024 EXV

Note 2 to entry: Examples are shown in Figure 23.

[SOURCE: IEC 60050-581:2008, 581-27-19, modified — "part of a component or an accessory" has been replaced with "component", "or conduit" has been added and part of the definition is included in a note.]

3.19
entry membrane
component or integral part of the switch used to protect the wires or cable which may be used to support the cable or conduit at the point of entry

Note 1 to entry: An entry membrane may also prevent the ingress of moisture or contaminants and may be part of a grommet.

Note 2 to entry: Examples are shown in Figure 23.

3.20
protecting membrane
component or integral part of the switch that is not intended to be penetrated in normal use and is intended to provide protection against ingress of water or solid objects and/or to allow the operation of an accessory

Note 1 to entry: Examples are shown in Figure 23

3.21
self ballasted lamp
SBL
unit which cannot be dismantled without being permanently damaged, which is provided with a lamp cap or caps and which incorporates a light source and any additional elements necessary for starting and stable operation of the light source

Note 1 to entry: In the text, a self ballasted lamp is also called CFLi or LEDi, where:

- CFL stands for Compact Fluorescent Lamp;
- LED stands for Light Emitting Diode;
- “i” means that the control gear is incorporated in the lamp.

Note 2 to entry: This note applies to the French language only.

3.22
externally ballasted lamp
lamp other than an incandescent lamp which cannot be dismantled without being permanently damaged, which is provided with a lamp cap and which incorporates a light source to be controlled by a separate lamp control gear

Note 1 to entry: For lamp control gear, see definitions in IEC 61347-1.

3.101
time-delay switch
TDS
switch provided with a time-delay device which operates for a certain time (the delay time)

Note 101 to entry: Time-delay switches may be either manually actuated and/or remotely electrically initiated.

3.101.1
electronic TDS
TDS containing electronic component(s)

3.102
rated control voltage
voltage assigned to the control circuit by the manufacturer

Documents
Document Sharing Hub
Full document details: IEC 60669-2-3 2024 EXV

3.103
switching circuit
circuit which contains the parts which allow the rated current to flow through the TDS

3.104
control circuit
circuit which includes electrical parts to control the switching circuit in an electrically controlled TDS

3.105
control mechanism
all parts which are intended for the operation of the TDS

3.106
incorporated hand-operated device
device which allows the switching circuit to be operated, directly or indirectly

Note 101 to entry: An incorporated hand-operated device is not intended for the normal operation of the TDS.

3.107
delay time
period during which the switching circuit(s) is (are) kept closed

Note 101 to entry: Any time taken for the decreasing of the voltage (e.g. to reduce the light) at the end of the delay period is included within the delay time.

3.108
delay device
all components which have an influence on the delay time

Note 101 to entry: The delay device is energized by means of an impulse into the control circuit in an electrically controlled TDS.

Note 102 to entry: The delay time may be adjustable.

3.109
disconnectable TDS
TDS consisting of two parts, the first being used as a base and including the terminals, the other being removable and including the switching and the control circuits, the two parts being resiliently connected together using a means which allows joining and/or separating with or without the use of a tool

4 General requirements

Switches and boxes of surface mounting accessories shall be so designed and constructed that, in normal use, their performance is reliable and safety is achieved by reducing risk to a tolerable level as defined in ISO/IEC Guide 51:2014.

The operation of a TDS shall not be impaired when it is mounted at an angle deviating by not more than 5° from the specified position of use.

Compliance is checked by meeting all the relevant requirements and tests specified.

5 General remarks on tests

Tests according to this document are type tests.

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Full document details: IEC 60669-2-3 2024 EXV

Unless otherwise specified, the specimens are tested as delivered and under normal conditions of use.

Switches having provision for pilot lights shall be tested with pilot lights fitted, unless otherwise stated. The results of the tests shall be considered to apply to switches of the same type which do not have provision for pilot lights.

Flush and semi-flush type switches shall be tested when installed in a box complying with the applicable standard sheet(s), if any. In case the switch is manufactured for a specific box, the tests shall be conducted when the switch is installed in the corresponding box as specified by the manufacturer.

Unless otherwise specified, the tests are carried out in the order of the clauses, at an ambient temperature between +15 °C and +35 °C.

In case of doubt, the tests are made at an ambient temperature of (+20 ± 5) °C.

For each of the two combinations of rated voltages and rated currents marked on the switch, three specimens are subjected to all the relevant tests except the test of 19.2 and 19.3, where two further sets of three specimens are used.

For switches with a rated current up to and including 16 A the tests of 19.1, 19.2 and 19.3 shall be carried out.

For switches with a rated current above 16 A and up to and including 20 A the tests of 19.1 and 19.3 shall be carried out.

For switches with a rated current above 16 A and up to 20 A inclusive the test of 19.2 shall be carried out only if the manufacturer has assigned the switch with an externally ballasted lamp current rating.

For switches with a rated current above 20 A, only the tests of 19.1 shall be carried out.

A switch marked 250 V/400 V is tested as a 400 V switch.

Momentary contact switches are not to be submitted to the tests of 18.3, 19.2 and 19.3.

Switches of pattern 3 and 03 are submitted to the tests of 18.3 if they have a rated voltage over 250 V, but are not to be submitted to the tests of 19.2 and 19.3.

The number of specimens required for the tests shall be as specified in Table 1.

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Full document details: IEC 60669-2-3 2024 EXV

Table 1 – Number of specimens needed for the tests

Clauses and subclauses		Number of specimens	Number of additional specimens for dual current rating
6	Ratings	A	
7	Classification	A	
8	Marking	A	
9	Checking of dimensions	ABC	
10	Protection against electric shock	ABC	
11	Provision for earthing	ABC	
12	Terminals [a,f,l]	ABC	JKL
13	Constructional requirements [b, m]	ABC	
14	Mechanism	ABC	
15	Resistance to ageing, protection provided by enclosures of switches, and resistance to humidity	ABC	
16	Insulation resistance and electric strength [c]	ABC	
17	Temperature rise	ABC	JKL
18	Making and breaking capacity	ABC [i]	JKL
19	Normal operation	ABC [i]	JKL
20	Mechanical strength [d,g]	ABC	
21	Resistance to heat [h]	ABC	
22	Screws, current-carrying parts and connections	ABC	
23	Creepage distances, clearances and distances through sealing compound	ABC	
19.2	Test for switches intended for externally ballasted lamp loads	DEF [j]	MNO
19.3	Test for switches intended for self ballasted lamp loads	UVW [k]	XYZ
24.1	Resistance to abnormal heat and to fire	GHI	
24.2	Resistance to tracking [e]	GHI	
25	Resistance to rusting	GHI	
101	Abnormal operation of the control circuit	PQR	
	TOTAL	12	9

[a] Five extra screwless terminals are used for the test of 12.3.11 and one extra set of specimens is used for the test of 12.3.12.

[b] An extra set of membranes are needed for each of the tests of 13.15.1 and 13.15.2.

[c] One extra set of specimens of switches fitted with pilot light may be used for the tests of Clause 16.

[d] One extra set of specimens of cord-operated switches is needed for the test of 20.10.

[e] One extra set of specimens may be used.

[f] Two extra set of specimens of terminals suitable for rigid and flexible conductors are required for 12.2.5, 12.2.6 and 12.2.7.

[g] One extra set of specimens is needed for the tests of 20.5.1 and 20.5.2.

[h] One extra set of specimens may be used for the tests of 21.2 and 21.3. In this case the specimens shall be subjected first to the tests of 15.1.

[i] One extra set of specimens of switches of pattern number 7 are necessary for 18 and 19.1.

[j] One extra set of specimens of switches of pattern number 7 are necessary for 19.2.

[k] One extra set of specimens of switches of pattern number 7 are necessary for 19.3.

[l] Number of specimens required for insulation-piercing terminals (IPTs) are shown in Table D.1

[m] For switches with pilot light units if the electronic circuitry is so enclosed that the short-circuiting or disconnecting of components is impossible or difficult, the manufacturer shall provide additional prepared test specimens.

The specimens are submitted to all the relevant tests and comply with this document if all the requirements of all the relevant tests are met.

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Full document details: IEC 60669-2-3 2024 EXV

If one specimen does not satisfy a test due to an assembly or a manufacturing fault, that test and any preceding one which may have influenced the results of the test shall be repeated and also the tests which follow shall be made in the required sequence on another full set of specimens, all of which shall comply with the requirements.

The applicant may submit, together with a number of specimens specified in Table 1, the additional set of specimens which may be required, should one specimen fail. The test laboratory should then, without further request, test additional specimens and will reject them only if a further failure occurs. If the additional set of specimens is not submitted at the same time, the failure of one specimen will result in non compliance.

5.101 Incorporated hand-operated device

If a TDS is provided with an incorporated hand-operated device, actuating the switching circuit directly, it shall be tested as specified in 19.101.

5.102 Operated by hand

For a TDS operated by hand, the requirements relating to the control voltage do not apply.

5.103 Control and switching circuits without common point

In the case of a TDS for which the control and the switching circuits have no common point, the test is made with the circuits supplied with the rated voltages which are specified in this document.

6 Ratings

6.1 Rated voltage

Preferred values of rated voltage are:

– AC: 6 V, 8 V, 9 V, 12 V, 24 V, 42 V, 48 V, 110 V, 130 V, 220 V, 230 V and 240 V;

NOTE These rated voltages are aligned with the rated control voltages specified in 6.101 to simplify the tests on TDS having a common point between the control and switching circuits.

If any other voltage rating is used, it shall not be less than that specified in IEC 60038:2009, Table 1.

6.2 Rated current

Preferred values of rated current are 6 A, 10 A, 13 A, 16 A, 20 A, 25 A, 32 A, 40 A, 45 A, 50 A or 63 A.

The rated current of switches shall not be less than 6 A, except for momentary contact switches where a rated current of 1 A, 2 A or 4 A is allowed.

Switches with a rated current not exceeding 16 A shall have an externally ballasted lamp current rating equal to the rated current. This requirement does not apply to switches of pattern numbers 3 and 03 or to momentary contact switches.

Switches with a rated current not exceeding 20 A shall be tested with self ballasted lamp (SBL) circuits as given in 19.3.

Switches which are tested according to 19.3 are capable of switching the rated power of SBL circuits according to Table 2.

NOTE Higher values of rated power of SBL circuits can be declared by the manufacturer according to Table 3.

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Table 2 – Relationship between rated current of the switch and rated power of the SBL circuit

Rated current of the switch [A]	**Distribution system** [V]: **220/380** **230/400** **240/415** **Rated power of the SBL circuit** [W]	**Distribution system** [V]: **120/208** **120/240** **127/220** **Rated power of the SBL circuit** [W]
Up to and including 10	100	60
Above 10 up to and including 13	150	60
Above 13 up to and including 16	200	100
Above 16 up to and including 20	250	150

Compliance with the requirements of 6.1 and 6.2 is checked by inspection of the marking.

6.3 Preferred combinations of number of poles and ratings

Preferred combinations of number of poles and ratings are shown in Table 3.

Table 3 – Preferred combinations of numbers of poles and ratings

Rated current A	**Number of poles**	
	Rated voltage from 120 V to 250 V inclusive	**Rated voltage over 250 V**
1, 2 and 4	1	–
6	1 2	1 2
10 and 13	1 2	1 2 3 4
16, 20, 25, 32, 40, 45, 50 and 63	1 2 3 4	1 2 3 4

6.101 Rated control voltage

Preferred values of rated control voltage are:

– AC: 6 V, 8 V, 9 V, 12 V, 24 V, 42 V, 48 V, 110 V, 130 V, 220 V, 230 V and 240 V;
– DC: 6V, 9 V, 12 V, 24 V, 48 V, 60 V, 110 V and 220 V.

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Full document details: IEC 60669-2-3 2024 EXV

7 Classification

Switches are classified

7.1 according to the possible connections (see Figure 8 of IEC 60669-1:2017):

	Pattern number
– single-pole switches	1
– double-pole switches	2
– three-pole switches	3
– three-pole plus switched neutral switches	03
– two-way switches	6

NOTE 1 Two or more switches having the same or different pattern numbers can be mounted on a common base.

NOTE 2 For the pattern number for which an off-position is considered, the above classification refers also to push-button switches and momentary contact switches.

7.2 according to the contact opening:

– switches of normal-gap construction;
– switches of mini-gap construction;
– switches of micro-gap construction;
– switches without contact gap (semiconductor switching devices).

7.3 according to the degree of protection against access to hazardous parts and against harmful effects due to the ingress of solid foreign objects as described in IEC 60529.

7.4 according to the degree of protection against harmful effects due to the ingress of water as described in IEC 60529.

7.5 according to the method of actuating the switch:

– rotary;
– tumbler;
– rocker;
– push-button;
– cord-operated.
– time-delay switches (TDS):
  - manually operated;
  - remotely operated;
  - manually and remotely operated.

NOTE The above methods of operation can be combined with a complementary method of operation allowing permanent ON and/or permanent OFF. These possibilities are given by a complementary device acting either directly on the switching circuit, or on the control circuit.

7.6 according to the method of mounting the switch:

– surface-type;
– flush-type;
– semi flush-type;

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Full document details: IEC 60669-2-3 2024 EXV

– panel-type;
– architrave-type.

7.7 according to the method of installation, as a consequence of the design of the switch:

– switches where the cover or cover plate can be removed without displacement of the conductors (design A);
– switches where the cover or cover plate cannot be removed without displacement of the conductors (design B);
– disconnectable TDS.

NOTE If a switch has a base which cannot be separated from the cover or cover plate, and requires a supplementary plate to meet the standard, which can be removed for redecorating the wall without displacement of the conductors, it is considered to be of design A, provided the supplementary plate meets the requirements specified for covers and cover plates.

7.8 according to the type of terminal:

– switches with screw-type terminals;
– switches with screwless-type terminals.

7.9 according to the suitability to accept conductors:

– switches with terminals for rigid conductors only;
– switches with terminals for rigid and flexible conductors.

NOTE 1 In the following country, switches with terminals for rigid conductors only are not allowed: ES, IN and IT.

NOTE 2 In the following countries, switches with screw terminals for rigid conductors only are not allowed: DE, DK, IN and ZA.

7.101 according to the type of control mechanism:

– mechanical;
– thermal;
– pneumatic;
– hydraulic;
– electrical;
– combination(s) of the above.

8 Marking

8.1 General

Switches shall be marked with

a) rated current(s)
   – in amperes (A) if the switch is tested according to 19.1 only
   – in amperes (A) if the switch is tested according to 19.1 and 19.3 only or
   – in amperes (AX) if the switch is tested according to 19.1, 19.2 and 19.3 when the rated currents in amperes (A) and (AX) are equal or
   – in amperes (A and AX) if the switch is tested according to 19.1, 19.2 and 19.3 when the rated currents in amperes (A) and (AX) are not equal;
b) rated voltage(s) in volts and rated control voltage(s) in volts, if different from the rated voltage(s);
c) symbol for nature of supply;
d) manufacturer's or responsible vendor's name, trade mark or identification mark;

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e) type reference, which may be a catalogue number;

f) symbol for switches of mini-gap construction, if applicable;

g) symbol for switches of micro-gap construction, if applicable;

h) symbol for switches without contact gap (semiconductor switching device), if applicable;

i) first characteristic numeral for the degree of protection against access to hazardous parts and against harmful effects due to ingress of solid foreign objects, if declared to be higher than 4 in which case the second characteristic numeral shall also be marked;

j) second characteristic numeral for the degree of protection against harmful effects due to ingress of water, if declared to be higher than 2 in which case the first characteristic numeral shall also be marked;

k) length of insulation to be removed before the insertion of the conductor into the screwless-type terminal;

l) symbol for the suitability to accept rigid conductors only.

In addition the following information shall be given in the manufacturer's documentation:

m) for SBL loads: the rated power in watts and the type of load if the switch is tested according to 19.3;

n) symbol for the adjustment of the delay time, if applicable;

o) symbols for the positions "Permanent ON" and "Permanent OFF", if applicable;

p) symbol for "Delay time".

NOTE 1 Marking of the pattern number given in 7.1 can be made if the connections are not clear from an inspection of the switch; this pattern number may be part of the type reference.

NOTE 2 If a base carries two or more switches with separate operating devices, marking with the pattern numbers can be made, for example 1+6 or 1+1+1.

NOTE 3 If there is no marking on the terminals, they are suitable to accept both rigid and flexible conductors.

NOTE 4 In the following country, the marking of the type reference is not used: UK.

NOTE 5 In the following countries, the symbol that electrotechnical expertise is required (see IEC 60417-6182:2013-09) is to be placed on the packaging: DE.

NOTE 101 If a delay time value is indicated, it can be expressed in seconds, minutes and hours.

8.2 Symbols

When symbols are used, they shall be as follows:

Amperes (Rated current for externally ballasted loads) ..... AX

(other currents) ..... A

Volts V

Alternating current ..... ~

Watt ..... W

Neutral ..... N

Line L

Protective earth (IEC 60417-5019:2006-08) ..... ⏚

"open" position (off) ..... O

"closed" position (on) I

Mini-gap construction ..... m

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Full document details: IEC 60669-2-3 2024 EXV

Micro-gap construction ..... μ

Without contact gap (semiconductor switching device) ..... ε

Degree of protection, when relevant ..... IPXX

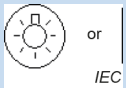
Degree of protection for fixed accessories to be installed on rough surfaces

(test wall of Figure 21) ..... IPXX

Suitability to accept rigid conductors only ..... r

Permanent ON

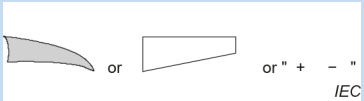
If the TDS may also be remote controlled, the symbol | is not to be used.



Delay time

Permanent OFF but only if the air gap of the switching contact of the TDS is not less than 3 mm

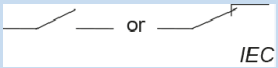
Adjustment of delay time



Control mechanism

IEC 60417-6457:2023-08

Switch



NOTE 1 Details of construction of certain symbols are given in IEC 60417.

NOTE 2 In the IP code the letter "X" is replaced by the relevant number.

NOTE 3 Lines formed by the construction of the tool are not considered as part of the marking.

NOTE 101 In the following country, the symbol consisting of 2 concentric circles is not used to indicate time delay: UK.

The symbol "AX" may be replaced by the symbol "X". For the marking with rated current and rated voltage the figures may be used alone.

The marking for the nature of supply shall be placed next to the marking for rated current and rated voltage.

NOTE 4 The marking for current, voltage and nature of supply can be, for example, as follows:

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Full document details: IEC 60669-2-3 2024 EXV

10 AX 250 V ~	or	10 X/250 ~	or	$\frac{10\ X}{250}$ ~
20 A – 16 AX 250 V ~	or	20 -16 X/250 ~	or	$\frac{20 - 16\ X}{250}$ ~
10 AX 400 V ~	or	10 X/400 ~	or	$\frac{10\ X}{400}$ ~
25 AX 400 V ~	or	25 X/400 ~	or	$\frac{25\ X}{400}$ ~
25 A 250 V ~	or	25/250 ~	or	$\frac{25}{250}$ ~
25 AX 440 V ~	or	25 X/440 ~	or	$\frac{25\ X}{440}$ ~

8.3 Visibility of markings

Markings shall be clearly visible with normal or corrected vision, without additional magnification.

Markings as given in 8.1 a), b), c), d), e) and, if applicable, f), g), h), k), l), n), o) and p) shall be placed on the main part of the TDS.

NOTE 1 Marking e) can be the series reference only.

NOTE 2 In the following country, the marking of the type reference is not used: UK.

Parts such as cover plates, which are necessary for safety purposes and are intended to be sold separately, shall be marked with the manufacturer's or responsible vendor's name, trade mark or identification mark and type reference.

Markings i) and j), when applicable, shall be marked so as to be easily discernible when the switch is mounted and wired as in normal use. These markings shall be placed on parts which cannot be removed without the use of a tool.

NOTE 3 Additional type references can be marked on the main part, or on the outside or the inside of the associated enclosure.

8.4 Marking on terminals for phase conductors

Terminals intended for the connection of phase conductors (supply conductors) shall be identified unless the method of connection is of no importance, is self-evident or is indicated on a wiring diagram. Such identification may take the form of a letter L or, in the case of more than one of such terminals, the letters L1, L2, L3, etc. The letters L1, L2, L3 may be accompanied by an arrow or arrows pointing to the relevant terminal or terminals.

These indications shall not be placed on screws or any other easily removable part.

Alternatively, the surface of such terminals shall be bare brass or copper, other terminals being covered with a metallic layer of another colour.

For switches of pattern numbers 2, 3, 03 and 6/2, terminals associated with any one pole shall have similar identification, if applicable, differing from that of the terminals associated with the other poles, unless the relationship is self-evident.

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If necessary, the wiring diagram on which the terminal reference is clearly indicated shall be fixed to the accessory or put inside the protective cover for the terminals.

The terminals of the control circuit shall be marked according to either IEC 60445 or with the symbols according to 8.2, or both.

NOTE 1 The wiring diagram can be an instruction sheet which accompanies the switch.

NOTE 2 "Easily removable parts" are those parts which can be removed during the normal installation of the switch.

8.5 Marking on terminals for neutral and earth conductors

Terminals intended exclusively for the neutral conductor shall be indicated by the letter N.

Earthing terminal for the connection of the protective conductor shall be indicated by the symbol ⏚ (IEC 60417-5019:2006-08).

These markings shall not be placed on screws or any other easily removable part.

NOTE "Easily removable parts" are those parts which can be removed during the normal installation of the switch.

Terminals provided for the connection of conductors not forming part of the main function of the switch shall be clearly identified unless their purpose is self-evident, or indicated in a wiring diagram which shall be fixed to the accessory.

The identification of switch terminals may be achieved by

– their marking with graphical symbols according to IEC 60417 or colours and/or alpha-numeric system;
– their physical dimension or relative location.

Leads of pilot lights are not considered to be conductors for the purpose of 8.5.

8.6 Marking of the switch position

If switches are marked to indicate the switch position, they shall be so marked that the direction of movement of the actuating member to its different positions or the actual position is clearly indicated. For switches having more than one actuating member, this marking shall indicate, for each of the actuating members, the effect achieved by its operation.

The marking shall be clearly visible on the front of the switch when fitted with its cover or cover plate.

If this marking is placed on the cover, cover plate, or removable actuating members, it shall not be possible to fix them in a position such that the marking is incorrect.

The symbols for "on" and "off" shall not be used for the indication of the switch positions unless, at the same time, they clearly indicate the direction of the movement of the actuating members.

NOTE 1 Other suitable means for the indication of the switch position can be used, for example pilot lights.

The short straight line indicating the "on" position shall be radial for rotary switches, perpendicular to the axis of rotation of the dolly for tumbler switches and rocker switches and vertical for push-button switches when mounted vertically.

These requirements do not apply to cord-operated switches and to switches of pattern numbers 6, 6/2 and 7.

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NOTE 2 This indication can be avoided for push-button switches.

Compliance with the requirements of 8.1 to 8.6 is checked by inspection.

8.7 Additional requirements for marking

If it is necessary to take special precautions when installing the switch, details of these shall be given in an instruction sheet which accompanies the switch.

Instruction sheets shall be written in the official language(s) of the country in which the switch is to be sold.

Compliance is checked by inspection.

NOTE 1 Special precautions can, for example, be necessary for unenclosed switches and for switches for panel mounting.

NOTE 2 After installation, the conditions necessary to meet the requirements of this document are achieved when the instruction sheet includes clear information with regard to the following:

– dimensions of the space to be provided for each switch;
– dimensions and position of the means for supporting and fixing the switch within this space;
– minimum clearance between the various parts of the switch and the surrounding parts where fitted;
– minimum dimensions of ventilating openings, if needed, and their correct arrangement.

NOTE 3 If necessary, information concerning the connection between the earthing terminal and accessible metal parts can be given.

8.8 Durability

Marking shall be durable and easily legible.

Compliance is checked by inspection and by the following test.

The marking is rubbed by hand for 15 s with a piece of cloth soaked with water and again for 15 s with a piece of cloth soaked with 95 % n-hexane.

NOTE 1 Marking made by impression, moulding, pressing, laser marking or engraving is not subjected to this test.

NOTE 2 95 % n-hexane (Chemical Abstracts Service Registry Number CAS RN 110-54-3) is available from a variety of chemical suppliers as a high pressure liquid chromatography (HPLC) solvent.

9 Checking of dimensions

Switches and boxes shall comply with the appropriate standard sheets, if any.

Compliance is checked by measurement.

10 Protection against electric shock

10.1 Prevention of access to live parts

Switches shall be so designed that when they are mounted and wired as in normal use, live parts are not accessible even after removal of parts which can be removed without the use of a tool.

Switches which are designed to be fitted with pilot lights supplied at voltages other than ELV shall have means to prevent direct contact with the lamp.

Compliance is checked by inspection and, if necessary, by the following test:

Documents
Document Sharing Hub
Full document details: IEC 60669-2-3 2024 EXV

The specimen is mounted as in normal use and fitted with conductors of the smallest cross-sectional area specified in Clause 12; the test is repeated using conductors of the largest cross-sectional area specified in Clause 12.

Test probe B of IEC 61032 is applied in every possible position, an electrical indicator with a voltage between 40 V and 50 V being used to show contact with the relevant part.

Switches having enclosures or covers in thermoplastic or elastomeric material are subjected to the following additional test, which is carried out at an ambient temperature of (35 ± 2) °C, the switches being at this temperature.

During the additional test, the switches are subjected for 1 min to a force of 75 N, applied through the tip of test probe 11 of IEC 61032.

This finger, with an electrical indicator as described above, is applied to all places where yielding of insulating material could impair the safety of the switch, but is not applied to membranes or the like and is applied to thin-walled knock-outs with a force of only 10 N.

During this test, switches with their associated mounting means shall not deform to such an extent that live parts can be touched with the test probe 11 of IEC 61032.

NOTE Membranes or the like are tested according to 13.15.1 only.

10.2 Requirements for operating parts

Knobs, operating levers, push-buttons, rockers and the like shall be of insulating material, unless their accessible metal parts are separated from the metal parts of the mechanism by double insulation or reinforced insulation, or, as an alternative, they are reliably connected to earth.

Compliance is checked by inspection and by the tests of Clauses 16 and 23.

This requirement does not apply to removable keys or intermediate parts, such as chains or rods.

10.3 Requirements for accessible metal parts

10.3.1 Accessible parts of switches when in normal use shall be made of insulating material with the exception of the following:

– small screws and the like which are isolated from live parts and which are used for the fixing of the base and of covers, cover plates and other parts of the enclosure;
– actuating members complying with 10.2;
– the covers, cover plates and other parts of the enclosure made of metal which comply with the requirements of 10.3.2 or 10.3.3.

10.3.2 Covers or cover plates of metal shall be protected by additional insulation made by insulating linings or insulating barriers. The insulating linings or insulating barriers shall either

– be fixed to covers or cover plates or the body of the switches in such a way that they cannot be removed without being permanently damaged, or
– be so designed that
  - they cannot be replaced in an incorrect position;
  - if they are omitted, the accessories are rendered inoperable or manifestly incomplete;
  - there is no risk of accidental contact between live parts and metal covers or cover plates, for example through their fixing screws, even if a conductor should come away from its terminal;

AVA Documents
Document Sharing Hub
Full document details: IEC 60669-2-3 2024 EXV

- precautions are taken in order to prevent creepage distances or clearances becoming less than the values specified in Clause 23.

Compliance is checked by inspection.

The above linings or barrier shall comply with the tests of Clauses 16 and 23.

NOTE Insulating coating sprayed on the inside or on the outside of the metal cover or cover plate is not deemed to be an insulating lining or barrier for the purpose of 10.3.2.

10.3.3 The earthing of metal covers or cover plates can be made with fixing screws or other integral means, the resulting connection shall be of low resistance.

Compliance is checked by inspection and by the tests of 11.4.

10.4 Requirements for insulation of the mechanism

Metal parts of the mechanism, such as the spindle or the pivot of the dolly or rocker, that are not insulated from live parts, shall not protrude from the enclosure.

However, for switches operated by means of a removable key or similar device, such metal parts of the mechanism shall be insulated from live parts.

Compliance is checked by inspection and, if necessary, after the actuating member has been removed or broken.

If the actuating member has to be broken, compliance is checked by the test of Clause 23.

10.5 Requirements for insulation of the mechanism with respect to the surrounding environment

Metal parts of the mechanism shall not be accessible and shall be insulated from accessible metal parts when the switch is fixed as in normal use.

These requirements do not apply if the metal parts of the mechanism are separated from live parts in such a way that the creepage distances and clearances have at least twice the values specified in Clause 23, or, as an alternative, if they are reliably connected to earth.

Compliance is checked by inspection and, if necessary, by measurement and by the tests of Clauses 10 and 16.

NOTE When checking the inaccessibility of metal parts of the mechanism of unenclosed switches or architrave-type switches, the protection provided by the normal way of mounting the switch is taken into account.

For unenclosed stack-type switches having a metal spindle pivoting in a metal base plate, the additional requirement means that the creepage distances and clearances between live parts and the spindle, and between metal parts of the mechanism and base plate, shall have at least twice the values specified in Clause 23.

10.6 Requirements for switches operated indirectly

Switches operated by means of a removable key or by means of an intermediate part, such as a cord, a chain or a rod, shall be so designed that the key or intermediate part can only touch parts which are insulated from live parts.

The key or intermediate part shall be insulated from metal parts of the mechanism, unless the creepage distances and clearances between live parts and metal parts of the mechanism have at least twice the values specified in Clause 23.

Documents
Document Sharing Hub

Full document details: IEC 60669-2-3 2024 EXV

Compliance is checked by inspection, by the test of 16.3 and, if necessary, by measurement.

NOTE Lacquer or enamel is not considered to be insulating material for the purposes of 10.1 to 10.6.

10.7 Requirements for switches with replaceable pull cord

Where cord-operated switches are provided with a pull cord which can be fitted or replaced by the user, they shall be so designed that it is impossible to touch live parts when fitting or replacing the pull cord in the normal way.

Compliance is checked by inspection.

11 Provision for earthing

11.1 General

Accessible metal parts, which can become live in the event of an insulation fault, shall be provided with, or permanently and reliably connected to, an earthing terminal.

This requirement does not apply to the metal cover plates mentioned in 10.3.2.

For the purpose of this requirement, small screws and the like, isolated from live parts, are not considered as accessible parts which can become live in the event of an insulation fault.

11.2 Earthing terminals

Earthing terminals shall be terminals with screw clamping or screwless terminals and shall comply with the appropriate requirements of Clause 12.

11.3 Requirements for surface-type switches

Surface-type switches with an enclosure of insulating material, having an IP code higher than IPX0 and more than one cable inlet, shall be provided with either an internal fixed earthing terminal or adequate space for a floating terminal allowing the connection of an incoming and outgoing conductor for the continuity of the earthing circuit.

Clause 12 does not apply to floating terminals which shall comply with IEC 60998-1 and the relevant sub-part of IEC 60998-2.

Compliance with 11.1 to 11.3 is checked by inspection and by the tests of Clause 12.

Compliance for adequate space for floating terminals is checked by performing a test connection using the type of terminal specified by the manufacturer.

11.4 Test for earthing connection

The connection between the earthing terminal and accessible metal parts to be connected thereto shall be of low resistance.

Compliance is checked by the following test:

A current derived from an AC source having a no-load voltage not exceeding 12 V and equal to 1,5 times the rated current or 25 A, whichever is the greater, is passed between the earthing terminal and each of the accessible metal parts in turn.

The voltage drop between the earthing terminal and the accessible metal part is measured, and the resistance calculated from the current and this voltage drop.

AVA Documents
Document Sharing Hub

Full document details: IEC 60669-2-3 2024 EXV

In no case shall the resistance exceed 0,05 Ω.

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

12 Terminals

12.1 General

Switches shall be provided with terminals having screw clamping or with screwless terminals.

The means for clamping the conductors in the terminals shall not serve to fix any other component, although they may hold the terminals in place or prevent them from turning.

All the tests on terminals, with the exception of 12.3.11, shall be carried out after the test of 15.1. Rigid solid conductors shall be of Class 1, rigid stranded conductors shall be of Class 2 and flexible conductors shall be of Class 5 according to IEC 60228.

Compliance is checked by inspection and by the tests of 12.2 or 12.3, as applicable.

12.2 Terminals with screw clamping for external copper conductors

12.2.1 Terminals with screw clamping may be of the type suitable for rigid copper conductors only or of the type suitable for both rigid and flexible copper conductors having cross-sectional areas as shown in Table 4.

Table 4 – Relationship between rated currents and connectable cross-sectional areas of copper conductors

Ranges of rated currents	Rigid conductors (solid or stranded)[c]	
	Nominal cross-sectional areas	Diameter of largest conductor
A	mm^2	mm
up to and including 4[a]	–	–
above 4 up to and including 6	From 0,75 up to 1,5 inclusive	1,45
above 6 up to and including 13[b]	From 1 up to 2,5 inclusive	2,13
above 13 up to and including 16[b]	From 1,5 up to 4 inclusive	2,72
above 16 up to and including 25	From 2,5 up to 6 inclusive	3,34
above 25 up to and including 32	From 4 up to 10 inclusive	4,34
above 32 up to and including 50	From 6 up to 16 inclusive	5,46
above 50 up to and including 63	From 10 up to 25 inclusive	6,85

[a] For special purposes such as ELV applications, where flexible conductors are used (from 0,5 mm^2 up to 1 mm^2 inclusive).

[b] Each supply terminal of switches, other than those of pattern numbers 3, 03 and 7, shall allow the connection of two 2,5 mm^2 conductors. For switches having a rated voltage not exceeding 250 V a round hole is sufficient for the connection of two 2,5 mm^2 conductors.

[c] The use of flexible conductors is permitted.

The conductor space shall be at least that specified in Figures 1, 2, 3, 4 and 5.

Compliance is checked by inspection and by fitting conductors of the smallest and largest cross-sectional areas specified.

Documents
Document Sharing Hub

Full document details: IEC 60669-2-3 2024 EXV

12.2.2 Terminals with screw clamping shall allow the conductor to be connected without special preparation.

Compliance is checked by inspection.

NOTE The term "special preparation" covers soldering of the wires of the conductor, use of cable lugs, formation of eyelets, etc., but not the reshaping of the conductor before its introduction into the terminal or the twisting of a flexible conductor to consolidate the end.

12.2.3 Terminals with screw clamping shall have adequate mechanical strength.

Screws and nuts for clamping the conductors shall have a metric ISO thread or a thread comparable in pitch and mechanical strength.

Screws shall not be of metal which is soft or liable to creep, such as zinc or aluminium.

Compliance is checked by inspection and by the tests of 12.2.6 and 12.2.8.

NOTE Provisionally SI, BA, and UN threads are considered to be comparable in pitch and mechanical strength to metric ISO thread.

12.2.4 Terminals with screw clamping shall be resistant to corrosion.

Terminals, the body of which is made of copper or copper alloy as specified in 22.5 are considered as complying with this requirement.

12.2.5 Terminals with screw clamping shall be so designed and constructed that they clamp the conductor(s) without undue damage to the conductor(s).

Compliance is checked by the following test:

Terminals suitable for rigid conductors only are checked with rigid solid conductors and on a new set of specimens with rigid stranded conductors, if existing.

NOTE “if existing” means that the conductor is available in the market where the product is sold and installed.

Terminals suitable for rigid and flexible conductors are checked with rigid conductors as above and on a new set of specimens with flexible conductors.

The terminal is placed in the test apparatus according to Figure 9. The terminal is fitted first with a conductor of the smallest and then with a conductor of the largest cross-sectional area according to Table 4, the clamping screw(s) or nut(s) being tightened with the torque according to Table 5.

Where a screw has a hexagonal head with a slot for tightening with a screwdriver and the values of columns 3 and 5 are different, the test is made twice, first applying to the hexagonal head the torque specified in column 5 and then applying the torque specified in column 3 by means of a screwdriver. If the values of columns 3 and 5 are the same, only the test with the screwdriver is made.

For mantle terminals, the specified nominal diameter is that of the slotted stud.

The shape of the blade of the test screwdriver shall suit the head of the screw to be tested.

The screws and nuts shall be tightened in one smooth and continuous motion.

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Document Sharing Hub
Full document details: IEC 60669-2-3 2024 EXV

Table 5 – Tightening torque for the verification of the mechanical strength of screw-type terminals

Nominal diameter of thread mm	Torque Nm					
	1	**2**	**3**	**4**	**5**	**6**
Up to and including 2,8	0,2	–	0,4	–	0,4	–
Over 2,8 up to and including 3,0	0,25	–	0,5	–	0,5	–
Over 3,0 up to and including 3,2	0,3	–	0,6	–	0,6	–
Over 3,2 up to and including 3,6	0,4	–	0,8	–	0,8	–
Over 3,6 up to and including 4,1	0,7	1,2	1,2	1,2	1,2	–
Over 4,1 up to and including 4,7	0,8	1,2	1,8	1,8	1,8	–
Over 4,7 up to and including 5,3	0,8	1,4	2,0	2,0	2,0	–
Over 5,3 up to and including 6,0	–	1,8	2,5	3,0	3,0	–
Over 6	–	–	–	–	–	0,8

Column 1 applies to screws without heads if the screw when tightened does not protrude from the hole, and to other screws which cannot be tightened by means of a screwdriver with a blade wider than the diameter of the screw.

Column 2 applies to nuts of mantle terminals which are tightened by means of a screwdriver.

Column 3 applies to other screws which are tightened by means of a screwdriver.

Column 4 applies to nuts of mantle terminals in which the nut is tightened by means other than a screwdriver.

Column 5 applies to screws or nuts, other than nuts of mantle terminals, which are tightened by means other than a screwdriver.

Column 6 applies to nuts of switches with central hole fixing.

The length of the test conductor shall be 75 mm longer than the height (H) specified in Table 6.

The end of the conductor is passed through an appropriate sized bushing in a platen positioned at a height (H) below the equipment as given in Table 6. The bushing shall be positioned in a horizontal plane such that its centre line describes a circle of 75 mm diameter, concentric with the centre of the clamping unit in the horizontal plane. The platen is then rotated at a rate of (10 ± 2) r/min.

The distance between the mouth of the clamping unit and the upper surface of the bushing shall be within ± 15 mm of the height of Table 6. The bushing may be lubricated to prevent binding, twisting, or rotation of the insulated conductor.

A mass as specified in Table 6 is to be suspended from the end of the conductor. The duration of the test shall be 15 min.

During the test, the rigid conductor, or any wire of rigid stranded or flexible conductor, shall neither slip out of the clamping unit nor break near the clamping unit, nor shall the conductor be damaged in such a way as to render it unfit for further use.

In the case of the flexible conductor, the breakage of a few wires shall not be taken into account provided it does not exceed 15 % of the original number of wires.

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Full document details: IEC 60669-2-3 2024 EXV

Table 6 – Test values for flexion and pull out for copper conductors

Conductor cross-sectional area [a]	Diameter of bushing hole [b]	Height *H* [c]	Mass for conductor
mm^2	mm	mm	kg
0,5	6,5	260	0,3
0,75	6,5	260	0,4
1,0	6,5	260	0,4
1,5	6,5	260	0,4
2,5	9,5	280	0,7
4,0	9,5	280	0,9
6,0	9,5	280	1,4
10,0	9,5	280	2,0
16,0	13,0	300	2,9
25,0	13,0	300	4,5

[a] AWG sizes corresponding to mm^2 can be found in IEC 60999-1.

[b] If the bushing hole diameter is not large enough to accommodate the conductor without binding, a bushing having the next larger hole size may be used.

[c] Tolerance for height *H* = ± 15 mm.

12.2.6 Terminals with screw clamping shall be so designed that they clamp the conductor reliably between metal surfaces.

Compliance is checked by inspection and by the following test:

Terminals suitable for rigid conductors only are checked with rigid solid conductors and on a new set of specimens with rigid stranded conductors, if existing.

NOTE 1 “if existing” means that the conductor is available in the market where the product is sold and installed.

Terminals suitable for rigid and flexible conductors are checked with rigid conductors as above and on a new set of specimens with flexible conductors.

The terminals are fitted first with conductors of the smallest and then with conductors of the largest cross-sectional area specified in Table 4, the terminal screws being tightened with a torque equal to two-thirds of the torque shown in the appropriate column of Table 5.

If the screw has a hexagonal head with a slot, the torque applied is equal to two-thirds of the torque shown in column 3 of Table 5.

The conductor is then subjected to a pull as specified in Table 7, applied without jerks, for 1 min, in the direction of the axis of the conductor space.

If the clamp is intended for two conductors, the appropriate pull is applied consecutively to each conductor.

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Full document details: IEC 60669-2-3 2024 EXV

Table 7 – Test values for pulling out test

Cross-section of conductors connected to the terminal mm²	**0,75**	**1**	**1,5**	**2,5**	**4**	**6**	**10**	**16**	**25**
Pull N	30	35	40	50	50	60	80	90	100

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

If the clamp is intended for connection of more than two conductors, reference is made for the testing to the requirements given in the appropriate part of IEC 60998.

NOTE 2 In the following countries, terminals allowing connection of two conductors are additionally tested with one rigid solid conductor and one rigid stranded conductor with the same cross-sectional area connected at the same time: DK, FI, NO, SE and ZA.

12.2.7 Terminals with screw clamping shall be so designed or placed that neither a rigid solid conductor nor a wire of a stranded conductor can slip out while the clamping screws or nuts are tightened.

This requirement does not apply to lug terminals.

Compliance is checked by the following test:

Terminals suitable for rigid conductors only are checked with rigid solid conductors and on a new set of specimens with rigid stranded conductors, if existing.

NOTE "if existing" means that the conductor is available in the market where the product is sold and installed.

Terminals suitable for rigid and flexible conductors are checked with rigid conductors as above and on a new set of specimens with flexible conductors.

The terminals are fitted with conductors having the largest cross-sectional area specified in Table 4.

Terminals intended for the looping-in of two or three conductors are checked, fitted with the permissible number of conductors.

The terminals are fitted with conductors having the composition given in IEC 60228.

Before insertion into the clamping means of the terminal, wires of rigid (solid or stranded) conductors are straightened; rigid stranded conductors may, in addition, be twisted to restore them approximately to their original shape and flexible conductors are twisted in one direction so that there is a uniform twist of one complete turn in a length of approximately 20 mm.

The conductor is inserted into the clamping means of the terminal for the minimum distance prescribed or, where no distance is prescribed, until it just projects from the far side of the terminal and in the position most likely to allow the wire to escape.

The clamping screw(s) or nut(s) is (are) then tightened with a torque equal to two-thirds of the torque shown in the appropriate column of Table 5.

After the test, no wire of the conductors shall have escaped outside the clamping unit thus reducing creepage distances and clearances to values lower than those indicated in Table 23.

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12.2.8 Terminals with screw clamping shall be so fixed or located within the switch that, when the clamping screws or nuts are tightened or loosened, the terminals shall not work loose from their fixing to the switch.

Movement of the terminal is allowed as long as it is sufficiently limited so as to prevent non-compliance with this document.

The use of sealing compound or resin is considered to be sufficient for preventing a terminal from working loose, provided that

– the sealing compound or resin is not subject to stress during normal use, and
– the effectiveness of the sealing compound or resin is not impaired by temperatures attained by the terminal under the most unfavourable conditions specified in this document.

Compliance is checked by inspection, by measurement and by the following test:

A solid rigid copper conductor of the largest cross-sectional area specified in Table 4 is placed in the terminal.

Screws and nuts are tightened and loosened five times by means of a suitable test screwdriver or spanner, the torque applied when tightening being equal to the torque shown in the appropriate column of Table 5 or in the table of the appropriate Figures 1 to 4, whichever is the highest.

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

During the test, terminals shall not work loose and there shall be no damage, such as breakage of screws or damage to the heads, slots, threads, washers or stirrups that will impair the further use of the terminals.

12.2.9 Clamping screws or nuts of earthing terminals with screw clamping shall be adequately locked against accidental loosening and it shall not be possible to loosen them without the aid of a tool.

Compliance is checked by manual test.

In general, the designs of terminals shown in Figures 1, 2, 3, 4 and 5 provide sufficient resiliency to comply with this requirement; for other designs, special provisions, such as the use of an adequately resilient part which is not likely to be removed inadvertently, may be necessary.

12.2.10 Earthing terminals with screw clamping shall be such that there is no risk of corrosion resulting from contact between these parts and the copper of the earthing conductor, or any other metal that is in contact with these parts.

The body of the earthing terminals shall be of brass or other metal no less resistant to corrosion, unless it is a part of the metal frame or enclosure, when the screw or nut shall be of brass or other metal no less resistant to corrosion.

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

Compliance is checked by inspection.

NOTE Screws or nuts of plated steel withstanding the corrosion test are considered to be of a metal no less resistant to corrosion than brass.

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Full document details: IEC 60669-2-3 2024 EXV

12.2.11 For pillar terminals, the distance between the clamping screw and the end of the conductor, when fully inserted, shall be at least that specified in Figure 1.

NOTE The minimum distance between the clamping screw and the end of the conductor applies only to pillar terminals in which the conductor cannot pass right through.

For mantle terminals, the distance between the fixed part and the end of the conductor, when fully inserted, shall be at least that specified in Figure 5.

Compliance is checked by measurement, after a solid conductor of the largest cross-sectional area specified for the appropriate rated current in Table 4 has been fully inserted and fully clamped.

12.2.12 Lug terminals shall be used only for switches having a rated current of 40 A or greater; if such terminals are provided, they shall be fitted with spring washers or equally effective locking means.

Compliance is checked by inspection.

12.3 Screwless terminals for external copper conductors

12.3.1 Screwless terminals may be of the type suitable for rigid copper conductors only or of the type suitable for both rigid and flexible copper conductors.

For the latter type, the tests are carried out with rigid conductors first and then repeated with flexible conductors.

12.3 is not applicable to switches provided with

– screwless terminals requiring the fixing of special devices to the conductors before clamping in the screwless terminal, for example flat push-on connectors;
– screwless terminals requiring twisting of the conductors, for example those with twisted joints;
– screwless terminals providing direct contact to the conductors by means of edges or points penetrating the insulation.

12.3.2 Screwless terminals shall be provided with clamping units which allow the proper connection of rigid or of rigid and flexible copper conductors having nominal cross-sectional areas as shown in Table 8.

Table 8 – Relationship between rated currents and connectable cross-sectional areas of copper conductors for screwless terminals

Rated current	Conductors		
	Nominal cross-sectional areas	Diameter of largest rigid conductor	Diameter of largest flexible conductor
A	mm^2	mm	mm
Up to and including 4	0,75 to 1	1,19	-
Above 4 and including 6	1 to 1,5	1,45	1,73
Above 6 and including 16[a]	1,5 to 2,5	2,13	2,21

[a] Each supply terminal of switches other than those of pattern numbers 3, 03 and 7 shall allow the connection of two 2,5 mm^2 conductors. In such cases a terminal with separate independent clamping means for each conductor shall be used.

Compliance is checked by inspection and by fitting conductors of the smallest and largest cross-sectional areas specified.

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12.3.3 Screwless terminals shall allow the conductor to be connected without special preparation.

Compliance is checked by inspection.

NOTE The term "special preparation" covers soldering of the wires of the conductor, use of terminal ends, etc., but not the reshaping of the conductor before introduction into the terminal or the twisting of a flexible conductor to consolidate the end.

12.3.4 Parts of screwless terminals mainly intended for carrying current shall be of materials as specified in 22.5.

Compliance is checked by inspection and by chemical analysis.

NOTE Springs, resilient units, clamping plates and the like are not considered as parts mainly intended for carrying current.

12.3.5 Screwless terminals shall be so designed that they clamp the specified conductors with sufficient contact pressure and without undue damage to the conductor.

The conductor shall be clamped between metal surfaces.

Compliance is checked by inspection and by the test of 12.3.10.

12.3.6 It shall be clear how the connection and disconnection of the conductors is to be made.

The disconnection of a conductor shall require an operation, other than a pull on the conductor, so that it can be made manually with or without the assistance of a general purpose tool.

It shall not be possible to confuse the opening for the use of a tool to assist the connection or disconnection with the opening intended for the insertion of the conductor.

Compliance is checked by inspection and by the test of 12.3.10.

12.3.7 Screwless terminals which are intended to be used for the interconnection of two or more conductors shall be so designed that

– the clamping of one of the conductors is independent of the clamping of the other conductor(s);
– during the connection or disconnection the conductors can be connected or disconnected either at the same time or separately;
– each conductor shall be introduced in a separate clamping unit (not necessarily in separate holes);
– it shall be possible to clamp securely any number of conductors up to the maximum as designed.

Compliance is checked by inspection and by the tests with the appropriate conductors.

12.3.8 Screwless terminals shall be so designed that over-insertion of the conductor is prevented and adequate insertion is obvious.

Screwless terminals of switches shall be so designed that undue insertion of the conductor is prevented by a stop if further insertion is liable to reduce the creepage distances and/or clearances required in Table 23, or to influence the mechanism of the switch.

Compliance is checked by inspection and by the test of 12.3.10.

Documents
Document Sharing Hub
Full document details: IEC 60669-2-3 2024 EXV

12.3.9 Screwless terminals shall be properly fixed to the switch.

They shall not work loose when the conductors are connected or disconnected during installation.

Compliance is checked by inspection and by the test of 12.3.10.

Covering with sealing compound without other means of locking is not sufficient. However, self-hardening resins may be used to fix terminals which are not subject to mechanical stress in normal use.

12.3.10 Screwless terminals shall withstand the mechanical stresses occurring in normal use.

Compliance is checked by the following tests which are carried out with uninsulated conductors on one screwless terminal of each specimen, using a new specimen for each test.

The test is carried out with solid copper conductors, first with conductors having the largest cross-sectional area, and then with conductors having the smallest cross-sectional area specified in 12.3.2.

Conductors are connected and disconnected five times, new conductors being used each time, except for the fifth time, when the conductors used for the fourth connection are clamped at the same place. For each connection the conductors are either pushed as far as possible into the terminal or are inserted so that adequate connection is obvious.

After each connection, the conductor is subjected to a pull of 30 N; the pull is applied without jerks, for 1 min, in the direction of the longitudinal axis of the conductor space.

During the application of the pull, the conductor shall not come out of the screwless terminal.

The test is then repeated with rigid stranded copper conductors having the largest and smallest cross-sectional areas specified in 12.3.2; these conductors are, however, connected and disconnected only once.

Screwless terminals, intended for both rigid and flexible conductors, shall also be tested with flexible conductors, applying five connections and disconnections.

Each conductor of screwless terminals is subjected for 15 min to a circular motion with (10 ± 2) r/min using an apparatus, an example of which is shown in Figure 9. The conductor is subjected to a pull having a value shown in Table 6.

During the test, the conductors shall not move noticeably in the clamping unit.

After these tests, neither the terminals nor the clamping means shall have worked loose and the conductors shall show no deterioration impairing their further use.

12.3.11 Screwless terminals shall withstand the electrical and thermal stresses occurring in normal use.

Compliance is checked by the following tests a) and b), which are carried out on five screwless terminals which have not been used for any other test.

Both tests are carried out with new copper conductors.

a) The test is carried out by loading the screwless terminals for 1 h with an alternating current as specified in Table 9 and connecting rigid solid conductors 1 m long having the cross-sectional area as specified in Table 9.

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b) The test is carried out on each clamping unit.

Table 9 – Test current for the verification of electrical and thermal stresses in normal use of screwless terminals

Rated current A	Test current A	Cross-sectional area of the conductor mm^2
Up to including 4	9	0,75
Above 4 and including 6	13,5	1
Above 6 and including 13	17,5	1,5
Above 13 and including 16	22	2,5

During the test, the current is not passed through the switch but only through the terminals.

Immediately after this period, the voltage drop across each screwless terminal is measured with rated current flowing.

In no case shall the voltage drop exceed 15 mV.

The measurements are made across each screwless terminal and as near as possible to the place of contact.

If the back connection of the terminal is not accessible, the second connecting point in the case of two-way switches may be used for the returning wire; in the case of one-way switches the specimens may be adequately prepared by the manufacturer; care should be taken not to affect the behaviour of the terminal.

During the period of the test, including the measurements, the conductors and the measurement means shall not be moved so that the result of the test is affected.

The screwless terminals already subjected to the determination of the voltage drop specified in the previous test a) are tested as follows:

– *During the test, a current equal to the test current value given in Table 9 is passed.*

The whole test arrangement including the conductors shall not be moved until the measurements of the voltage drop have been completed.

The terminals are subjected to 192 temperature cycles, each cycle having a duration of approximately 1 h and being carried out as follows:

– *the current is flowing for approximately 30 min;*
– *for a further approximately 30 min no current is flowing.*

The voltage drop in each screwless terminal is determined as prescribed for the test of a) and is done at the following moments:

– *after the first 24 temperature cycles and after the 192 temperature cycles;*
– *additional measurements to be done after any three of the following temperature cycles: after the 48th, 72nd, 96th, 120th, 144th or 168th temperature cycles.*

In no case shall the voltage drop exceed 22,5 mV or two times the value measured after the 24th cycle, whichever is the smaller.

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Full document details: IEC 60669-2-3 2024 EXV

After this test, an inspection by normal or corrected vision without additional magnification shall show no changes evidently impairing further use such as cracks, deformation or the like.

In addition, the mechanical strength test according to 12.3.10 is repeated and all specimens shall withstand this test.

12.3.12 Screwless terminals shall be so designed that the connected rigid solid conductor remains clamped, even when it has been deflected during normal installation, for example during mounting in a box, and the deflecting stress is transferred to the clamping unit.

Compliance is checked by the following test which is made on three specimens of switches which have not been used for any other test.

The test apparatus, the principle of which is shown in Figure 10a, shall be so constructed that

- *a specified conductor properly inserted into a terminal is allowed to be deflected in any of the 12 directions differing from each other by 30°, with a tolerance referred to each direction of ±5°, and*
- *the starting point can be varied by 10° and 20° from the original point.*

A reference point need not be specified.

The deflection of the conductor from its straight position to the testing positions shall be effected by means of a suitable device applying a specified force to the conductor at a certain distance from the terminal.

The deflecting device shall be so designed that

- *the force is applied in the direction perpendicular to the undeflected conductor;*
- *the deflection is attained without rotation or displacement of the conductor within the clamping unit, and*
- *the force remains applied while the prescribed voltage drop measurement is made.*

Provision shall be made so that the voltage drop across the clamping unit under test can be measured when the conductor is connected, as shown for example in Figure 10b.

The specimen is mounted on the fixed part of the test apparatus in such a way that the specified conductor inserted into the clamping unit under test can be freely deflected.

To avoid oxidation, the insulation of the wire shall be removed immediately before starting the test.

NOTE 1 If necessary, the inserted conductor can be permanently bent around obstacles, so that these do not influence the results of the test.

NOTE 2 In some cases, with the exception of the case of guidance for the conductor, it may be advisable to remove those parts of the specimens which do not allow the deflection of the conductor corresponding to the force to be applied.

A clamping unit is fitted as for normal use with a rigid solid copper conductor having the smallest cross-sectional area specified in Table 10 and is submitted to a first test sequence. The same clamping unit is submitted to a second test sequence using the conductor having the largest cross-sectional area, unless the first test sequence has failed.

The force for deflecting the conductor is specified in Table 11, the distance of 100 mm being measured from the extremity of the terminal, including the guidance, if any, for the conductor, to the point of application of the force to the conductor.

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Full document details: IEC 60669-2-3 2024 EXV

The test is made with continuous current (i.e. the current is not switched on and off during the test). A suitable power supply should be used and an appropriate resistance should be inserted in the circuit so that the current variations are kept within ±5 % during the test.

Table 10 – Cross-sectional areas of rigid copper conductors for deflection test of screwless terminals

Rated current of the switch A	Cross-sectional area of the test conductor mm^2	
	1st test sequence	2nd test sequence
≤ 6	1,0[a]	1,5
Above 6 up to and including 16	1,5	2,5
[a] Only for countries allowing the use of 1,0 mm^2 conductors in fixed installations.		

Table 11 – Deflection test forces

Cross-sectional area of the test conductor mm^2	Force for deflecting the test conductor[a] N
1,0	0,25
1,5	0,5
2,5	1,0
[a] The forces are chosen so that they stress the conductors close to the limit of elasticity.	

A test current equal to the rated current of the switch is passed through the clamping unit under test. A force according to Table 11 is applied to the test conductor inserted in the clamping unit under test in one of the 12 directions shown in Figure 10a and the voltage drop across this clamping unit is measured. The force is then removed.

The force is then applied successively in each one of the remaining 11 directions shown in Figure 10a following the same test procedure.

If for any of the 12 test directions the voltage drop is greater than 25 mV, the force is maintained in this direction until the voltage drop is reduced to a value below 25 mV, but for not more than 1 min. After the voltage drop has reached a value below 25 mV, the force is maintained in the same direction for a further period of 30 s, during which period the voltage drop shall not have increased.

The other two specimens of switches of the set are tested following the same test procedure, but moving the 12 directions of the force so that they differ by approximately 10° for each specimen. If one specimen has failed at one of the directions of application of the test force, the tests are repeated on another set of specimens, all of which shall comply with the repeated tests.

13 Constructional requirements

13.1 Mechanical requirements for insulating means

Insulating linings, barriers and the like shall have adequate mechanical strength and shall be secured in a reliable manner.

Compliance is checked by inspection after the tests of Clause 20.

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Full document details: IEC 60669-2-3 2024 EXV

13.2 Installation requirements

Switches shall be constructed so as to permit

– easy introduction into the terminal and reliable connection of the conductors in the terminals, except for lead wires of pilot lights;

NOTE 1 Screw terminals shown in Figures 1 to 5 are considered suitable for reliable connection of the conductors.

– correct positioning of the conductors;

– easy fixing of the switch to a wall or in a box;

– adequate space between the underside of the main part and the surface on which the main part is mounted or between the sides of the main part and the enclosure (cover or box) so that, after installation of the switch, the insulation of the conductors is not necessarily pressed against live parts of different polarity or against moving parts of the mechanism, such as the spindle of a rotary switch.

NOTE 2 This requirement does not imply that the metal parts of the terminals are necessarily protected by insulation barriers or insulating shoulders, to avoid contact, due to incorrect installation of the terminal metal parts, with the insulation of the conductor.

Surface-type switches shall be constructed so that the fixing means do not damage the insulation of the cables during the installation.

Compliance is checked by inspection and by an installation test using conductors of the largest cross-sectional area specified, for the relevant ranges of rated currents, in Table 4.

NOTE 3 For surface-type switches, mounted on a mounting plate, a wiring channel may be needed to comply with this requirement.

In addition, for switches comprising screwless terminals, the switches shall be so constructed that the connecting and/or disconnecting means of the screwless terminals cannot be activated by the conductors during and after installation of the switch in a box or on a wall.

NOTE 4 This requirement does not imply that the connecting and/or disconnecting means cannot be touched by the conductors.

NOTE 5 This requirement can be met by the placement of the connecting and/or disconnecting means and/or the use of protective barriers or shoulders placed around the connecting and/or disconnecting means.

Compliance is checked by inspection and in case of doubt by the following test.

The test is carried out with a solid copper conductor having the smallest cross-sectional area specified in 12.3.2.

The conductor is pushed as far as possible into the terminal under test or is inserted so that adequate connection is obvious.

A test probe 1 of IEC 61032 is pushed against the connecting or disconnecting means with a force of 120 N in the direction opposite to the mounting direction as described in Figure 22a.

During the application of the force, the conductor, except for lead wires of pilot lights, is subjected to a pull of 30 N; the pull is applied in one smooth and continuous motion, for 1 min, in the direction of the longitudinal axis of the conductor space.

During the application of the pull, the conductor shall not come out of the screwless terminal.

The force of 120 N has to be applied before the force of 30 N is applied. The force of 30 N is maintained on the conductor during the complete test.

Documents
Document Sharing Hub
Full document details: IEC 60669-2-3 2024 EXV

Care should be taken that the test probe does not touch the conductor during the application of the forces.

Where the axis between the application force and the axis through the force necessary to operate the connecting/disconnecting means deviates by more than 20°, it is allowed to exert the calculated resulting force directly onto the connecting/disconnecting means using the test probe. An example is shown in Figure 22b.

If the angle is greater than 60° no test is necessary and the product is deemed to comply with the requirements without further tests.

If it is not possible to exert a force onto the connecting/disconnecting device, the product is deemed to comply with the requirements without further tests.

In addition, switches classified as design A shall permit easy positioning and removal of the cover or cover plate, without displacing the conductors or activating the connecting and/or disconnecting means of screwless terminals.

NOTE 6 This requirement does not imply that the connecting and/or disconnecting means cannot be touched by the cover or cover plate.

13.3 Fixing of covers, cover plates and actuating members

13.3.1 Covers, cover plates and actuating members or parts of them, which are intended to ensure protection against electric shock, shall be held in place at two or more points by effective fixing.

Covers, cover plates and actuating members or parts of them may be fixed by means of a single fixing, for example by a screw, provided that they are located by another means (for example by a shoulder).

NOTE 1 The most appropriate method for fixings covers, cover plates or actuating members is to ensure that they are captive. The use of tight fitting washers of cardboard or the like is deemed to be an adequate method for securing screws intended to be captive.

NOTE 2 Non-earthed metal parts, separated from live parts in such a way that creepage distances and clearances have values specified in Table 23, are not considered as accessible if the requirements of 13.3 are met.

Where the fixing of covers, cover plates or actuating members of switches of design A serves to fix the main part there shall be means to maintain the main part in position, even after removal of the covers, cover plates or actuating members.

Compliance is checked according to 13.3.2, 13.3.3 or 13.3.4.

13.3.2 *For covers, cover plates or actuating members whose fixing is of the screw-type:*

by inspection only.

13.3.3 *For covers, cover plates or actuating members whose fixing is not dependent on screws and whose removal is obtained by applying a force in a direction approximately perpendicular to the mounting/supporting surface (see Table 12),*

– *when their removal may give access, with the test probe B of IEC 61032, to live parts:*

by the tests of 20.5;

– *when their removal may give access, with the test probe B of IEC 61032, to non-earthed metal parts separated from live parts in such a way that creepage distances and clearances have the values at least equal to those shown in Table 23:*

by the test of 20.6;

Documents
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Full document details: IEC 60669-2-3 2024 EXV

– *when their removal may give access, with the test probe B of IEC 61032, only to*
  - *insulating parts, or*
  - *earthed metal parts, or*
  - *metal parts separated from live parts in such a way that creepage distances and clearances have at least twice the values shown in Table 23, or*
  - *live parts of SELV circuits not greater than 25 V AC and 60 V DC:*

by the test of 20.7.

Table 12 – Forces to be applied to covers, cover-plates or actuating members whose fixing is not dependent on screws

Accessibility with the test probe B of IEC 61032 after removal of covers, cover plates or parts of them	Test according to …	Force to be applied N			
		Switches complying with 20.8 and 20.9		Switches not complying with 20.8 and 20.9	
		Shall not come off	Shall come off	Shall not come off	Shall come off
To live parts	20.5	40	120	80	120
To non-earthed metal parts separated from live parts by creepage distances according to 23.1	20.6	10	120	20	120
To insulating parts, earthed metal parts, the live parts of SELV ≤ 25 V AC and 60 V DC or metal parts separated from live parts by creepage distances and by clearances twice those according to 23.1	20.7	10	120	10	120

13.3.4 *For covers, cover plates or actuating members whose fixing is not dependent on screws and whose removal is obtained by using a tool, in accordance with the manufacturer's instructions given in an instruction sheet or catalogue:*

by the same tests of 13.3.3 except that the covers, cover plates, actuating members or parts of them need not come out when applying a force not exceeding 120 N in directions perpendicular to the mounting/supporting surface.

13.4 Openings in normal use

Switches shall be so constructed that, when they are fixed and wired as in normal use, there are no free openings in their enclosures according to their IP classification.

Compliance is checked by inspection and by an installation test with conductors of the smallest cross-sectional area specified in Table 4.

NOTE Drain holes, small gaps between enclosures and conduits or cables, or between enclosures and operating means can be neglected if they comply with the relevant IP classification.

13.5 Attachment of knobs

Knobs of rotary switches shall be securely attached to the shaft or part operating the mechanism.

Compliance is checked by the following test.

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Full document details: IEC 60669-2-3 2024 EXV

Where it is possible to apply an axial pull in normal use, an axial pull shall be applied for 1 min to try to pull off the actuating member.

If the shape of the actuating member is such that an axial pull is likely to be applied in normal use, the force is 30 N.

If the shape of the actuating member is such that an axial pull is unlikely to be applied in normal use, the force is 15 N.

After this, knobs of switches having only one direction of operation are turned, if possible, without undue force, 100 times in the reverse direction.

During the test, the knob shall not become detached.

13.6 Mounting means

Screws or other means for mounting the switch on a surface or in a box or enclosure shall be easily accessible from the front. These means shall not serve any other fixing purpose.

NOTE Switch mounting means, if used to lock the rotation of the box, do not constitute a use for “any fixing purpose”.

13.7 Combination of switches

Combinations of switches, or of switches and socket-outlets, comprising separate bases shall be so designed that the correct position of each main part is ensured. The fixing of each main part shall be independent of the fixing of the combination to the mounting surface.

Compliance with the requirements of 13.6 and 13.7 is checked by inspection.

13.8 Accessories combined with switches

Accessories combined with switches shall comply with their relevant standard, if any, unless a standard exists for the combination.

13.9 Surface-type switches having an IP code higher than IP20

Surface-type switches that have an IP code higher than IP20 shall be according to their IP classification when fitted with conduits or with sheathed cables as for normal use.

Surface-type switches that have degrees of protection IPX4, IPX5 and IPX6 shall have provisions for opening a drain hole.

If a switch is provided with a drain hole, it shall be not less than 5 mm in diameter, or 20 mm^2 in area with a width and a length not less than 3 mm.

If the design of the switch is such that only one mounting position is possible, the drain hole shall be effective in that position. Alternatively, the drain hole shall be effective in at least two positions of the switch when this is mounted on a vertical wall, one of these with the conductors entering at the top and the other with the conductors entering at the bottom.

Lid springs, if any, shall be of corrosion resistant material, such as bronze or stainless steel.

Compliance is checked by inspection, by measurement and by the relevant tests of 15.2.

NOTE A drain hole in the back of the enclosure is deemed to be effective only if the design of the enclosure ensures a clearance of at least 5 mm from the wall, or provides a drainage channel of at least the size specified.

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