BRITISH STANDARD

BS 3676-1: 1989

Incorporating Amendments Nos. 1 and 2 and Corrigendum No. 1

Switches for household and similar fixed electrical installations

Part 1: Specification for general requirements

ICS 29.120.40

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Power Electrical Engineering Standards Policy Committee (PEL/-) to Technical Committee PEL/4, upon which the following bodies were represented:

ASTA Certification Services
Association of Consulting Engineers
Association of Control Manufacturers — TACMA (BEAMA Ltd.)
Association of Manufacturers of Domestic Electrical Appliances
British Electrical Systems Association (BEAMA Ltd.)
British Electrotechnical Approvals Board
British Plastics Federation
BSI Testing
Consumer Policy Committee of BSI
Decorative Lighting Association
Department of Health and Social Security
Department of Trade and Industry (Consumer Safety Unit, CA Division)
ERA Technology Ltd.
Electrical Contractors' Association
Electrical Installation Equipment Manufacturers' Association (BEAMA Ltd.)
Electrical Power Engineers' Association
Electricity Supply Industry in England and Wales
Institution of Electrical Engineers
Lighting Industry Federation Ltd.
National Inspection Council for Electrical Installation Contracting

The following body was also represented in the drafting of the standard, through subcommittees and panels:

Electronic Components Industry Federation

This British Standard, having been prepared under the direction of the Power Electrical Engineering Standards Policy Committee, was published under the authority of the Board of BSI and comes into effect on 29 September 1989

First published as BS 3676 November 1963
First revision as BS 3676-1 September 1989

The following BSI references relate to the work on this standard:
Committee reference PEL/4
Draft for comment 87/31450 DC

ISBN 0 580 17291 0

Amendments issued since publication

Amd. No.	Date	Comments
8222	October 1994	
10148	November 1998	Supersedes AMD 9185 (March 1997), which has been withdrawn
10625 Corrigendum	August 1999	Clause **16** and **18.1**, text deleted

Contents

Foreword

This Part of BS 3676:1989, including Amendments Nos. 1 and 2, has been prepared by Technical Committee PEL/23 (formerly PEL/4). It is based on IEC Publication 669-1 published by the International Electrotechnical Commission (IEC) and takes into account proposals for modifying that standard that have been discussed in the European Committee for Electrotechnical Standardization (CENELEC).

This Part of BS 3676:1989 supersedes BS 3676:1963 which is withdrawn.

Amendment No. 2 has been prepared to cover a situation brought about by the publication of BS EN 60669-1 (which supersedes BS 3676-1:1989) and the need to keep BS 3676-1:1989 up to date until such time as it is withdrawn. The foreword of the European Standard EN 60669-1 makes reference to the "date of withdrawal" of the relevant national standard. In this case the relevant national standard is BS 3676-1:1989, which will be withdrawn on 2005-10-15.

Corrigendum No. 1 has been issued to delete text in clause **16** and in **18.1**.

To facilitate future CENELEC harmonization, the format of the IEC Standard has been closely followed. Certain tables and figures are not appropriate for the British Standard, and have been omitted, but the numbering sequence of the IEC Standard has been maintained as far as possible. The numbering system is therefore not fully consistent with BSI style.

This part of BS 3676:1989 calls for the use of substances and procedures that may be injurious to health if adequate precautions are not taken. It refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety at any stage.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 46, an inside back cover and a back cover.

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1 Scope

This part of this British Standard specifies requirements and tests for manually operated general purpose switches with a rated voltage not exceeding 440 V a.c. or d.c. and a rated current not exceeding 63 A a.c. or d.c., intended for household and similar fixed electrical installations, either indoors or outdoors. The rated current is limited to 10 A a.c. or d.c. for switches provided with screwless terminals.

The requirements specified in this part of BS 3676 have particular reference to safety in normal use.

This standard also applies to switches such as:

a) switches supplied with boxes;

b) switches intended for mounting in boxes to BS 4662;

c) switches intended for mounting in boxes other than BS 4662;

d) switches incorporating pilot lights;

e) electromagnetic remote control switches;

f) switches incorporating a time delay device;

g) electronic switches.

Particular requirements for electronic switches, electromagnetic remote-control switches and time-delay switches will be given in Part 2 of this standard at a later date. With regard to electronic switches, attention is drawn to BS 5518 which will remain the appropriate standard for such switches until the publication of a section of Part 2 of this standard covering electronic switches.

Switches complying with BS 3676-1 are suitable for use in air temperatures from – 5 °C to + 40 °C with an average value over a period of 24 h not exceeding + 25 °C. Switches complying with BS 3676-1 are suitable for use where the altitude of the site of installation does not exceed 2 000 m.

NOTE In locations where special conditions prevail, as in ships, vehicles and the like and in hazardous locations, for instance where explosions are liable to occur, special constructions may be required.

This part of BS 3676 does not apply to circuit-breakers for household and similar installations, to switches for appliances and to (in-line) cord switches.

2 Definitions

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

For the purposes of this part of BS 3676 the following definitions apply.

2.1
switch

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

2.2
isolating switch

a switch designed to make and break the current in all current carrying poles of an electric circuit to provide the safe isolation of equipment from the supply

2.3
functional switch

a switch not intended for safety isolating purposes

2.4
operation or movement

the transfer of the moving contacts from one position of rest to another

2.5
terminal

a conductive part of a device, provided for re-usable electrical connection to external circuits

2.6
clamping unit

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

2.7
terminal with screw clamping

a terminal intended for the connection, by clamping only, of external rigid or flexible conductors

2.8
pillar terminal

a terminal with screw clamping in which the conductor is inserted into a hole or cavity, where it is clamped under the end of the screw or screws. The clamping pressure may be applied directly by the end of the screw or through an intermediate clamping member to which pressure is applied by the end of the screw

NOTE Examples of pillar terminals are shown in Figure 3.

2.9
screw terminal

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

NOTE Examples of screw terminals are shown in Figure 4.

2.10
stud terminal

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

NOTE Examples of stud terminals are shown in Figure 4.

2.11
saddle terminal

a terminal with screw clamping in which the conductor is clamped under a saddle by means of two or more screws or nuts

NOTE Examples of saddle terminals are shown in Figure 5.

2.12
lug terminal

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

NOTE Examples of lug terminals are shown in Figure 6.

2.13
mantle terminal

a terminal with screw clamping in which the conductor is clamped against the base of a slot in a threaded stud by means of a nut

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 Examples of mantle terminals are shown in Figure 7.

2.14
screwless terminal

a connecting device for the connection and subsequent disconnection of a rigid (solid or stranded) or flexible conductor or the interconnection of two conductors capable of being disconnected, 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

2.15
mechanical time-delay device

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

2.16
base

a part of the switch retaining current-carrying parts and, in general, the mechanism, in position

2.17
rated voltage

the voltage assigned to the switch by the maker

2.18
rated current

the current assigned to the switch by the maker

2.19
type test

a test of one or more switches to show that all switches made to the same specification and having the same essential details would pass an identical test

2.20
actuating member

that part which is moved, pulled, pushed or turned to operate the switch mechanism

2.21
pole

a conducting path in a switch equipped with a set of contacts for making, breaking and carrying the current through the switch

2.22
surface switch

a switch provided with a seating surface so that when mounted, it projects wholly above the surface on which it is mounted

2.23
flush switch

a switch for mounting behind or incorporated with a switch plate, the back of the plate being flush with the surface of the wall or box

2.24
semi flush switch

a switch for mounting with its base partially sunk into the surface of a wall or box

2.25
panel switch

a switch for mounting to a panel or box having an aperture through which the intended accessible surface of the switch protrudes

2.26
architrave switch

a switch having a cover plate of such proportions that it may be accommodated within a narrow box

2.27
pull cord switch

a switch intended for mounting on a suitable overhead surface and operated by means of a cord or the like

2.28
pull cord

the cord by which the pull cord switch is manually operated

2.29
operating member

that part of a pull cord switch which connects the internal mechanism with the pull cord. It is usually attached to the actuating member of the switch

2.30
live parts

current carrying parts and those metal parts in contact with them during normal use

NOTE Metal parts of the earthing circuit are not considered to be current carrying parts

2.31
flexible cord or cable outlet switch

a switch having provision for an outlet for a flexible cord or cable

NOTE Flexible cables below and including nominal conductor cross-sectional areas of 4 mm^2 are referred to as flexible cords.

2.32
polarity

the voltage difference between terminals intended for the connection of live and neutral conductors in switches of pattern numbers 2, 0.3, 6/2

2.33
push button switch

control switch having one actuator intended to be operated by force exerted by a part of the human body, usually the finger or the palm of the hand, and which has stored energy return, e.g. a spring

3 General requirements

Switches and boxes shall be so designed and constructed that, in normal use, their performance is reliable and without danger to the user or surroundings. Such switches and boxes shall be capable of meeting all the relevant requirements and tests specified in this part of BS 3676. Where tolerances are not specified in this standard the values are to be regarded as nominal.

4 Requirements for type testing

4.1 Tests according to this part of BS 3676 are type tests.

A manufacturer or responsible vendor who claims compliance with BS 3676-1, for any product, shall submit representative type test samples of that product to the relevant tests of this standard in the order specified below. The results of such tests shall be recorded and retained for reference and inspection.

4.2 Unless otherwise specified, the samples shall be tested as delivered and under normal conditions of use.

Switches shall be tested together with their appropriate boxes.

4.3 Unless otherwise specified, the tests shall be carried out in the order of the clauses, at an ambient temperature of 20 ± 5 °C.

4.4 For switches which are marked with one rated voltage and one rated current, one set of 15 samples is required.

For switches marked with two rated voltages and two corresponding rated currents, two sets of 15 samples are required, one set for each current rating.

For switches marked with two rated voltages and one rated current, the test shall be carried out at the higher voltage and one set of 15 samples is required.

For switches marked with ratings which are different for a.c. and d.c., one set of 15 samples is required for a.c. testing, plus three additional samples for d.c. testing.

Each set of 15 samples shall be tested in accordance with the test schedule in Table W.

For switches marked with the letter X, three additional samples shall be tested in accordance with sequence f) of the test schedule.

For switches other than ordinary, three additional samples shall be tested in accordance with sequence g) of the test schedule.

For switches having membranes in inlet openings, three additional samples shall be tested in accordance with sequence h) and three additional samples shall be tested in accordance with sequence i) of the test schedule.

Push button switches intended to operate bells, electromagnetic remote control switches or time-delay switches are not submitted to the tests of clause **17** and **18.2**.

For the tests of **11.3.11**, additional samples of switches having in total at least five screwless terminals are required.

4.5 If no sample fails in the complete series of tests given in **4.4**, switches of that type shall be deemed to comply with this standard.

Alternatively, if one sample fails in any group in the complete series of tests specified in **4.4**, then switches of that type shall be deemed to have failed to comply with this standard, unless that switch can be shown to be not representative of normal production or design, in which case a further set of samples shall be submitted to the test or tests in that group. If there is no failure in this re-test then switches of that type shall be deemed to comply with this standard.

If more than one sample fails in the complete series of tests given in **4.4** the switches of that type shall be deemed to have failed to comply with this standard.

5 Ratings

5.1 Switches shall preferably have rated voltages of 130 V, 250 V and 440 V (for a.c. and/or d.c.) and 250 V, 277 V, 380 V and 415 V (for a.c. only).

For push-button switches intended to operate bells, electromagnetic remote control switches or time-delay switches, the standard rated voltages are 130 V and 250 V.

If another voltage rating is used, it shall be not less than 120 V.

5.2 Switches shall preferably have rated currents of 6 A, 10 A, 16 A, 20 A, 25 A, 32 A, 45 A and 63 A.

The rated current shall be not less than 6 A, except that rated currents of 1 A, 2 A and 4 A are allowed for push-button switches intended to operate bells, electromagnetic remote control switches or time-delay switches.

For fluorescent lamp circuits, unless otherwise specified, the maximum current is:

a) 0.25 times rated current of the switch, when capacitors are connected in parallel;

b) 0.5 times rated current of the switch, when the capacitors are connected in series.

The derating for fluorescent lamp circuits is not necessary if the switches pass the tests described in **18.2** of this standard and are marked accordingly.

Compliance with the requirements of **5.1** and **5.2** is checked by inspection of the marking and by the tests of this standard.

6 Classification

6.1 Switches are classified under the headings of **6.1.1** to **6.1.9**.

6.1.1 Classification according to the nature of the supply:

a) switches for a.c. only;

b) switches for d.c. only;

c) switches for both a.c. and d.c.

6.1.2 Classification according to the possible connections (see Figure 1):

a) single-pole switches (Pattern No. 1);

b) double-pole switches (Pattern No. 2);

c) three-pole switches (Pattern No. 3);

d) three-pole plus switched neutral switches (Pattern No. 03);

e) two-way switches (Pattern No. 6);

f) two-circuit switches with a common incoming line (Pattern No. 5);

g) two-way switches with one "off" position (Pattern No. 4);

h) two-way double-pole switches (Pattern No. 6/2);

i) two-way double-pole reversing switches or intermediate switches (Pattern No. 7).

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

6.1.3 Classification according to the application:

a) isolating switches;

b) functional switches.

6.1.4 Classification according to the degree of protection against electric shock:

a) unenclosed switches;

b) enclosed switches (degree of protection IP2X).

NOTE 1 The degrees of protection are based on BS 5490.

NOTE 2 For unenclosed switches, the protection against electric shock is given by the box in which the switch is intended to be mounted. For enclosed switches, the protection against electric shock is provided by compliance with the requirements of clause **9**.

6.1.5 Classification according to the degree of protection against harmful ingress of water:

a) ordinary switches having no special protection against harmful ingress of water;

b) splash-proof switches with degree of protection IPX4;

c) jet-proof switches with degree of protection IPX5.

NOTE For the purposes of this part of BS 3676 the term "ordinary" applies only to the degree of protection against harmful ingress of water.

6.1.6 Classification according to the method of actuating the switch:

a) rotary switches;

b) tumbler switches;

c) rocker switches;

d) push-button switches;

e) pull cord switches.

6.1.7 Classification according to the method of installation:

a) surface-type switches;

b) flush-type switches;

c) semi flush-type switches;

d) panel-type switches;

e) architrave-type switches;

f) flexible cord or cable outlet switches.

Table W — Test schedule

Sequence	Samples	Switch type	Clause no
a) See notes 1 and 2	3 3	All (switches with screw type terminals) All (switches with screwless terminals)	**4, 5, 6, 7, 8, 9, 10, 14.1, 11.2, 12** **4, 5, 6, 7, 8, 9, 10, 11.3.11, 14.1, 11.3** (excluding **11.3.11**), **12**
b) See note 3	3	All	**4, 13, 14,** (excluding **14.2** and **14.4**), **15, 16, 17** and **18.1**
c)	3		**4, 19, 20, 21**
d)	3		**4, 22, 23.3, 24**
e)	3		**4, 23.2**
f)	3	For switches marked with the letter "X" following the rated current	**4, 14** (excluding **14.2** and **14.4**), **15, 16, 18.2**
g)	3	For switches other than ordinary	**4, 14.2**
h) i)	3 3	For switches having membranes in inlet openings	**4, 14.1, 14.4.1** **4, 14.4.2**

NOTE 1 The order of tests given in sequence a) above is preferred but not mandatory except where required within the text of the appropriate clause.
NOTE 2 For the tests of **11.3.11**, additional samples of switches having in total at least five screwless terminals are required.
NOTE 3 Switches suitable for ac/dc operation are tested in accordance with **17.1** and **17.2**, separate samples being used for each test.

6.1.8 Classification according to the method of installation, as a consequence of the design:

a) switches where the cover or cover plate can be removed without displacement of the conductors (design A);

b) switches where the cover or cover plate cannot be removed without displacement of the conductors (design B).

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. It is considered to be of design A, provided the supplementary plate meets the requirements specified for covers and cover plates.

6.1.9 Classification according to type of terminal:

a) switches with screw-type terminals;

b) switches with screwless terminals for rigid conductors only;

c) switches with screwless terminals for rigid and flexible conductors.

6.2 Preferred combinations of number of poles and ratings are shown in Table 1.

Table 1 — Preferred combinations of number of poles and ratings

Rated current	Number of poles		
	Rated voltages from 120 V up to 250 V inclusive	Rated voltage over 250 V a.c. only	Rated voltages over 250 V d.c. only
A 1, 2 and 4	1	—	—
6	1 2	1 2	— —
10	1 2 — —	1 2 3 4	— 2 — —
16, 20, 25, 32, 45 and 63	1 2 3 4	1 2 3 4	— 2 — —

7 Markings

7.1 Switches shall be marked with the following.

a) The number of this British Standard, i.e. BS 3676[1)]

b) Rated current is amperes, followed by the letter "X" where the fully rated fluorescent load test is met (see **18.2**)

c) Rated voltage(s) in volts.

d) Nature of supply, if the switch is not intended for both a.c. and d.c. or if the rating is different for a.c. and d.c.

e) Maker's or responsible vendor's name or trade mark or identification mark.

f) Symbol for isolating switch, if applicable.

g) Symbol for degree of protection against ingress of solid foreign bodies, if higher than IP2X.

h) Symbol for degree of protection against harmful ingress water, if applicable, in which case the symbol for degree of protection against ingress of solid foreign bodies shall be marked, even if not higher than IP2X.

i) Where cord anchorages are intended to clamp effectively cords and/or cables other than those cross-sectional areas appropriate to the rating of the switch as given in Table 2, then the minimum and maximum sizes for which anchorage is provided shall be indicated.

It may be marked in an area adjacent to the anchorage, e.g. "6 mm – 16 mm" or "6 – 16". The information shall be put on the switch and/or the packaging unit.

j) In addition, switches with screwless terminals shall be marked with an indication of the suitability to accept rigid conductors only, for those switches having this restriction.

The information may be put on the switch and/or the packaging unit.

NOTE 1 Ordinary switches are not marked with any symbol for protection against harmful ingress of water.

NOTE 2 Marking of the pattern number given in **6.1.2** is recommended if the connections are not clear from an inspection of the switch.

NOTE 3 If a base carries two or more switches with separate operating devices, marking with the pattern numbers is recommended. For example "1 – 6" or "1 + 1 + 1".

7.2 When symbols are used, they shall be as follows.

Amperes	A or AX (see **7.1**)
Volts	V
Alternating current	∿
Direct current	⎓
Line (phase)	L
Neutral	N
Earth	⏚ or ⏚

NOTE 1 It is recommended that, where practicable, the symbol ⏚ should be used.

"Off" position	O
"On" position	I
Isolating switch construction and/or "off" position of an isolating switch	◎
Splash-proof construction	IPX4
Jet-proof construction	IPX5

[a] The letter "X" should be replaced by the relevant number.

For the marking with rated current and rated voltage, figures may be used alone. The figure for the d.c. current rating, if any, shall then be placed before the figure for the a.c. current rating, and separated from it by an oblique line or dash, these figures being placed before or above that for the rated voltage and separated from the latter by a line.

If the current rating figures are separated by an oblique line, a second oblique line shall not be used to separate the current rating figures from the voltage rating figures.

If a symbol for nature of supply is used, it shall be placed next to the marking for rated current and rated voltage.

NOTE 2 The marking for current, voltage and nature of supply may be, for instance, as follows:

10 A 250 V	or	10/250	or	$\frac{10}{250}$
10AX 250V ~	or	10X/250 ~	or	$\frac{10X}{250}$ ~
10/16A 250V	or	10-16/250	or	$\frac{10\text{-}16}{250}$
10 A 250/380 V ~	or	$\frac{10}{250/380}$ ~		
25 A 380 V ~	or	25/380 ~	or	$\frac{25}{380}$ ~

7.3 The marking for rated current, rated voltage, nature of supply, maker's or responsible vendor's name, trade mark or identification mark, shall be on the main part of the switch.

[1)] Marking BS 3676 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is therefore solely the responsibility of the person making the claim. Such a declaration is not to be confused with third party certification of conformity, which may also be desirable.

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

The symbol for degree of protection against harmful ingress of water, if applicable, shall be marked on the outside of its associated box so as to be easily discernible when the switch is mounted and wired as in normal use.

NOTE 1 Type references may be marked on the main part, or on the outside or the inside of the associated box.

NOTE 2 The term "main part" means the part carrying the contacts and any part integral with them; it does not include the knob, handle and the like, or parts intended to be sold separately.

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

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.

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

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

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

Earthing terminals shall be indicated by the symbols shown in **7.2**. These markings shall not be placed on screws, or any other easily removable part.

Lines formed incidentally by the construction of the production tools are not considered as part of the marking.

Compliance with the requirements of **7.1** to **7.5** is checked by inspection.

7.6 Switches which are marked so that the "off" or "on" positions are indicated, shall have those indications clearly visible from the front of the switch when fitted with its cover or cover plate.

If these indications are placed on the cover or cover plates, it shall not be possible to fix the cover or cover plates in a position such that the indications are incorrect.

Where the symbol for "on" is used it shall be radial for rotary switches, perpendicular to axis of rotation of the dolly for tumbler switches and rocker switches and vertical for push-button switches when mounted vertically.

For switches having more than one actuating member the requirement shall apply to each actuating member individually.

Where indications of "on" and "off" positions are given it shall not be possible for the switch to indicate "off" with the actuating member at a position of rest if the contacts are still closed.

Switches for isolating purposes shall be of Pattern Numbers 2, 3, 03 and shall be marked such that the position of the switch contacts in the "off" or open position is clearly indicated by the position of the actuating member and/or marking.

NOTE The isolating switch symbol shown in **7.2** may be used in place of the word "off" or the symbol for "off".

Compliance with **7.6** is checked by inspection, manual operation and continuity test.

7.7 A push-button shall be coloured red only if it serves to open the circuit to be controlled. However, it may also serve to close auxiliary contacts for control circuits, pilot lamps, etc.

7.8 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.

Compliance with the requirements of **7.7** and **7.8** is checked by inspection.

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

In order to ensure that, after installation, the conditions necessary to meet the requirements of this standard are achieved, the instruction sheet should include clear information with regard to the following:

a) dimensions of the space to be provided for the switch;

b) dimensions and position of the means for supporting and fixing the switch within this space;

c) minimum clearances between the various parts of the switch and the surrounding parts where fitted;

d) minimum dimensions of ventilating openings, if needed, and their correct arrangement.

7.9 Marking shall be durable and easily legible and shall not be placed on screws, washers or other easily removable parts.

Compliance for legibility shall be by inspection, using normal or corrected vision without additional magnification.

Compliance for durability shall be checked by rubbing the marking by hand for 15 s with a piece of cloth soaked in water and again for 15 s with a piece of cloth soaked in petroleum spirit.

After testing the marking shall be easily legible; it shall not be possible to remove easily any marking plates and they shall show no curling.

The petroleum spirit used shall consist of a solvent hexane having a maximum aromatics content of 0.1 % by volume, a Kauri-butanol value of 29, an initial boiling point of approximately 65 °C, a dry point of approximately 69 °C, and a density at 15/15 °C of approximately 0.68 g/cm^3.

NOTE The density may be determined by the method specified in BS 4714.

Marking made by engraving, moulding or a similar permanent process is deemed to comply with the requirement for durability without testing.

8 Dimensions

For flush mounted switches intended to be used in boxes complying with BS 4662, the minimum overall sizes of the cover plates, either of insulating material or metal or a combination of both, shall be greater than the associated boxes so as to afford the protection required by clause **9**.

The size and disposition of the fixing screw holes shall be such as to allow satisfactory attachment to boxes having a tolerance of ± 0.8 mm on the centres of the 3.5 mm dia. fixing screws.

Compliance is checked by inspection and measurement.

9 Accessibility of live parts

9.1 Switches shall be so designed that when they are mounted and correctly 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.

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

The sample is mounted as in normal use removing those parts which may be removed without the use of a tool and fitted with conductors of the smallest cross-sectional area specified in clause **11**; the test is repeated using conductors of the largest cross-sectional area specified in clause **11**. For flexible cord and cable outlet switches the test is carried out without the flexible cord or cable fitted.

Test finger I of BS 3042 is applied in every possible position, an electrical indicator, with a voltage not less than 40 V and not more than 50 V, being used to show contact with the relevant part.

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

During this additional test, the switches are subjected for I min to a force of 75 N, applied through the tip of a straight unjointed test finger of the same dimensions as the test finger I of BS 3042.

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. It is not applied to membranes but is applied to thin walled knock-outs with a force of 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 unjointed test finger. Membranes are tested only according to **14.4.1**.

9.2 Knobs, operating members, push-buttons, rockers and the like shall be of insulating material, unless their accessible metal parts are separated from the live 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 **15** and **22**.

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

9.3 Accessible parts shall be of insulating material, with the exception of the following:

a) small screws and the like, which are isolated from live parts and which are used for fixing bases and covers or cover plates;

b) actuating members, complying with **9.2**;

c) covers, cover plates and other parts of the enclosure of metal which comply with the relevant requirements of **9.3.1**.

9.3.1 Covers, cover plates and other parts of the enclosure of metal shall be either:

a) protected by supplementary insulation, made by insulating linings or insulating barriers fixed to the covers, cover plates, or other parts of the enclosure, or to the body of the accessories, in such a way that the insulating linings or insulating barriers cannot be removed without being permanently damaged; or

b) so designed that they cannot be replaced in an incorrect position and that, if they are omitted, the accessories are rendered inoperable or manifestly incomplete; or

c) so designed that there is no risk of accidental connection between live parts and covers, cover plates or other parts of the enclosure, for example through their fixing screws, even if a conductor should come away from its terminal; or

d) arranged such that covers or cover plates are automatically connected to earth via other parts of the accessory. Fixing screws or other means are allowed for such automatic connection.

Compliance shall be checked by inspection and:

1) for the linings and barriers, by the tests of clauses **15** and **22**;

2) for the effectiveness of connection to earth by the test of **10.4**.

NOTE Insulating coating sprayed on the inside or on the outside of the metal covers or cover plates is not deemed to be an insulating lining or barrier for the purpose of this sub-clause.

9.4 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 box.

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, if necessary after the actuating member has been removed or broken.

NOTE If the actuating member has to be broken, compliance is checked after the test of clause **23**.

9.5 Metal parts of the mechanism, such as the spindle or the pivot of the dolly or rocker, shall not be accessible when the switch is fixed as in normal use.

In addition, they shall be insulated from accessible metal parts, including metal frames supporting the base of flushtype switches liable to be mounted in a metal box, and from screws for fixing the base to its support.

The additional requirement does 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 **22**, 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 **9** and **15**.

NOTE 1 When checking the inaccessibility of metal parts of the mechanism of unenclosed switches or of architrave-type switches, the protection provided by the normal way of mounting of the switch is taken into account.

NOTE 2 For unenclosed stack-type switches having a metal spindle pivoting in a metal base plate, the additional requirement necessitates the creepage distances and clearances between live parts and the spindle, and between metal parts of the mechanism and the base plate, being at least twice the values specified in clause **22**.

9.6 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 **22**.

Compliance is checked by inspection and the test of **15.2** and, if necessary, by measurement.

NOTE Lacquer or enamel is not considered to be insulating material for the purposes of **9.1** to **9.6**.

9.7 Pull cord switches shall be so designed that the pull cord is insulated from current-carrying parts, and so that it is impossible to touch live metal when replacing a pull cord in the normal way. The pull cord shall itself be of suitable flexible insulating material, and not less than 1 500 mm long.

Compliance is checked by inspection.

10 Provision for earthing

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

For the purpose of this requirement, small screws and the like, isolated from live parts, for fixing bases, covers or cover plates, are not considered as accessible parts which may become live in the event of an insulation fault.

This requirement does not apply to the metal cover plates mentioned in **9.3.1** and knobs etc., referred to in **9.2**.

10.2 Where provided, earthing terminals shall be terminals with screw clamping and shall comply with the appropriate requirements of clause **11**. They shall have a capacity not less than that of the corresponding terminals for the supply conductors.

10.3 Switches having more than one cable inlet, other than ordinary switches with a box of insulating material, shall be provided with an internal earthing terminal allowing the connection of an incoming and outgoing conductor for the continuity of the earthing circuit.

Compliance with the requirements of **10.1** to **10.3** is checked by inspection and by the tests of clause **11**.

10.4 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.

Table 2 — Conductors to be accommodated by terminals with screw clamping

Ranges of rated currents	Rigid conductors (solid or stranded) nominal cross-sectional area	Flexible conductors cords or cables nominal cross-sectional area
A	mm^2	mm^2
Up to and including 10[a]	From 1 to 1.5 inclusive	From 1 to 1.5 inclusive
Above 10 up to and including 16[a]	From 1 to 2.5 inclusive	From 1 to 1.5 inclusive
Above 16 up to and including 25	From 1.5 to 4.0 inclusive	From 1.5 to 2.5 inclusive
Above 25 up to and including 32	From 4.0 to 6.0 inclusive	From 2.5 to 4.0 inclusive
Above 32 up to and including 45	From 6.0 to 10.0 inclusive	From 4.0 to 6.0 inclusive
Above 45 up to and including 63	From 10.0 to 16.0 inclusive	From 6.0 to 10.0 inclusive

[a] Each supply terminal of switches, other than those of pattern numbers 3, 03 and 7, shall allow the connection of two designated largest conductors.

A current derived from an a.c. source having a no-load voltage not exceeding 12 V and equal to 1.5 times 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 is calculated from the current and this voltage drop. In no case shall the resistance exceed 0.05 Ω.

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

11 Terminals

11.1 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.

Compliance is checked by inspection and by the tests of **11.2** or **11.3** as applicable.

All the tests on terminals, with the exception of the test of **11.3.11**, shall be carried out after the test of clause **14**.

11.2 Terminals with screw clamping for external copper conductors

11.2.1 Switches shall be provided with terminals which shall allow the proper connection of copper conductors having nominal cross-sectional areas as shown in Table 2 except that for special purposes, such as extra low voltage applications with current ratings not exceeding 4 A, provision shall be made for flexible conductors from 0.5 mm^2 up to 1.0 mm^2 inclusive.

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

11.2.2 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.

11.2.3 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 **11.2.6** and **11.2.8**.

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

11.2.4 Terminals with screw clamping shall be resistant to corrosion.

Terminals as specified in **21.5** are considered as complying with this requirement.

11.2.5 Screw-type terminals shall be so designed that they clamp the conductor(s) without undue damage to the conductor(s).

Compliance is checked by the following test:

The terminal is fitted with a rigid (solid or stranded) conductor(s), according to Table 2: first with the smallest and then with the largest cross-sectional area, the clamping screws or nuts being tightened with the torque according to Table 5.

Each conductor in turn is subjected separately to two circular motions as shown in Figure 2a) using the appropriate H value.

The conductor is moved in one direction at a constant speed of 1 turn per 5 s.

During the circular motion, the conductor is subjected to a pull having a value shown in Table 3.

The terminal shall not be subjected to additional torsion and pull forces.

During the test, the solid conductor or any strand of a stranded conductor shall not come out of or break at the terminal.

Table 3 — Pull for terminal clamping test

Conductor size (in mm^2)	1	1.5	2.5	4	6	10	16
Pull (in N)	30	40	50	50	60	80	90

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

Compliance is checked by inspection and by the following test.

The terminals are fitted with rigid (solid or stranded) conductors of the smallest and largest cross-sectional areas specified in Table 2, 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.

Each conductor is then subjected to a pull as specified in Table 3, applied without jerks, for 1 min in the direction of the axis of the conductor space.

If the clamp is provided for two or three conductors, the appropriate pull is applied consecutively to each conductor. During the test, the conductor shall not move noticeably in the terminal.

11.2.7 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.

The terminals are fitted with conductors having the largest cross-sectional area specified in Table 2.

The terminals are checked both with solid conductors and with stranded conductors.

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

Terminals are fitted with conductors having the composition shown in Table 4.

Before insertion into the clamping means of the terminal, wires of rigid (solid or stranded) conductors are straightened and rigid stranded conductors may be, in addition, twisted to restore them approximately to their original shape.

Table 4 — Wires used for terminal clamping test

Cross-sectional area	**Number of wires and nominal diameter of wires (in mm)**	
	Solid conductor	**Stranded conductor**
mm^2		
1	1 × 1.13	7 × 0.42
1.5	1 × 1.38	7 × 0.52
2.5	1 × 1.78	7 × 0.67
4	1 × 2.25	7 × 0.86
6	1 × 2.76	7 × 1.05
10	1 × 3.57	7 × 1.35
16	—	7 × 1.70

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 is 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 shall have escaped from the retaining device.

11.2.8 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 fixings to switches.

NOTE 1 These requirements do not imply that the terminals should be so designed that their rotation or displacement is prevented, but any movement should be sufficiently limited so as to prevent non-compliance with this standard.

NOTE 2 The use of sealing compound or resin is considered to be sufficient for preventing a terminal from working loose, provided that:

a) the sealing compound or resin is not subject to stress during normal use, and

b) 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 standard.

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 2 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 figure, whichever is the higher. A new conductor end is used each time the screw or nut is loosened.

Table 5 — Torque values for test of terminal fixing

Nominal outside diameter of thread	Torque					
	1	2	3	4	5	6
mm	N·m	N·m	N·m	N·m	N·m	N·m
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

NOTE 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.

Where a screw has a hexagonal head with a slot for tightening with a screwdriver and the values in 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 in columns 3 and 5 are the same, only the test with the screwdriver is made.

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

NOTE 1 For mantle terminals the specified nominal diameter is that of the slotted stud.
NOTE 2 It is essential that the shape of the blade of the test screwdriver suits the head of the screw to be tested.
NOTE 3 It is essential that screws and nuts are not tightened in jerks.

11.2.9 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 Figure 3, Figure 4, Figure 5, Figure 6 and Figure 7, 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.

11.2.10 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 earthing terminals shall be of brass or other metal no less resistant to corrosion, unless it is a part of the metal frame or box, 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 box 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.

11.2.11 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 3.

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 7.

Compliance is checked by measurement, after a solid conductor of the largest cross-sectional area specified in Table 2 has been fully inserted and fully clamped.

11.2.12 Lug terminals shall be used only for switches having a rated current of 45 A and 63 A; if such terminals are provided, they shall be fitted with spring washers or equally effective locking means.

Compliance is checked by inspection.

11.3 Screwless terminals for external copper conductors

11.3.1 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.

This sub-clause is not applicable to switches provided with:

a) screwless terminals requiring the fixing of special devices to the conductors before clamping them in the screwless terminal, for example flat push-on connectors;

b) screwless terminals requiring twisting of the conductors, for example those with twisted joints;

c) screwless terminals providing direct contact to the conductors by means of edges or points penetrating the insulation.

11.3.2 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 5a) below.

NOTE Table 5b) of the IEC Standard is not appropriate, and has been omitted.

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

11.3.3 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 reshaping of the conductor before its introduction into the terminal or the twisting of a flexible conductor to consolidate the end.

11.3.4 Parts of screwless terminals mainly intended for carrying current shall be of materials as specified in **21.5**.

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.

11.3.5 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 **11.3.10**.

Table 5a) — Conductors to be accommodated by screwless terminals

Rated current	Conductors		
	Nominal cross-sectional areas	Diameter of largest rigid conductor[b]	Diameter of largest flexible conductor[b]
A	mm^2	mm	mm
4	0.75 to 1	1.19	—
6	1 to 1.5	1.45	1.73
10[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 a case a terminal with separate independent clamping means for each conductor shall be used, for a switch of 10 A rated current.
[b] The diameters shown in the table are 5 % larger than the diameters, according to IEC Publication 719, for the conductors with the largest nominal cross-sectional area.

11.3.6 It shall be clear how the insertion and disconnection of the conductors is intended to be effected.

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

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

Compliance is checked by inspection and by the test of **11.3.10**.

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

a) during the insertion, the operation of the clamping means of one of the conductors is independent of the operation of that of the other conductor(s);

b) during the disconnection, the conductors can be disconnected either at the same time or separately;

c) each conductor is 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 tests with the appropriate conductors (number and size).

11.3.8 Screwless terminals shall be so designed that undue insertion of the conductor is prevented and adequate insertion is obvious.

For the purpose of this requirement an appropriate marking indicating the length of insulation to be removed before the insertion of the conductor into the screwless terminal may be put on the switch or given in an instructional sheet which accompanies the switch.

Compliance is checked by inspection and by the test of **11.3.10**.

11.3.9 Screwless terminals shall be properly fixed to the switch.

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

Compliance is checked by inspection and by the test of **11.3.10**.

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

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

Compliance is checked by the following test, which is carried out with uninsulated conductors on one screwless terminal of each sample.

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 **11.3.2**.

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

After each insertion, 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 **11.3.2**; these conductors are, however, inserted and disconnected only once.

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

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.

11.3.11 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 loading the screwless terminals for 1 h with an alternating current as specified in Table 5c), and connecting rigid solid conductors 1 m long having the cross-sectional area as specified in the same table.

The test is carried out on each clamping unit.

Table 5c) — Current for electrical and thermal stress test

Rated current	Test current	Cross-sectional area of the conductor
A	A	mm^2
4	9.0	0.75
6	13.5	1
10	17.5	1.5

NOTE For switches having rated current different from the preferred ones, the test current is determined by interpolation between the next lower and higher preferred rated currents and the cross-sectional area of the conductors is chosen equal to the one specified for the next higher preferred rated current.

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 samples may be adequately prepared by the maker; care shall be taken not to affect the behaviour of the terminal.

Care shall be taken that, during the period of the test, including the measurements, the conductors and the measurement means are not moved noticeably.

b) 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 5c) 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:

1) with the current flowing for approximately 30 mins;

2) with no current flowing for a further 30 min approximately.

The voltage drop in each screwless terminal is determined as prescribed for the test a) after every 24 temperature cycles and after the 192 temperature cycles have been completed.

In no case shall the voltage drop exceed 22.5 mV or twice the value measured after the 24th cycle, whichever is the smaller.

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

Furthermore, the mechanical strength test according to **11.3.10** is repeated and all samples shall withstand this test.

12 Constructional requirements

12.1 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 **19**.

12.2 Switches shall be so constructed as to permit:

a) easy introduction and connection of the conductors in the terminals;

b) correct positioning of the conductors;

c) easy fixing of the switch onto a wall or into a box as applicable;

d) adequate space between the underside of the base and the surface on which the base is mounted or between the sides of the base and the enclosure (cover or box) so that, after installation of the switch, the insulation of the conductors does not come in contact with live parts of different polarity or with moving parts of the mechanism, such as the spindle of a rotary switch.

Surface-type constructions shall be made in such a way that the fixing means do not damage the insulation of the cables during the installation.

NOTE 1 This requirement does not imply that the metal parts of the terminals are necessarily protected by insulating barriers or insulating shoulders in order to avoid contact, due to incorrect installation of the terminal metal parts, with the insulation of the conductor.

NOTE 2 For surface-type switches, mounted on a mounting plate, a wiring channel may be needed to comply with this requirement.

In addition, switches classified as design A shall permit:

1) easy fixing of the base to a wall or in a box and correct positioning of the conductors;

2) easy positioning and removal of the cover or cover plate, without displacing the conductors.

Compliance is checked by inspection and by an installation test with conductors of the largest cross-sectional area specified in Table 2.

12.3 Covers and cover plates shall be held in place at two or more points in such a way that their removal requires the use of a tool.

NOTE 1 It is recommended that the fixings of cover plates be captive. The use of tight fitting washers of cardboard or the like is deemed to be an adequate method for securing screws which are to be captive.

For ordinary switches the fixing of covers or cover plates shall not serve to fix any other part, except the knobs.

In design A switches where the fixings of covers or cover plates serve also to fix the base, there shall be sufficient means to maintain the base in position after removal of the cover or cover plate.

NOTE 2 Tests for screwless fixing of covers or cover plates are under consideration.

NOTE 3 Decorative covers, cover plates or parts thereof, not providing protection against electric shock are not considered as covers or cover plates in the meaning of this sub-clause.

Compliance is checked by inspection and by an installation test.

12.4 Ordinary switches shall be so constructed that, when they are fixed and wired as in normal use, there are no free openings in their boxes.

Compliance is checked by inspection and by an installation test with conductors of the smallest cross-sectional area specified in Table 2.

NOTE Small gaps between boxes and conduits or cables, or between enclosures and operating means are neglected.

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

Compliance is checked by the following test.

The knob is subjected for one minute to an axial pull of 100 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 uncoupled.

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

12.7 Combinations of switches, or of switches and socket-outlets, comprising separate bases, shall be so designed that the correct position of each base is ensured.

The fixing of each base shall be independent of the fixing of the combination to the mounting surface.

Compliance with the requirements of **12.6** and **12.7** is checked by inspection.

12.8 Combinations of switches with other electrical accessories shall comply with the relevant standards if any.

12.9 Switches other than ordinary shall be totally enclosed when fitted with screwed conduits or with polyvinyl chloride (PVC) sheathed or similar type of cables.

Surface-type switches other than ordinary shall have provision for opening a drain hole at least 5 mm in diameter, or 20 mm^2 in area, with a width and a length of at least 3 mm.

Drain holes shall be located in such a manner that one of the holes can always become effective in any intended position of the box. If the position of the switch is such that only one mounting is possible, a drain hole shall be effective in that position.

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

Compliance is checked by inspection, measurement and the use of the probe as shown in Figure X. The probe may enter the drain hole providing it does not touch live parts.

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

12.10 Switches to be installed in a box shall be so designed that the conductor ends can be prepared after the box is mounted in position, but before the switch is fitted in the box.

In addition the base shall have adequate stability when mounted in the box.

Compliance is checked by inspection and by an installation test with conductors of the largest cross-sectional area specified in Table 2.

12.11 Switches other than ordinary, of pattern numbers 1, 5 and 6, with a box having more than one inlet opening, shall be provided with an additional terminal for maintaining the continuity of a second current-carrying conductor and complying with the appropriate requirements of clause **11**.

Compliance is checked by inspection and by the relevant tests of clause **11**.

12.12 Inlet openings shall allow the introduction of the conduit or the protective covering of the cable so as to afford complete mechanical protection.

Ordinary surface-type switches shall be so constructed that the conduit or protective covering can enter at least 1 mm into the box.

In ordinary surface-type switches, the inlet openings for conduit entries if any, or at least two of them if there are more than one, shall be capable of accepting conduit sizes of 16, 20, 25 or 32 mm or a combination of at least two of any of these sizes.

Ordinary surface-type switches intended for back entry from a conduit shall be designed for back entry from a conduit perpendicular to the mounting surface of the switch.

Compliance is checked by inspection during the test of **12.10** and by measurement.

NOTE Inlet opening of adequate size may also be obtained by the use of knock outs or of suitable insertion pieces.

12.13 Any flexible cord or cable outlet switch shall be so designed that an appropriate 2-core or 3-core flexible cord or cable, complying with Table 4, Table 5, Table 6, Table 9, Table 15 or Table 16 of BS 6500:1984, or that designated by the manufacturer, may enter the switch through a suitable hole, groove or gland. The entry shall accept the maximum dimensions of the outer sheath of the appropriate flexible cord or cable, having conductors of the cross-sectional area specified in Table 2, according to the current rating of the switch and the entry shall be so shaped as to prevent damage to the flexible cord or cable.

An anchorage shall be provided such that the conductors are relieved from strain, including twisting, where they are connected to the terminals.

The anchorage shall contain the sheath and shall be either of insulating material or, if of metal, shall be provided with an insulating lining fixed to the metal parts. Anchorages shall anchor the cord securely to the accessory. The design shall ensure that:

a) the anchorage cannot be released from the outside;

b) anchorage restraint is not effected by a metal part bearing directly on the flexible cord or cable;

c) at least one part of the anchorage is securely fixed to the switch, or its mounting box;

d) clamping the cord or cable does not require the use of a special purpose tool.

Anchorage lamping screws shall not serve to fix any other components unless the switch is rendered manifestly incomplete if the component is omitted or is replaced in an incorrect position, or the component intended to be fixed cannot be removed without further use of a tool.

Compliance shall be checked by inspection and by the following tests.

Switches are fitted with a 2-core circular flexible cord (to Table 15 of BS 6500:1994) having the smallest cross-sectional area referred to in Table 2 for its rating, or the minimum designated by the manufacturer.

The conductors are introduced into the terminals and the terminal screws tightened just sufficiently to prevent the conductors easily changing their positions. The anchorage is used in the normal way, the clamping screws, if any, being tightened to a torque of two-thirds of that given in Table 5. The assembly is then left untouched for 24 h.

After this preparation, it shall not be possible to push the flexible cord or cable into the switch or its box to such an extent as to impair safety or so that the anchorage is loosened.

The flexible cord is then subjected 25 times to the pull designated for the size of the conductor in Table X. The pulls are applied without jerks in the most unfavourable position, each time for 1 s. Immediately afterwards, the flexible cord is subjected for 1 min to a torque designated for the size of the conductor in Table X as near as practicable to the cord entry.

This test is then repeated, the switch being fitted with the largest appropriate flexible cord or cable nominated in **12.13**, the forces for the pull and torque tests being those designated in Table X.

Table X — Pull and torque tests for cord anchorages

Conductor size (in mm^2)	0.5	0.75	1.0	1.5	2.5	4	6	10
Pull (in N)	30	35	40	45	55	65	85	100
Torque (in N·m)	0.15	0.15	0.15	0.15	0.2	0.25	0.30	0.35

After the tests the flexible cord or cable shall not have been displaced by more than 2 mm.

For the measurement of longitudinal displacement a mark is made on the sheath whilst it is subjected to the pull at a distance of approximately 20 mm from the anchorage before starting the tests. After the test the displacement of the mark in relation to the anchorage is measured whilst the cord or cable is again subject to the pull.

3 750 V a.c. is applied for 1 min between the conductors. Breakdown or flashover is considered to indicate damage to the flexible cord or cable.

During the test the insulation of the flexible cord or cable shall not be damaged.

13 Mechanism

13.1 The actuating member of a switch, when released, shall automatically take up the position corresponding to that of the moving contacts, except that for cord-operated switches and for those with a single push-button, the actuating member may take up a single rest position.

Switches, other than those for a.c. only, shall be of the quick make and break (snap action) type and the speed of contact making and breaking shall be independent of the speed at which the actuating member is operated.

13.2 Switches shall be so constructed that the moving contacts can come to rest only in the "on" and "off" positions, except where there is an intermediate position corresponding to an intermediate position of the actuating member, and the insulation between the fixed and moving contacts is adequate when checked as follows.

The insulation between the fixed and the moving contacts, when in an intermediate position, is checked by an electric strength test as specified in **15.2**, the test voltage being applied between the relevant terminals without removing the cover or cover plate of the switch.

Compliance with the requirements of **13.1** and **13.2** is checked by inspection and by manual test.

13.3 Switches for a.c. only shall be so constructed that undue arcing cannot occur when the switch is operated slowly.

Compliance is checked by causing the switch, at the end of the test of clause **18**, to break the circuit a further ten times, the actuating member being however, moved steadily by hand over a period of 2 s and the moving contacts being stopped if possible in an intermediate position, the actuating member being then released. During the test, no sustained arcing shall occur.

13.4 Switches of pattern numbers 2, 3, 03 and 6/2 shall make and break all poles substantially simultaneously except that for switches of pattern number 03, the neutral pole shall not make after or break before the other poles. Contact clearances shall be not less than those shown in Table 13.

Compliance is checked by inspection and by manual test.

13.5 If the covers or cover plates are removable for installation purposes the action of the mechanism shall be independent of the presence of the cover or cover plate.

NOTE In some constructions the actuating member may constitute the cover.

Compliance is checked by connecting the switch, without cover or cover plate fitted, in series with a lamp and by pressing the actuating member normally without undue force.

During the test the lamp shall not flicker.

13.6 Pull cord switches shall be so constructed that when the pull cord is released after operating the switch, the relevant parts of the actuating mechanism cannot normally fail to return to a position from which they allow the immediate performance of the next movement in the cycle of operations of the switch.

Compliance is checked by inspection and by the normal operation test of clause **18**.

13.7 Pull cord switches shall be capable of being operated from the "off" to the "on" position and from the "on" to the "off" position, by application and removal of a steady pull not exceeding 45 N normal to the plane of the base or not exceeding 67 N at 45° to the plane of the base.

Compliance is checked by test.

14 Resistance to ageing, to harmful ingress of water and to humidity

14.1 Resistance to ageing

Switches shall be resistant to ageing.

Compliance is checked by the following test.

Switches and boxes, mounted as in normal use, are subjected to a test in a heating cabinet with an atmosphere having the composition and pressure of the ambient air and ventilated by natural circulation.

Switches other than ordinary are tested after having been mounted and assembled as prescribed in **14.2.1**.

The temperature in the cabinet is 70 ± 2 °C.

The samples are kept in the cabinet for 7 days (168 h).

The use of an electrically heated cabinet is recommended.

Natural air circulation may be provided by holes in the walls of the cabinet.

After the treatment, the samples are removed from the cabinet and kept at room temperature for at least 4 h.

The samples shall show no cracks visible with normal or corrected vision without additional magnification. Nor shall the material have become sticky or greasy, this being judged as follows.

The sample is pressed with a force of 5 N with the forefinger wrapped in a dry piece of rough cloth.

No traces of the cloth shall remain on the sample and the material of the sample shall not stick to the cloth.

After the test, the samples shall show no damage which would lead to non-compliance with this standard.

The force of 5 N can be obtained in the following way.

The sample is placed on one of the pans of a balance and the other pan is loaded with a mass equal to the mass of the sample plus 500 g.

Equilibrium is then restored by pressing the sample with the forefinger, wrapped in a dry piece of rough cloth.

14.2 Resistance to harmful ingress of water

The enclosure of switches other than ordinary shall provide a degree of protection against harmful ingress of water in accordance with the classification of the switches. Compliance is checked by the appropriate treatment specified in **14.2.1** to **14.2.3**.

NOTE The tests are based on BS 5490.

14.2.1 The surface-type switches are mounted on a vertical surface with the open drain hole in the lowest position.

Flush-type and semi flush-type switches are fixed vertically in an appropriate box which is placed in a recess in a block of hardwood.

Unenclosed switches are tested under a simulation of conditions of normal use, taking into account the manufacturer's instructions.

Switches with screwed glands or membranes are fitted and connected with cables within the connecting range specified in Table 2.

Fixing screws for boxes are tightened with a torque equal to two-thirds of the values given in Table 5.

Glands are tightened with a torque equal to two-thirds of that applied during the test of **19.3**.

Parts which can be removed without the aid of a tool are removed.

NOTE Glands are not filled with sealing compound or the like.

14.2.2 Splash-proof switches are subjected to the test specified for the degree of protection IPX4, according to the requirements of BS 5490.

14.2.3 Jet-proof switches are subjected to the test specified for the degree of protection IPX5, according to the requirements of BS 5490.

Immediately after the tests specified in **14.2.2** and **14.2.3** the samples shall withstand an electric strength test as specified in **15.2** and inspection shall show that water has not entered the samples to any appreciable extent and has not reached live parts.

14.3 Resistance to humidity

Switches shall be proof against humidity which may occur in normal use.

Compliance is checked by the humidity treatment described in this sub-clause, followed immediately by the measurement of the insulation resistance and by the electric strength test specified in clause **15**.

Inlet openings, if any, are left open; if knock outs are provided, one of them is opened.

Parts which can be removed without the aid of a tool are removed and subjected to the humidity treatment with the main part; spring lids are open during this treatment. The humidity treatment is carried out in a humidity cabinet containing air with a relative humidity maintained between 91 % and 95 %.

The temperature of the air in which the samples are placed is maintained within ± 1 °C of any convenient value t between 20 °C and 30 °C.

Before being placed in the humidity cabinet, the samples are brought to a temperature between t and $t + 4$ °C. The samples are kept in the cabinet for:

a) 2 days (48 h) for ordinary switches;

b) 7 days (168 h) for switches other than ordinary.

NOTE 1 In most cases, the samples may be brought to the specified temperature by keeping them at this temperature for at least 4 h before the humidity treatment.

NOTE 2 A relative humidity between 91 % and 95 % can be obtained by placing in the humidity cabinet a saturated solution of sodium sulphate ($Na_2 SO_4$) or potassium nitrate (KNO_3) in water having a sufficiently large contact surface with the air.

NOTE 3 In order to achieve the specified conditions within the cabinet, it is necessary to ensure constant circulation of the air within and, in general, to use a cabinet which is thermally insulated.

After this treatment, the samples shall show no damage within the meaning of this standard.

14.4 Requirements for membranes in inlet openings

14.4.1 Membranes shall be reliably fixed and shall not be displaced by the mechanical and the thermal stresses occurring in normal use.

Compliance is checked by the following test.

Membranes are tested when assembled in the switches.

First the switches are fitted with membranes which have been subjected to the treatment specified in **14.1**. The switches are then placed for 2 h in a heating cabinet as described in **14.1**, the temperature being maintained at 40 ± 2 °C.

Immediately after this period, a force of 30 N is applied for 5 s to various parts of the membranes by means of the tip of a straight unjointed test finger III of BS 3042.

During these tests, the membranes shall not deform to such an extent that live parts become accessible.

For membranes likely to be subjected to an axial pull in normal use, an axial pull of 30 N is applied for 5 s.

During this test, the membranes shall not come out.

The test is then repeated with membranes which have not been subjected to any treatment.

14.4.2 Membranes shall be so designed and made of such material that the introduction of the cables into the switches is possible when the ambient temperature is low.

Compliance is checked by the following test.

The switches are fitted with membranes which have not been subjected to any ageing treatment, those without opening being suitably pierced.

The switches are then kept, for 2 h, in a refrigerator at a temperature of – 15 ± 2 °C.

After this period, the switches are removed from the refrigerator and immediately afterwards while the switches are still cold, it shall be possible to introduce, without undue force, cables of the heaviest type through the membranes.

After the tests in **14.4.1** and **14.4.2** the membranes shall show no harmful deformation, cracks or similar damage, which would lead to non-compliance with this standard.

15 Insulation resistance and electric strength

The insulation resistance and the electric strength of switches shall be adequate.

Compliance is checked by the following tests, which are made immediately after the test of **14.3**, in the humidity cabinet or in the room in which the samples were brought to the prescribed temperature, after reassembly of those parts which may have been removed without the aid of a tool.

Where neon indicators are fitted, one pole shall be disconnected before making the tests of **15.1** and **15.2**.

15.1 The insulation resistance is measured with a d.c. voltage of approximately 500 V applied, the measurement being made 1 min after application of the voltage.

The measurements are made consecutively as indicated in Table 7, the switch positions and the connections necessary for items a), b) and c) being as shown in Table 6.

The term "body" includes accessible metal parts, metal frames supporting the base of flush-type switches, operating keys, metal foil in contact with the outer surface of accessible external parts and operating keys of insulating material, the point of anchorage of the cord, chain or rod for switches operated by such means, fixing screws of bases or covers and cover plates, external assembly screws, earthing terminals and any metal part of the mechanism if required to be insulated from live parts (see **9.4**).

For the measurements according to a) and b) in Table 7 the metal foil is applied in such a way that sealing compound is effectively tested. While wrapping the metal foil around the outer surface or placing it in contact with the inner surface of parts of insulating material, it is pressed against holes or grooves by means of a straight unjointed test finger having the same dimensions as test finger III of BS 3042.

The test according to item e) in Table 7 is only made if any insulating lining is necessary to provide insulation.

The insulation resistance shall be not less than the values shown in Table 7.

15.2 The insulation is subjected for 1 min to a voltage of substantially sinewave form having a nominal frequency of 50 Hz or 60 Hz. The value of the test voltage and the points of application are shown in Table 7.

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

No flashover or breakdown shall occur during the test.

NOTE 1 The high-voltage transformer used for the test shall be so designed that, when the output terminals are short-circuited after the output voltage has been adjusted to the appropriate test voltage, the output current is at least 200 mA.

NOTE 2 The overcurrent relay shall not trip when the output current is less than 100 mA.

NOTE 3 Care is to be taken that the r.m.s. value of the test voltage applied is measured within ± 3 %.

NOTE 4 Glow discharges without drop in voltage are neglected.

16 Temperature rise

Switches shall be so constructed that the temperature rise in normal use is not excessive.

The metal and the design of the contacts shall be such that the operation of the switch is not adversely affected by oxidation or any other deterioration.

Compliance is checked by the following test.

The switches are fitted as in normal use with rigid PVC insulated copper conductors as specified in Table 8, the terminal screws or nuts being tightened with a torque equal to two-thirds of that specified in Table 5. Connections shall be as shown in Table 6.

NOTE 1 To ensure normal cooling of the terminals, the conductors connected to them shall have a length of at least 1 m.

NOTE 2 The rigid conductors may be solid or stranded, as applicable.

The switches are loaded for 1 h with an alternating current having the value shown in Table 8, except for push button switches where the rated current is used.

For switches of pattern numbers 4, 5, 6, 6/2 and 7, only one circuit is loaded.

Switches are mounted vertically in their appropriate boxes as in normal service. Flush and semi-flush switches shall have their mounting boxes recessed into a block of hardwood, such as to leave a thickness of $25\ ^{+5}_{0}$ mm of wood surrounding all four sides and back of the mounting box.

Surface mounted switches together with their mounting boxes are mounted onto a block of hardwood having a thickness of $25\ ^{+5}_{0}$ mm.

All cables or cords shall enter boxes through suitable knock-outs fitted, if appropriate, with rubber grommets and sealed so as to eliminate circulating air influencing the test results.

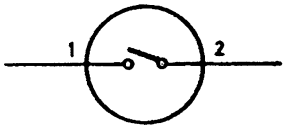
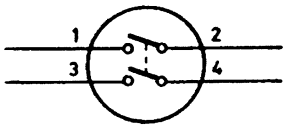
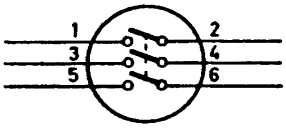
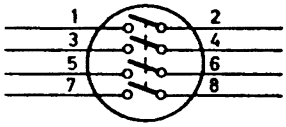
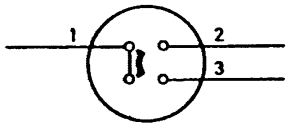
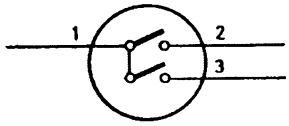
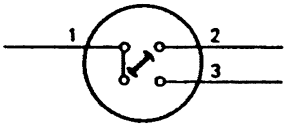
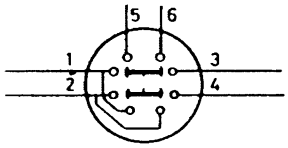
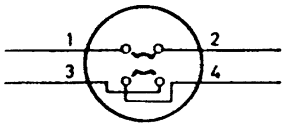
The temperature is determined by means of fine wire thermocouples, having wires not exceeding 0.3 mm diameter, so chosen and positioned that they have negligible effect on the temperature being determined.

The temperature rise of the terminals shall not exceed 45 K.

During the test the temperature rises necessary to perform the test of **20.4** are to be determined.

NOTE 3 In case of a combination of switches, the test is carried out separately on each switch.

Table 6 — Connections for insulation resistance and electric strength tests

Pattern number	Diagrams of connections	Position	Application of voltage[a]	
			Between	
			terminals No.	and body (B) together with terminals No.
1		Off	1 2	B + 2 B + 1
		On	1 – 2	B
2		Off	1 + 3 2 + 4	B + 2 + 4 B + 1 + 3
		On	1 – 2 1 – 2 + 3 – 4	B + 3 – 4 B
3		Off	1 + 3 + 5 2 + 4 + 6	B + 2 + 4 + 6 B + 1 + 3 + 5
		On	1 – 2 3 – 4 5 – 6	B + 3 – 4 + 5 – 6 B + 1 – 2 + 5 – 6 B + 1 – 2 + 3 – 4
03		Off	1 + 3 + 5 + 7 2 + 4 + 6 + 8	B + 2 + 4 + 6 + 8 B + 1 + 3 + 5 + 7
		On	1 – 2 + 5 – 6 1 – 2 + 7 – 8	B + 3 – 4 + 7 – 8 B + 3 – 4 + 5 – 6
4		Off	1	B + 2 + 3
		On	1 – 2 1 – 3	B + 3 B + 2
5		Off	2 + 3 1	B + 1 B + 2 + 3
		On	1 – 3 1 – 2 – 3	B + 2 B
6		—	1 – 3 1 – 2	B + 2 B + 3
6/2		—	1 – 3 + 2 – 4 1 – 5 + 2 – 6	B + 5 + 6 B + 3 + 4
7		—	1 – 2 3 – 4 1 – 4 2 – 3	B + 3 – 4 B + 1 – 2 B + 2 – 3 B + 1 – 4

NOTE The terminal numbers are given for test purposes only and are not those required to be marked on the product.

[a] – denotes an existing electrical connection.
+ denotes an electrical connection made for the test.

Table 7 — Insulation resistance and test voltages

Insulation to be tested	Minimum value of insulation resistance	Test voltage for switches having a rated voltage		
		⩽ 130 V	> 130 V ⩽ 250	> 250
	MΩ	V	V	V
a) Between all poles connected together and the body, with the switch in the "on" position.	5	1 250	1 500	2 000
b) Between each pole in turn and all others connected to the body, with the switch in the "on" position.	2	1 250	1 500	2 000
c) Between the terminals which are electrically connected together when the switch is in the "on" position, the switch being in the "off" position.	2	1 250	1 500	2 000
d) Between metal parts of the mechanism, when insulated from live parts and:				
1) live parts;	5	1 250	1 500	2 000
2) metal foil in contact with the surface of the knob or a similar actuating member;	5	1 250	1 500	2 000
3) the key of key-operated switches, if insulation is required (see **9.6**);	5	1 250	1 500	2 000
4) the point of anchorage of the cord, chain or rod for switches operated by such means, if insulation is required (see **9.6**);	5	1 250	1 500	2 000
5) accessible metal parts, including fixing screws of the base, if insulation is required (see **9.5**).	5	1 250	1 500	2 000
e) Between any metal box and metal foil in contact with the inner surface of its insulation linings, if any[a].	5	1 250	1 500	2 000
f) Between live parts and accessible metal parts, if the metal parts of the mechanism are not insulated from live parts.	—	1 250	1 500	3 000
g) Between live parts and metal parts of the mechanism:				
1) if the latter parts are not insulated from accessible metal parts (see **9.5**);	—	2 000	2 500	3 000
2) if the latter parts are not insulated from the point of contact with a removable key or operating cord, chain or rod (see **9.6**).	—	2 000	2 500	3 000
h) Between live parts and metal knobs, push-buttons and the like (see **9.2**).	—	2 500	3 000	4 000

[a] This test is only made if any insulating lining is necessary.

17 Making and breaking capacity

Switches shall have adequate making and breaking capacity.

Compliance shall be checked by the following tests when the switches are connected as shown in Figure 9.

Switches shall make and break the test load 100 times (200 movements) at a rate of approximately 15 movements per minute, the "on" and "off" periods being approximately equal.

For switches pattern numbers 6, 6/2 and 7, the selector switch S shall be placed in one circuit position for the 100 movements and in the other circuit position for the remaining 100 movements.

17.1 Switches for d.c. operation shall make and break a load of 1.1 times rated voltage and 1.25 times rated current in a substantially non-inductive d.c. circuit.

17.2 Switches for a.c. only operation shall make and break a load of 1.1 times rated voltage and 1.25 times rated current in an inductive a.c. circuit having a lagging power factor of $\cos \phi = 0.3 \pm 0.05$.

Iron-core inductors may be used, provided the current has substantially sinewave form.

For the a.c. circuit, resistors and inductors are not connected in parallel, except that, if an air cored inductor is used a resistor taking approximately 1 % of the current through the inductor is connected in parallel with it.

17.3 Switches suitable for a.c./d.c. operation are tested in accordance with **17.1** and **17.2**, separate samples being used for each test.

17.4 During the above tests, all metal parts normally connected to earth in service shall be earthed through a fine-wire fuse which shall remain intact throughout the test. The fuse element shall comprise a copper wire not greater than 0.12 mm in diameter and not less than 80 mm in length.

Table 8 — Test currents and conductors for temperature rise test

Rated current	Test current	Nominal cross-sectional area of conductors
A	A	mm^2
1	1.5	1.0
2	3	1.0
4	5	1.5
6	8	1.5
10	13.5	1.5
16	20	2.5
20	26	4.0
25	32	4.0
32	38	6.0
45	51	10.0
63	75	16.0

NOTE the test currents for switches having other rated currents are determined by interpolation between the next lower and higher ratings, the cross-sectional area of the test conductor being that related to the higher rating.

17.5 After the above tests, switches shall still be in a serviceable condition as checked by the following additional tests.

a) By inspection and continuity test it shall be verified that the indicated position of the actuator and/or marking corresponds with the positions of the moving contact.

b) Insulation resistance, as in **15.1**.

c) Electric strength, as in **15.2**, but at voltage 50 % that given in Table 7.

NOTE Tables 9 and 10 of the IEC Standard are not appropriate and have been omitted.

18 Normal operation

Switches shall be capable of normal operation at their rated current and at their rated voltage for the number of switch movements shown in Table 11.

For pull cord switches, breakage of the pull cord is not considered as a failure.

Compliance shall be checked by the following test.

Table 11 — Number of switch movements for normal operation test

Rated current	Number of switch movements
Up to and including 16 A	30 000
Above 16 A up to and including 45 A	10 000
Above 45 A	5 000

18.1 All switches shall make and break a resistive load equal to their rated current, at their rated voltage, in a substantially non-inductive a.c. circuit (power factor $\cos \phi = 0.95 \pm 0.05$).

Switches shall be operated for the number of operations specified in Table 11 and in the sequence and connections shown in Figure 9 at a rate of 10 to 12 movements per minute with the actuator moving at a rate of approximately 150 mm per second, the "on" and "off" periods being approximately equal. During the tests, where applicable, the selector switch shall be placed in one circuit position for one half of the switch movements specified in Table 11, and in the other circuit position for the remaining movements. The characteristics of the test circuit shall be such that the voltage across the load will be the rated voltage of the switch under test when the relevant test current is flowing and not more than 1.1 times the rated voltage on open circuit.

During the test, all metal parts normally connected to earth in service shall be earthed through a fine-wire fuse which shall remain intact throughout the test. The fuse element shall comprise a copper wire not greater than 0.12 mm in diameter and not less than 80 mm in length. The temperature rise test of clause **16** shall be repeated, but with the test current reduced to the rated value, at the following positions in the sequence of switch movements.

a) For switches of pattern numbers 1, 2, 3, 03, 4 and 5, after one quarter of the movements specified in Table 11.

b) For switches of pattern numbers 6, 6/2 and 7 after one quarter and three quarters of the movements specified in Table 11.

The remainder of the specified number of operations shall then be completed.

The samples shall then not show wear impairing their further use, such as:

1) deterioration of boxes, insulating linings or barriers to such an extent that the switch cannot be further operated or that the requirements of clause **9** are no longer complied with;

2) loosening of electrical or mechanical connections;

3) seepage of sealing compound.

The following additional tests shall then be made.

i) By inspection and continuity test it shall be verified that the indicated position of the actuator and/or marking corresponds with the position of the moving contact.

ii) Insulation resistance shall be tested, as in **15.1**.

iii) Electric strength shall be tested, as in **15.2**, but at a voltage 50 % of that given in Table 7.

18.2 Switches for fully rated fluorescent load operation, identified by the letter "X" as specified in **7.1**, shall make and break a representative load of fluorescent lighting, nominally equivalent to their rated current, in an a.c. circuit at nominal values of 250 V, 50 Hz, as specified below.

a) 2 400 mm, 125 W lamps with switch start and series capacitor circuit, as shown in Figure 10a).

b) 1 500 mm, 65 W lamps with switch start and power-factor correction circuit as shown in Figure 10b).

c) 1 500 mm, 65 W lamps with switch start without power-factor correction as shown in Figure 10c).

For these tests, the loads shall be connected as shown in Figure 9. During the tests the selector switch S shall be placed in one circuit position for one half of the switch movements specified in Table 11 and in the other circuit position for the remaining movements.

During the tests, all metal parts normally connected to the earth in service shall be earthed through a fine wire fuse which shall remain intact throughout the test. The fuse element shall comprise a copper wire not greater than 0.12 mm dia. and not less than 80 mm in length.

The temperature rise test of clause **16** shall be repeated, but with the test current reduced to the rated value, at the following positions in the sequence of switch movements.

1) For switches of pattern numbers 1, 2, 3, 03, 4 and 5, after one quarter of the movements specified in Table 11.

2) For switches of pattern numbers 6, 6/2 and 7, after one quarter and three quarters of the movements specified in Table 11. The remainder of the specified number of movements shall then be completed.

A separate single switch shall be used for each test condition and tested for the number of movements specified in Table 11 at a rate not exceeding 2 movements per min. The "on" and "off" periods shall be approximately equal, provided that a steady load current is reached before the switch is opened and that the off period for the load is sufficient for the lamp cathodes to cool and the starter switch to return to a position of readiness.

Provided the above requirements regarding steady load current, lamp cathodes and starter switches are met, the use of independent switched multiple load banks is allowed at the discretion of the manufacturer to reduce overall testing times.

In each of the test conditions the appropriate number of lamps shall be chosen such that the total current, measured 10 min after initial switch-on, shall be as near as possible to, but not less than, the rated current of the switch when measured by a meter indicating r.m.s. values. The test circuit, including the source of supply, shall have sufficient capacity to reach a short-time fault current level at the supply terminals of the test circuit of not less than 3 000 A r.m.s. The total resistance between the supply terminals and the load, including connections of the switch, shall be not more than 0.15 Ω.

NOTE Items of the test equipment may be replaced during the course of the test run.

The samples shall then not show wear impairing their further use, such as:

i) deterioration of boxes, insulating linings or barriers to such an extent that the switch cannot be further operated or that the requirements of clause **9** are no longer complied with;

ii) loosening of electrical or mechanical connections;

iii) seepage of sealing compound.

The following additional tests shall then be made.

By inspection and continuity test it shall be verified that the indicated position of the actuator and/or marking corresponds with the position of the moving contact.

Insulation resistance shall be tested, as in **15.1**.

Electric strength shall be tested, as in **15.2**, but at a voltage 50 % that given in Table 7.

19 Mechanical strength

Switches, boxes and screwed glands shall have adequate mechanical strength so as to withstand the stresses imposed during installation and use.

Compliance is checked by the following tests:

a) for switches, **19.1** and **19.2**;

b) for boxes, **19.1**;

c) for screwed glands of switches other than ordinary, **19.3**.

Combinations of switches shall be tested in the following way:

1) in case of one common cover, like a single product;

2) in case of separate covers, like separate products.

19.1 The samples are subjected to blows by means of an impact-test apparatus as shown in Figure 11, Figure 12 and Figure 13.

The striking element has a hemispherical face of 10 mm radius, made of polyamide having a Rockwell hardness of R 100[2)], and has a mass of 150 ± 1 g.

It is rigidly fixed to the lower end of a steel tube with an external diameter of 9 mm and a wall thickness of 0.5 mm, which is pivoted at its upper end in such a way that it swings only in a vertical plane.

The axis of the pivot is 1 000 ± 1 mm above the axis of the striking element.

The design of the apparatus is such that a force between 1.9 N and 2.0 N has to be applied to the face of the striking element to maintain the tube in a horizontal position.

The samples are mounted on a sheet of plywood, 8 mm thick and 175 mm square, secured at its top and bottom edges to a rigid bracket, which is part of the mounting support.

The mounting support shall have a mass of 10 ± 1 kg and shall be mounted on a rigid frame by means of pivots. The frame is fixed on a solid wall.

The design of the mounting is such that:

a) the sample can be so placed that the point of impact lies in the vertical plane through the axis of the pivot;

b) the sample can be removed horizontally and turned about an axis perpendicular to the surface of the plywood;

c) the plywood can be turned about a vertical axis.

The switches and boxes are mounted on the plywood as in normal use.

Inlet openings which are not provided with knock-outs are left open; if they are provided with knock-outs, one of them is opened. Decorative cover plates removable without the use of a tool shall be removed prior to testing.

For flush-type switches the sample is mounted in its relevant mounting box in a recess provided in a block of hornbeam or similar material, which is fixed to a sheet of plywood, and with the rear of the plate flush with the surface of the block. If wood is used for the block, the direction of the wood fibres shall be perpendicular to the direction of the impact. The box is mounted simulating the conditions of normal use, so that the front edges of the box are between 2.5 mm and 5 mm below the front surface of the block.

Flush-type screw fixing switches shall be fixed by means of screws. Flush-type claw fixing switches shall be fixed by means of the claws.

Before applying the blows, fixing screws of bases and covers are tightened with a torque equal to two-thirds of that specified in Table 5.

The samples are mounted so that the point of impact lies in the vertical plane through the axis of the pivot.

The striking element is allowed to fall from a height of:

1) 7.5 cm for those parts of covers which are recessed to a depth of at least one-sixth of the largest dimension of the recessed part;

2) 10 cm for flat surfaces of cover plates of flush-type switches.

3) 20 cm for parts projecting from the mounting surfaces (e.g. rims exceeding 20 mm from the walls) of cover plates of flush-type switches and for boxes of surface types;

4) 25 cm for boxes of types other than ordinary.

The height of fall is the vertical distance between the position of a checking point, when the pendulum is released, and the position of that point at the moment of impact. The checking point is marked on the surface of the striking element where the line through the point of intersection of the axes of the steel tube of the pendulum and the striking element and perpendicular to the plane through both axes, meet the surface.

NOTE 1 Theoretically the centre of gravity of the striking element should be the checking point. As the centre of gravity in practice is difficult to determine, the checking point is chosen as described above.

The samples are subjected to ten blows, which are evenly distributed over the sample. The blows are not applied to "knock out" areas.

[2)] See BS 2782:Method 365C.

In general, five of the blows are applied as follows:

i) for flush-type switches, one blow in the centre, one at each extremity of the area over the recess in the block, and the other two approximately midway between the previous blows, the sample being moved horizontally;

ii) for other switches and for boxes, one blow in the centre, one on each side of the sample after it has been turned as far as possible but not through more than 60° about a vertical axis and the other two approximately midway between the previous blows.

The remaining blows are then applied in the same way after the sample has been turned through 90° about its axis perpendicular to the plywood.

If inlet openings are provided, the sample is so mounted that the two lines of blows are as nearly as possible equidistant from these openings.

Cover plates and other covers of multiple switches are treated as though they were the corresponding number of separate covers, but only one blow is applied to any one point.

Any lens incorporated in a switch shall receive one blow at a point approximately at its centre.

For switches other than ordinary, the test is made with the lids closed and, in addition, the appropriate number of blows is applied to those parts which are exposed when the lids are open.

After the test, the samples shall show no damage within the meaning of this standard. In particular live parts shall not become accessible.

After the test on a lens, the lens may be cracked and/or dislodged but it shall not be possible to touch live parts.

In case of doubt, it is verified that it is possible to remove and to replace external parts, such as boxes, covers and cover plates, without these parts or their insulating lining being broken.

If, however, a cover plate backed by an inner cover is broken, the test is repeated on the inner cover, which shall remain unbroken.

NOTE 2 Damage to the finish, small dents which do not reduce creepage distances or clearances below the value specified in **22.1** and small chips which do not adversely affect the protection against electric shock are neglected.

Cracks not visible to the naked eye using normal or corrected vision without magnification and surface cracks in fibre-reinforced mouldings and the like are ignored.

Cracks or holes in the outer surface of any part of the switch are ignored if the switch complies with this standard even if this part is omitted. If a decorative cover is backed by an inner cover, fracture of the decorative cover is neglected if the inner cover withstands the test after removal of the decorative cover.

19.2 This sub-clause of the IEC Standard is not appropriate and has been omitted.

19.3 Screwed glands are fitted with a cylindrical metal rod having a diameter, in mm, equal to the nearest whole number below the internal diameter, in mm, of the packing.

The glands are then tightened by means of a suitable spanner, the torque shown in Table 12 being applied to the spanner for 1 min.

Table 12 — Torque for mechanical test on glands

Diameter of test rod	Torque	
	Metal glands	Glands of moulded material
mm	N·m	N·m
Up to and including 14	6.25	3.75
Above 14 up to and including 20	7.5	5.0
Above 20	10.0	7.5

After the test, the glands and the boxes of the samples shall show no damage within the meaning of this standard.

19.4 If the operating member entering a pull-cord operated switch is of a woven cord like construction it shall have a minimum breaking strength of 500 N when new, and an adequate strength after completion of a normal operation test as specified in clause **18**, but in which the angle of the pull on the cord throughout the test is at 30° to the axis of the entry of the operating member into the switch. Breakage of the pull cord during the normal operation test shall not be considered a failure.

Compliance is checked by the following test.

The switch is supported at the point of entry of the operating member in such a position that the operating member enters in its normal plane and hangs vertically downwards. A weight of 13.5 kg is then attached to the end of the pull cord and left for 1 min. If no breakage occurs, the weight is increased by 4.5 kg increments at 1 min intervals until breakage occurs.

The breakage shall occur in the pull cord.

19.5 Pull-cord switches shall be capable of withstanding mechanical operating forces applied in normal use.

Compliance is checked by the following test.

The switch is fitted to a horizontal surface and a mass of 13.5 kg is suspended from the end of the pull cord for 5 min. After completion of the test the cord shall not have broken and there shall be no damage to any part of the switch.

20 Resistance to heat

Switches and boxes shall be sufficiently resistant to heat.

Compliance is checked:

a) for mounting boxes, separable covers, separable cover plates and separable frames by the test of **20.4**;

b) for switches, with the exception of the parts, if any, covered by a), by the tests of **20.1**, **20.3**, and, with the exception of parts made from natural or synthetic rubber or a mixture of both, **20.4**.

20.1 The samples are kept for 1 h in a heating cabinet at a temperature of 100 ± 20 °C.

After the test, they shall not have undergone any change impairing their further use and sealing compound, if any, shall not have flowed to such an extent that live parts are exposed.

After the test and after the samples have been allowed to cool down to approximately room temperature, there shall be no access to live parts which are normally not accessible when the samples are mounted as in normal use, applying test finger I of BS 3042 with a force of 5 N. After the test, markings shall still be legible.

Discoloration, blisters or slight displacement of the sealing compound is disregarded provided that safety is not impaired within the meaning of this standard.

20.2 This sub-clause of the IEC Standard is not appropriate and has been omitted.

20.3 Parts of insulating material necessary to retain current-carrying parts and parts of the earthing circuit in position are subjected to a ball-pressure test by means of the apparatus shown in Figure 15, except that insulating parts necessary to retain the earthing terminals in a box shall be tested as specified in **20.4**.

NOTE When it is not possible to carry out the test on the sample under test, the test should be carried out on a specimen of the material at least 2 mm thick.

The surface of the part to be tested is placed in the horizontal position and a steel ball of 5 mm diameter is pressed against the surface with a force of 20 N.

The test is made in a heating cabinet at a temperature of 125 ± 2 °C. After 1 h, the ball is removed from the sample which is then cooled down within 10 s to approximately room temperature by immersion in cold water.

The diameter of the impression caused by the ball is measured and shall not exceed 2 mm.

20.4 Parts of insulating material not necessary to retain current-carrying parts and parts of the earthing circuit in position even though they are in contact with them, are subjected to a ball-pressure test in accordance with **20.3**, but the test is made at a temperature of 70 ± 2 °C, or 40 ± 2 °C plus the highest temperature rise determined for the relevant part during the test of clause **16**, whichever is the higher.

21 Screws, current-carrying parts and connections

21.1 Connections, electrical or mechanical, shall withstand the mechanical stresses occurring in normal use. Screws used exclusively for cord grip purposes are deemed to meet this requirement provided they meet the requirements of **12.13**.

Screws or nuts which transmit contact pressure shall be in engagement with a metal thread.

Compliance is checked by inspection and, for screws and nuts which are operated when connecting the external conductors and mounting the switch during installation, by the following test.

NOTE 1 The requirements for the verification of terminals are given in clause **11**.

The screws or nuts are tightened and loosened:

a) 10 times for screws in engagement with a thread of insulating material;

b) five times in all other cases.

Screws or nuts in engagement with a thread of insulating material are completely removed and reinserted each time.

The test is made by means of a suitable test screwdriver or a suitable tool, applying a torque as specified in **11.2.8**.

The conductor is moved each time the screw or nut is loosened such that a new part of the conductor is utilized for each application.

During the test, no damage impairing the further use of the screwed connections shall occur, such as breakage of screws or damage to the head slots rendering them unserviceable, or damage to threads, washers or stirrups.

NOTE 2 Screws or nuts which are operated when assembling the switch include screws for fixing covers or cover plates etc., but not connecting means for screwed conduits and screws for fixing the base of a switch.

NOTE 3 It is essential that the shape of the blade of the test screwdriver suits the head of the screw to be tested. It is essential that screws and nuts are not tightened in jerks. Damage to covers is neglected.

21.2 For screws in engagement with a thread of insulating material which are used when mounting the switch during installation, correct introduction into the screw hole or nut shall be ensured.

Compliance is checked by inspection.

NOTE The requirement with regard to correct introduction is met if introduction of the screw in a slanting manner is prevented, for example, by guiding the screw by the part to be fixed, by a recess in the female thread or by the use of a screw with the leading thread removed.

21.3 Electrical connections shall be so designed that contact pressure is not transmitted through insulating material other than ceramic or pure mica unless there is sufficient resiliency in the metallic parts to compensate for any possible shrinkage or yielding of the insulating material.

Compliance is checked by inspection.

21.4 Screws and rivets which serve as electrical as well as mechanical connections shall be locked against loosening or turning.

Compliance is checked by inspection and by manual test.

NOTE 1 Spring washers may provide satisfactory locking.
NOTE 2 For rivets, a non-circular shank or an appropriate notch may be sufficient.
NOTE 3 Sealing compound which softens on heating provides satisfactory locking only for screw connections not subjected to torsion in normal use.

21.5 Current-carrying parts, including those of terminals (also earthing terminals), shall be of a metal having, under the conditions occurring in the equipment, mechanical strength, electrical conductivity and resistance to corrosion adequate for their intended use.

Compliance is checked by inspection and if necessary, by chemical analysis.

Examples of suitable metals, when used within the permissible temperature range and under normal conditions of chemical pollution, are:

a) copper;

b) an alloy containing at least 58 % copper for parts made from rolled sheet (in cold condition), or at least 50 % copper for other parts;

c) stainless steel containing at least 13 % chromium and not more than 0.09 % carbon;

d) steel provided with an electroplated coating of zinc according to BS 1706 the coating having a thickness of at least:

1) 5 μm, for ordinary equipment;

2) 12 μm, for splash-proof construction IPX4;

3) 25 μm, for jet-proof construction IPX5.

e) steel provided with an electroplated coating of nickel and chromium according to BS 1224, the coating having a thickness of at least:

1) 20 μm, for ordinary equipment;

2) 30 μm, for splash-proof construction IPX4;

3) 40 μm, for jet-proof construction IPX5.

f) steel provided with an electroplated coating of tin, according to BS 1872 having a thickness of at least:

1) 12 μm, for ordinary equipment;

2) 20 μm, for splash-proof construction IPX4;

3) 30 μm, for jet-proof construction IPX5.

Current-carrying parts which may be subjected to mechanical wear shall not be made of steel provided with an electroplated coating.

Compliance is checked by inspection.

Under moist conditions metals showing a great difference of electrochemical potential with respect to each other shall not be used in contact with each other.

Compliance is checked by inspection.

NOTE The requirement of this sub-clause does not apply to screws, nuts, washers, clamping plates and similar parts of terminals.

21.6 Contacts shall be of a metal resistant to corrosion.

Compliance with the requirements of **21.5** and **21.6** is checked by inspection and, if necessary, by chemical analysis.

21.7 Thread-forming screws shall not be used for the connection of current-carrying parts.

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

Compliance is checked by inspection.

22 Creepage distances, clearances and distances through sealing compound

22.1 Creepage distances, clearances and distances through sealing compound shall be not less than the values shown in Table 13.

Compliance is checked by measurement.

The measurements are made on the switch fitted with conductors of the largest cross-sectional area specified in clause **11**, and also without conductors.

Distances through slots or openings in external parts of insulating material are measured to metal foil in contact with the accessible surface; the foil is pushed into corners and the like by means of test finger III of BS 3042, but is not pressed into openings.

For ordinary surface-type switches, the most unfavourable conduit or cable is introduced for a distance of 1 mm into the switch, in accordance with **12.11**.

If the metal frame supporting the base of flush-type switches is movable, this frame is placed in the most unfavourable position.

NOTE 1 Any metal part in contact with a metal part of the mechanism is considered to be a metal part of the mechanism.
NOTE 2 In double-break switches, the creepage distance mentioned under a) or the clearance mentioned under e) in Table 13 is the sum of the creepage distance or clearance between one fixed contact and the moving part, and that between the moving part and the other fixed contact.
NOTE 3 The contribution to the creepage distance of any groove less than 1 mm wide is limited to its width.
NOTE 4 Any air-gap less than 1 mm wide is ignored in calculating the total clearance.
NOTE 5 The surface on which the base of a surface-type switch is mounted includes any surface in contact with the base when the switch is installed. If the base is provided with a metal plate at the back, this plate is not regarded as the mounting surface.

22.2 Insulating sealing compound shall not protrude above the edge of the cavity in which it is contained.

22.3 Ordinary surface-type switches shall not have bare current-carrying strips at the back.

Compliance with the requirements of **22.2** and **22.3** is checked by inspection.

The application of this requirement to switches other than ordinary surface-type is under consideration.

23 Resistance of insulating material to abnormal heat, to fire and to tracking

23.1 General

Parts of insulating material which might be exposed to thermal stresses due to electric effects and the deterioration of which might impair the safety of the switch, shall not be unduly affected by abnormal heat and by fire.

23.1.1 Compliance shall be checked by the tests of **23.2**.

23.2 Glow-wire test

The test is performed according to clauses **4** to **10** of BS 6458-2.1:1984 under the following conditions:

a) for parts of insulating material necessary to retain current-carrying parts in position, by the test made at a temperature of 850 °C;

b) for parts of insulating material not necessary to retain current-carrying parts in position, although they may be in contact with them, by the test made at a temperature of 650 °C.

If the tests specified have to be made at more than one place on the same switch, care shall be taken to ensure that any deterioration caused by previous tests does not affect the result of the test to be made.

Small parts, such as washers, are not subjected to the tests.

The tests are not made on parts of ceramic material.

The glow-wire test is applied to ensure that an electrically heated test wire under defined test conditions does not cause ignition of insulating parts or to ensure that a part of insulating material, which might be ignited by the heated test wire under defined conditions, has a limited time to burn without spreading fire by flame or burning parts or droplets falling down onto the pinewood board covered with a tissue paper from the tested part.

If possible, the specimen should be a complete switch.

If the test cannot be made on a complete switch, a suitable part may be cut from it for the purpose of the test. The test is made on one specimen. In case of doubt, the test shall be repeated on two further specimens.

The test is made applying the glow-wire once.

The specimen shall be positioned during the test in the most unfavourable position of its intended use (with the surface tested in a vertical position). The tip of the glow-wire shall be applied to the specified surface of the specimen taking into account the conditions of the intended use under which a heated or glowing element may come into contact with the switch.

The switch is regarded as having passed the glow-wire test if:

1) there is no visible flame and no sustained glowing, or if

2) flames and glowing at the switch extinguish within 30 s after the removal of the glow-wire.

There shall be no ignition of the wrapping tissue or scorching of the board.

23.3 Resistance to tracking

For switches other than ordinary, parts of insulating material retaining live parts in position shall be of material resistance to tracking.

For material other than ceramic compliance shall be checked according to the requirements of BS 5901 by the following test on one switch.

Table 13 — Creepage distances, clearances and distances through insulating sealing compound

Description	Distance
	mm
Creepage distance:	
a) between live parts which are separated when the contacts are open	3[b]
b) between live parts of different polarity	4[a]
c) between live parts and: accessible metal parts; parts of the earthing circuit; screws or devices for fixing bases, covers or cover plates; metal parts of the mechanism, if required to be insulated from live parts (see **9.4**)	3
d) between metal parts of the mechanism, if required to be insulated from accessible metal parts (see **9.5**) and: screws or devices for fixing bases, covers or cover plates; metal frames supporting the base of flush-type switches; accessible metal parts	3
Clearance:	
e) between live parts which are separated when the contacts are open	3[b]
f) between live parts of different polarity	3[b]
g) between live parts and metal parts of the mechanism, if required to be insulated from live parts (see **9.4**)	3
h) between live parts and: accessible metal parts not mentioned under i) and j); parts of the earthing circuit; metal frames supporting the base of flush-type switches; screws or devices for fixing bases, covers or cover plates	3
i) between live parts and earthed metal boxes without insulating lining, with the switch mounted in the most unfavourable position	4.5[c]
j) between live parts and the surface on which the base of a surface-type switch is mounted when the base is fixed directly on the wall	6
k) between live parts and the bottom of any conductor recess, if any, in a base of a switch for surface mounting when the base is fixed directly on the wall	3
l) between metal parts of the mechanism, if required to be insulated from accessible metal parts (see **9.5**) and: screws or devices for fixing bases, covers or cover plates; metal frame supporting the base of flush-type switches; accessible metal parts	3
Distance through insulating sealing compound:	
m) between live parts covered with at least 2 mm of sealing compound and the surface on which the base of a surface-type switch is mounted	4[a]
n) between live parts covered with at least 2 mm of sealing compound and the bottom of any conductor recess, if any, in the base of a surface-type switch.	2.5

[b] NOTE Clearance and creepage between live parts of different polarity is reduced to 1 mm for the distance between the lead wires in the pinch of a neon indicator lamp with external resistor.

[a] This value is reduced to 3 mm for switches having a rated voltage up to and including 250 V.
[b] This value is reduced to 1.2 mm, when the contacts are open, for live parts of switches of functional construction.
[c] This value is reduced to 2.5 mm for switches having a rated voltage up to and including 250 V.

A flat surface of the part to be tested at least 15 mm × 15 mm and at least 3 mm thick is placed in the horizontal position on the apparatus.

The material under test shall pass at a proof tracking index of 175 V using the test solution A with the interval between drops of 30 ± 5 s.

24 Resistance to excessive residual stresses and to rusting

24.1 Press-formed or similar current-carrying parts of copper alloy containing less than 80 % of copper shall be resistant to failure in use due to brittleness.

24.1.1 Compliance shall be checked by the following test.

The sample is degreased in a suitable alkaline degreasing solution or organic solvent, then immersed in an aqueous solution of mercurous nitrate containing 10 g of $Hg_2(NO_3)_2$ and 10 ml of HNO_3 (relative density 1.42) per L of solution for 30 min at a temperature of 20 ± 5 °C.

NOTE Attention is drawn to the fact that due precautions should be taken when using these liquids as they are toxic.

After the treatment the sample is washed in running water, any excess mercury wiped off, and the sample is immediately visually examined.

There shall be no cracks visible with normal or corrected vision without additional magnification.

24.2 Ferrous parts, including covers and boxes, shall be adequately protected against rusting.

Compliance is checked by the following test.

All grease is removed from the parts to be tested, by immersion in trichloroethane or an equivalent degreasing agent, for 10 min.

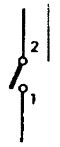
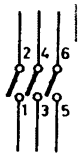
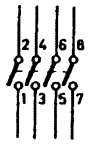
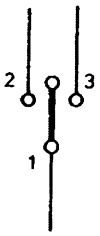
The parts are then immersed for 10 min in a 10 % solution of ammonium chloride in water at a temperature of 20 ± 5 °C.

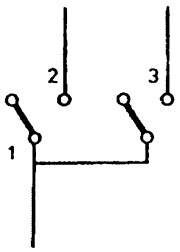
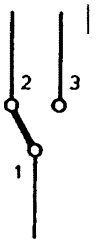
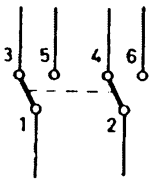
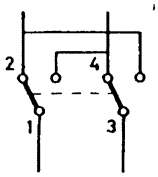
Without drying, but after shaking off any drops, the parts are placed for 10 min in a box containing air saturated with moisture at a temperature of 20 ± 50 °C.

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

NOTE 1 Traces of rust on sharp edges and any yellowish film removable by rubbing are ignored.

NOTE 2 For small springs and the like, and for inaccessible parts exposed to abrasion, a layer of grease may provide sufficient protection against rusting. Such parts are subjected to the test only if there is doubt about the effectiveness of the grease film and the test is then made without previous removal of the grease.

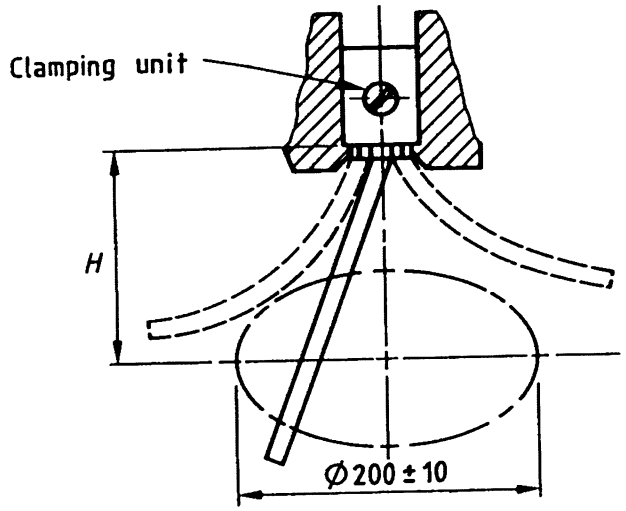
Pattern number	Number of poles	Possible connections
1	1	
2	2	
3	3	
03	4	
4	1	

Pattern number	Number of poles	Possible connections
5	1	
6	1	
6/2	2	
7	1	

NOTE The figures indicating terminals are given for test purposes only and are not those required to be marked on the product.

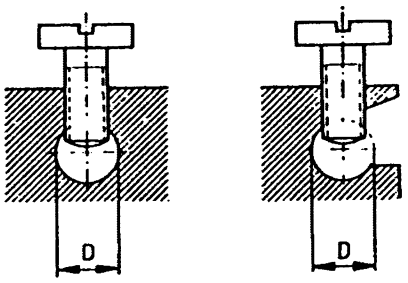
Figure 1 — Classification according to connections

NOTE Figure 2 of the IEC Standard is not appropriate and has been omitted.

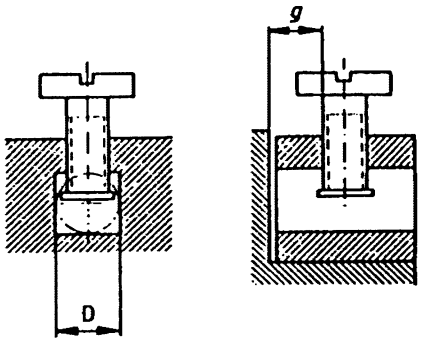


Conductor cross-sectional area	*H*
mm^2	mm
$\leqslant 4$	250 ± 10
$5 \leqslant 16$	500 ± 10
$25 \leqslant 35$	750 ± 10

Figure 2a) — Arrangement for checking damage to conductors



(a) Terminals without pressure plate



(b) Terminals with pressure plate

NOTE D = conductor space.

Conductor capacity of terminal	Minimum distance *g* between clamping screw and end of conductor when fully inserted		Torque					
			1[a]		3[a]		4[a]	
	One screw	Two screws	One screw	Two screws	One screw	Two screws	One screw	Two screws
mm^2	mm	mm	N·m	N·m	N·m	N·m	N·m	N·m
0.5 to 1.0	1.5	1.5	0.2	0.2	0.4	0.4	0.4	0.4
1.0 to 1.5	1.5	1.5	0.25	0.2	0.5	0.4	0.5	0.4
1.0 to 2.5	1.8	1.5	0.4	0.2	0.8	0.4	0.8	0.4
1.5 to 4.0	1.8	1.5	0.4	0.25	0.8	0.5	0.8	0.5
4.0 to 6.0	2.0	1.5	0.7	0.25	1.2	0.5	1.2	0.5
6.0 to 10.0	2.5	2.0	0.8	0.7	2.0	1.2	2.0	1.2
10.0 to 16.0	3.0	2.0	1.2	0.7	2.5	1.2	3.0	1.2

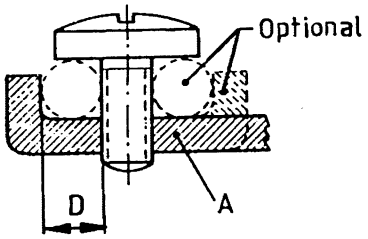
[a] The values specified apply to the screws covered by the corresponding columns in Table 5.

NOTE 1 The part of the terminal containing the threaded hole and the part of the terminal against which the conductor is clamped by the screw may be two separate parts as in the case of terminals provided with a stirrup.

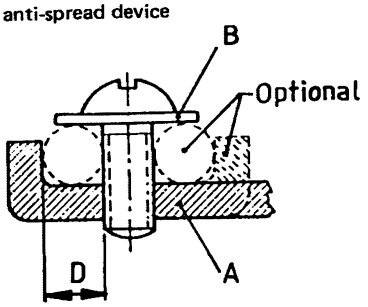
NOTE 2 The shape of the conductor space may differ from those shown.

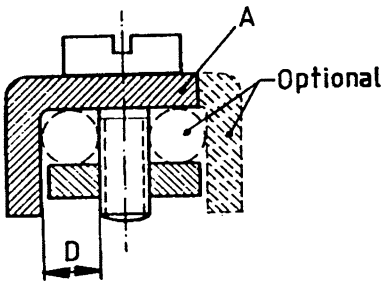
Figure 3 — Pillar terminals

Screw not requiring washer, clamping plate or anti-spread device

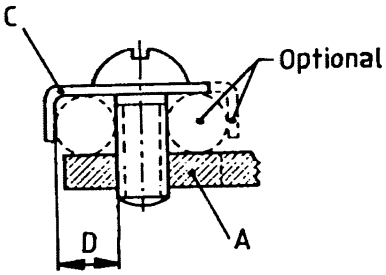


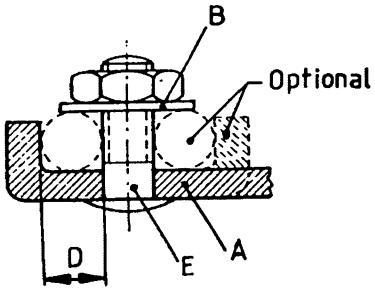
Screw requiring washer, clamping plate or anti-spread device



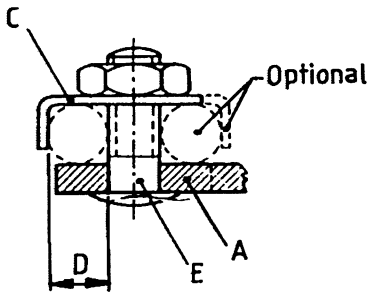


Screw terminals





Stud terminals



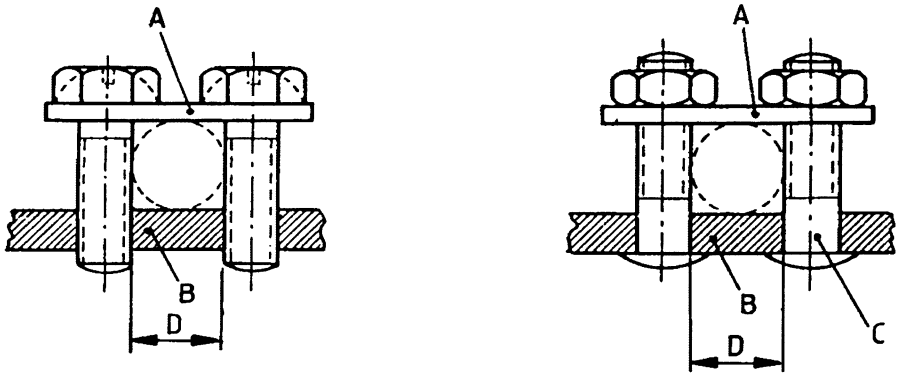
A Fixed part
B Washer or clamping plate
C Anti-spread device
D Conductor space
E Stud

Conductor capacity of terminal	Torque			
	3[a]		4[a]	
	One screw	Two screws	One screw or stud	Two screws or studs
mm^2	N·m	N·m	N·m	N·m
0.5 to 1.0	0.5	—	0.5	—
1.0 to 1.5	0.8	—	0.8	—
1.0 to 2.5	1.2	0.5	1.2	0.5
1.5 to 4.0	2.0	1.2	2.0	1.2
4.0 to 6.0	2.0	1.2	2.0	1.2
6.0 to 10.0	2.0	1.2	2.0	1.2
10.0 to 16.0	2.5	2.0	3.0	2.0

[a] The values specified apply to the screws covered by the corresponding columns in Table 5.

NOTE The part which retains the conductor in position may be of insulating material provided the pressure necessary to clamp the conductor is not transmitted through the insulating material.

Figure 4 — Screw terminals and stud terminals



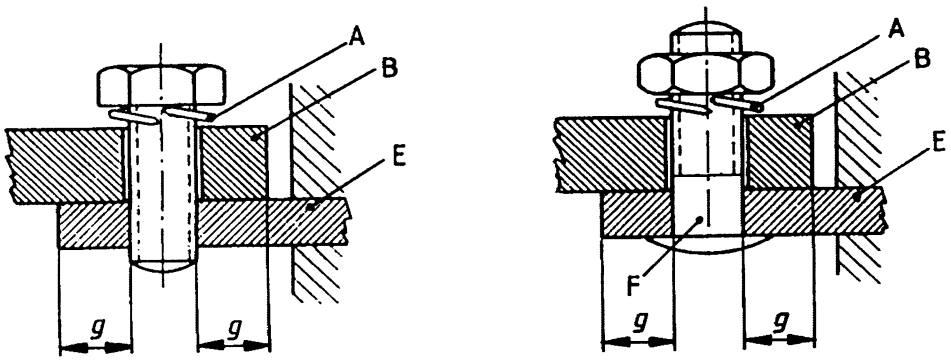
A Saddle
B Fixed part
C Stud
D Conductor space

Conductor capacity of terminal	Torque
mm^2	N·m
1.0 to 2.5	0.5
1.5 to 4.0	0.8
4.0 to 6.0	1.2
6.0 to 10.0	1.2
10.0 to 16.0	2.0

NOTE 1 The shape of the conductor space may differ from that shown in the figure.

NOTE 2 The shape of the upper and lower faces of the saddle may be different, to accommodate conductors of either small or large cross-sectional areas by inverting the saddle.

Figure 5 — Saddle terminals



A Locking means
B Cable lug or bar
E Fixed part
F Stud

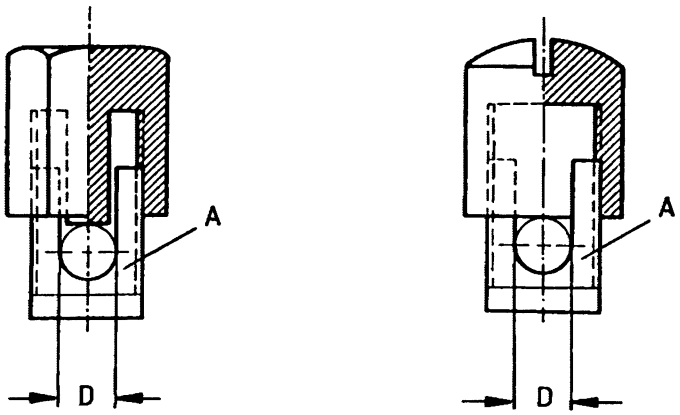
Conductor capacity of cable lug	Minimum distance *g* between edge of hole and side of clamping area	Torque	
		3[a]	4[a]
mm^2	mm	N·m	N·m
6.0 to 10	7.5	2.0	2.0
10 to 16	9.0	2.5	3.0

[a] The values specified apply to the studs covered by the corresponding columns in Table 5.

NOTE 1 For this type of terminal, a spring washer or equally effective locking means shall be provided and the surface within the clamping area shall be smooth.

NOTE 2 For certain types of switches, the use of lug terminals of sizes smaller than that required is allowed.

Figure 6 — Lug terminals

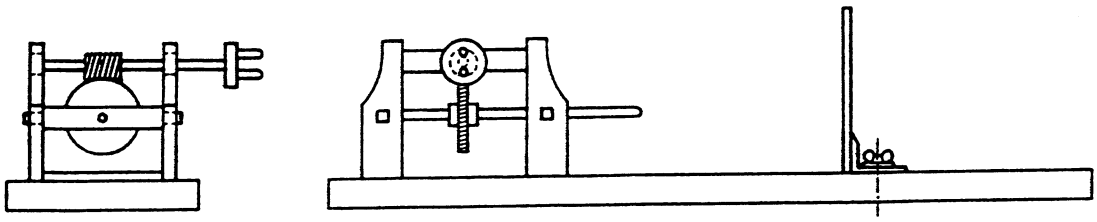


A Fixed part
D Conductor space*

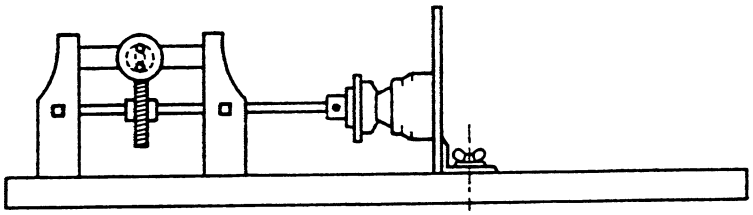
Conductor capacity of terminal	Minimum distance between fixed part and end of conductor when fully inserted
mm^2	mm
0.5 to 1.0	1.5
1.0 to 1.5	1.5
1.0 to 2.5	1.8
1.5 to 4.0	1.8
4.0 to 6.0	2.0
6.0 to 10.0	2.5
10.0 to 16.0	3.0

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

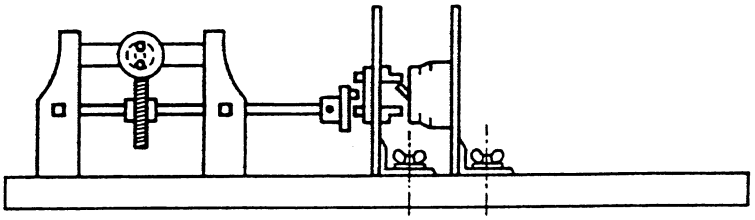
Figure 7 — Mantle terminals



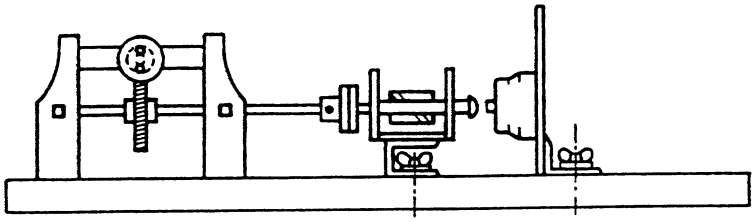
Driving mechanism



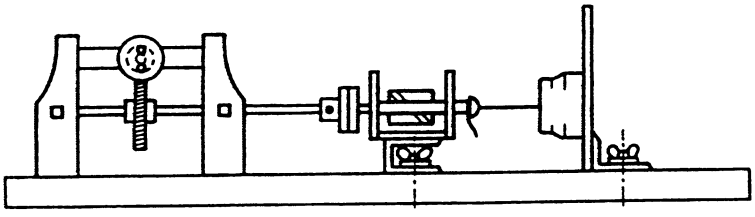
Arrangement for rotary switches



Arrangement for tumbler switches

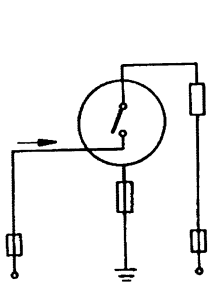


Arrangement for rocker switches and push-button switches

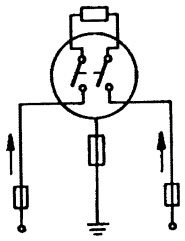


Arrangement for pull-cord switches

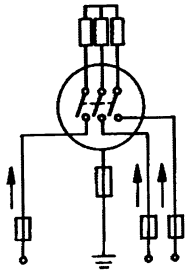
Figure 8 — Typical apparatus for making and breaking capacity and normal operation tests (not indicative of design requirements)



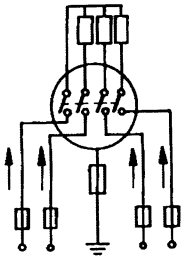
Switch pattern number 1



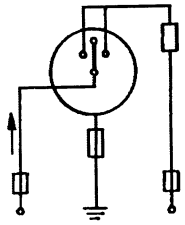
Switch pattern number 2



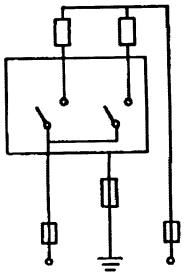
Switch pattern number 3



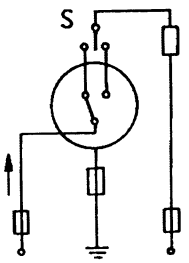
Switch pattern number 03



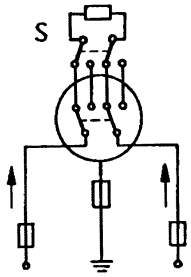
Switch pattern number 4



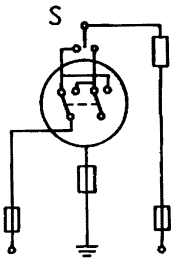
Switch pattern number 5



Switch pattern number 6



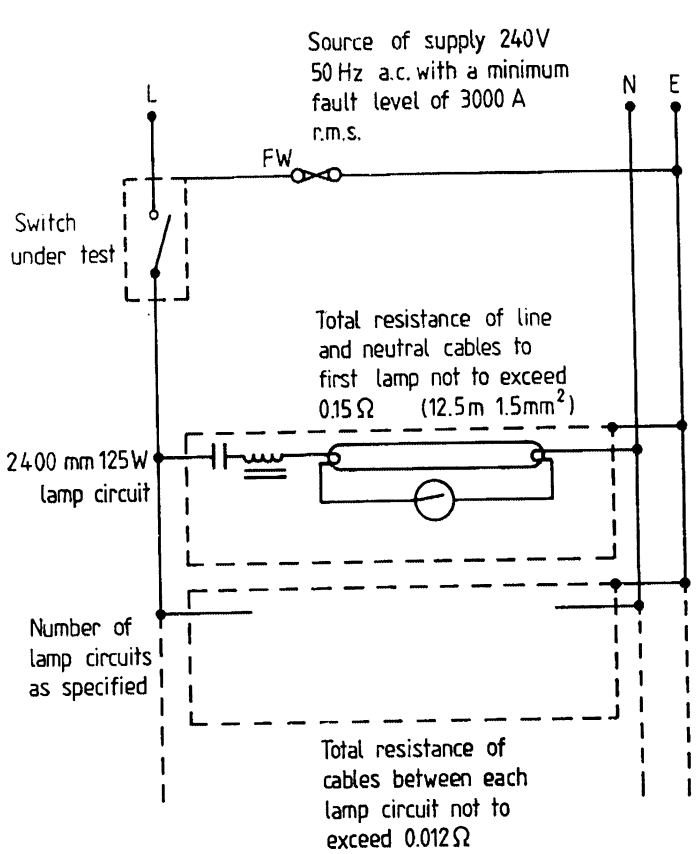
Switch pattern number 6/2



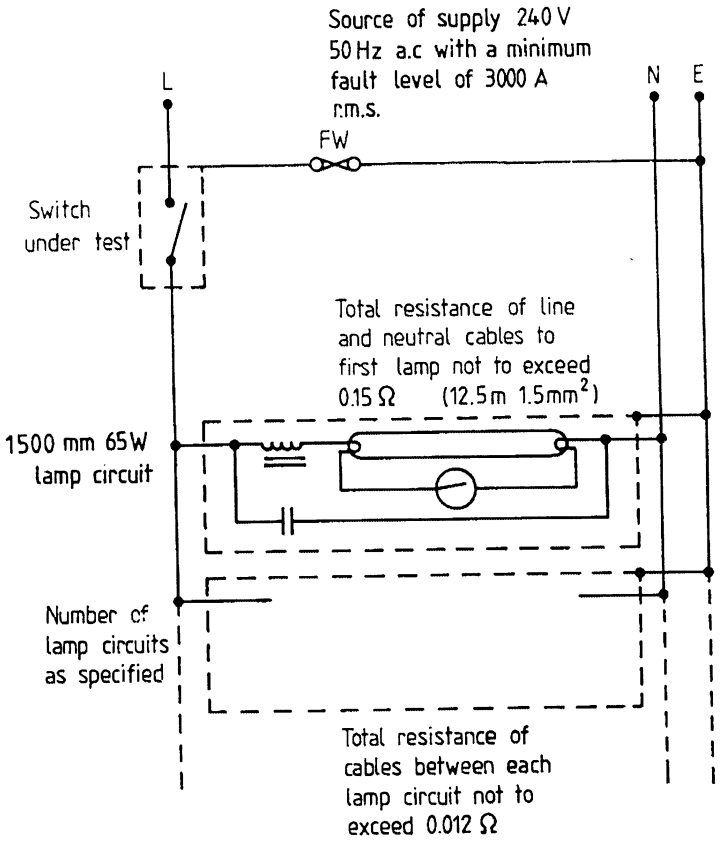
Switch pattern number 7

NOTE 1 The arrows indicating the connection of phase conductors are shown as examples only.
NOTE 2 When the marking made by the manufacturer indicates other connections, this marking shall be followed.

Figure 9 — Circuit diagrams for making and breaking capacity and normal operation tests

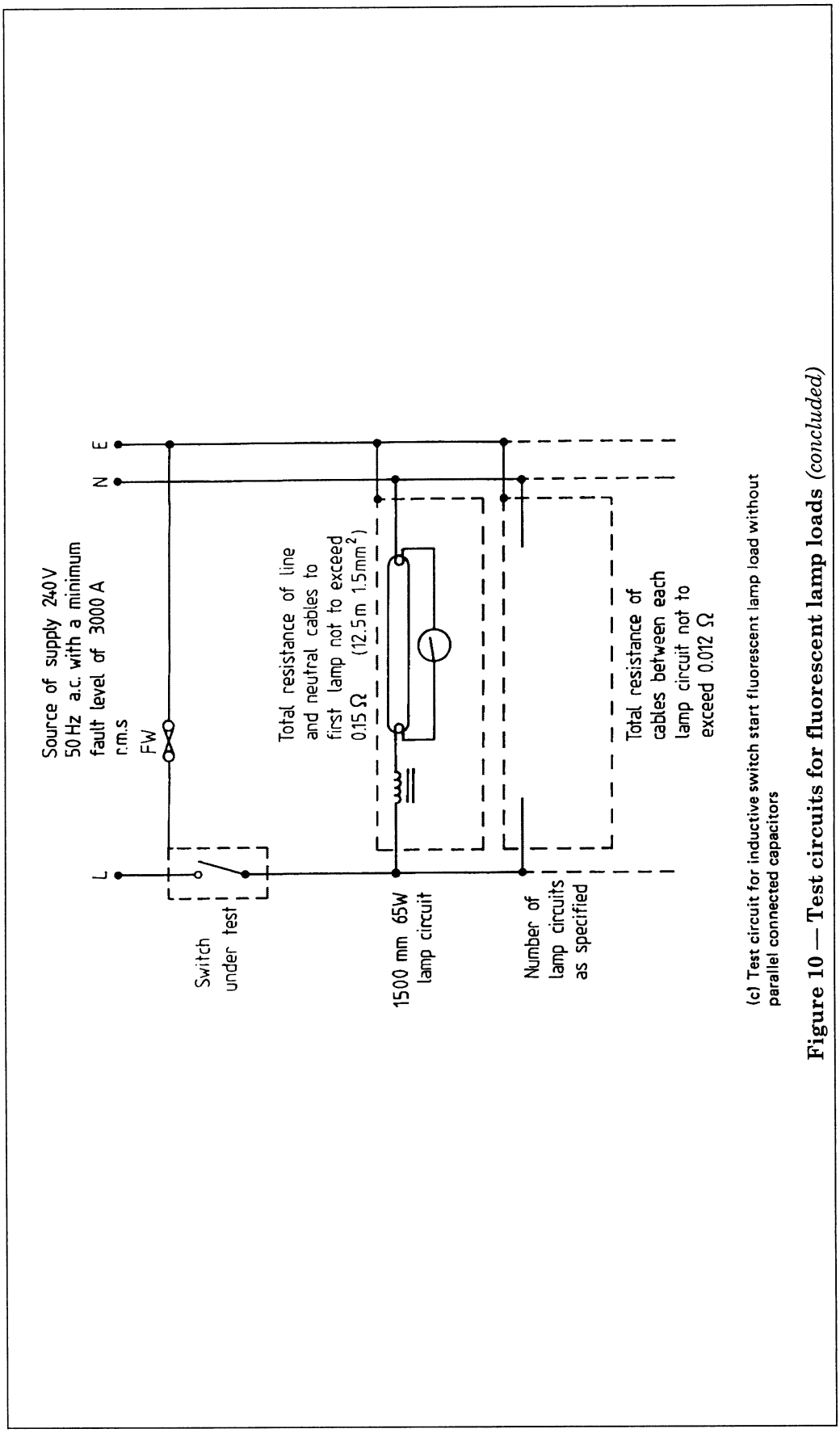


(a) Test circuit for series capacitor switch start fluorescent lamp load



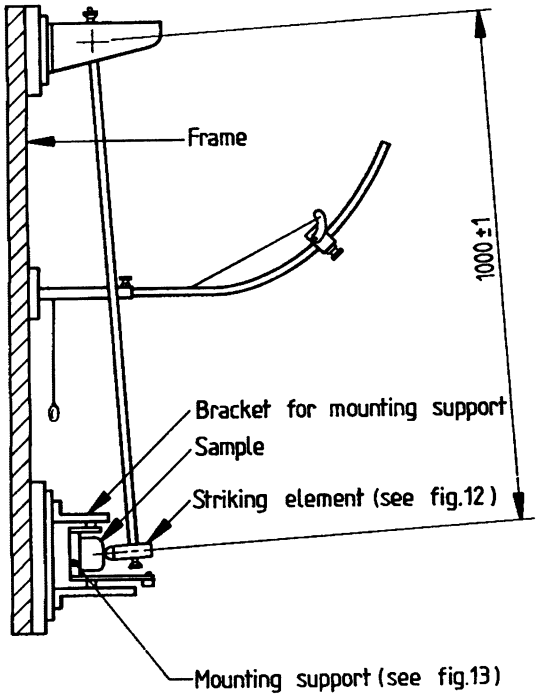
(b) Test circuit for inductive switch start fluorescent lamp load with parallel connected capacitors for P.F. correction

Figure 10 — Test circuits for fluorescent lamp loads



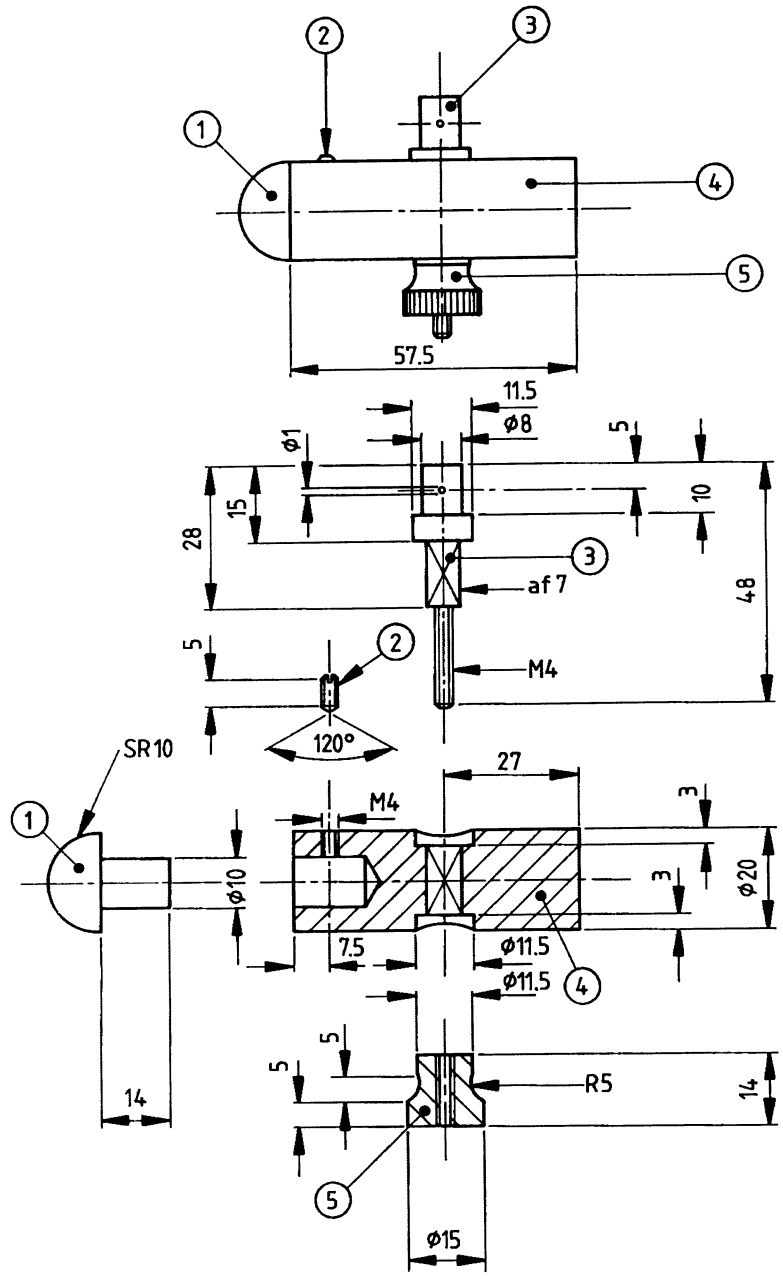
(c) Test circuit for inductive switch start fluorescent lamp load without parallel connected capacitors

Figure 10 — Test circuits for fluorescent lamp loads *(concluded)*



All dimensions are in millimetres.

Figure 11 — Impact test apparatus: general view

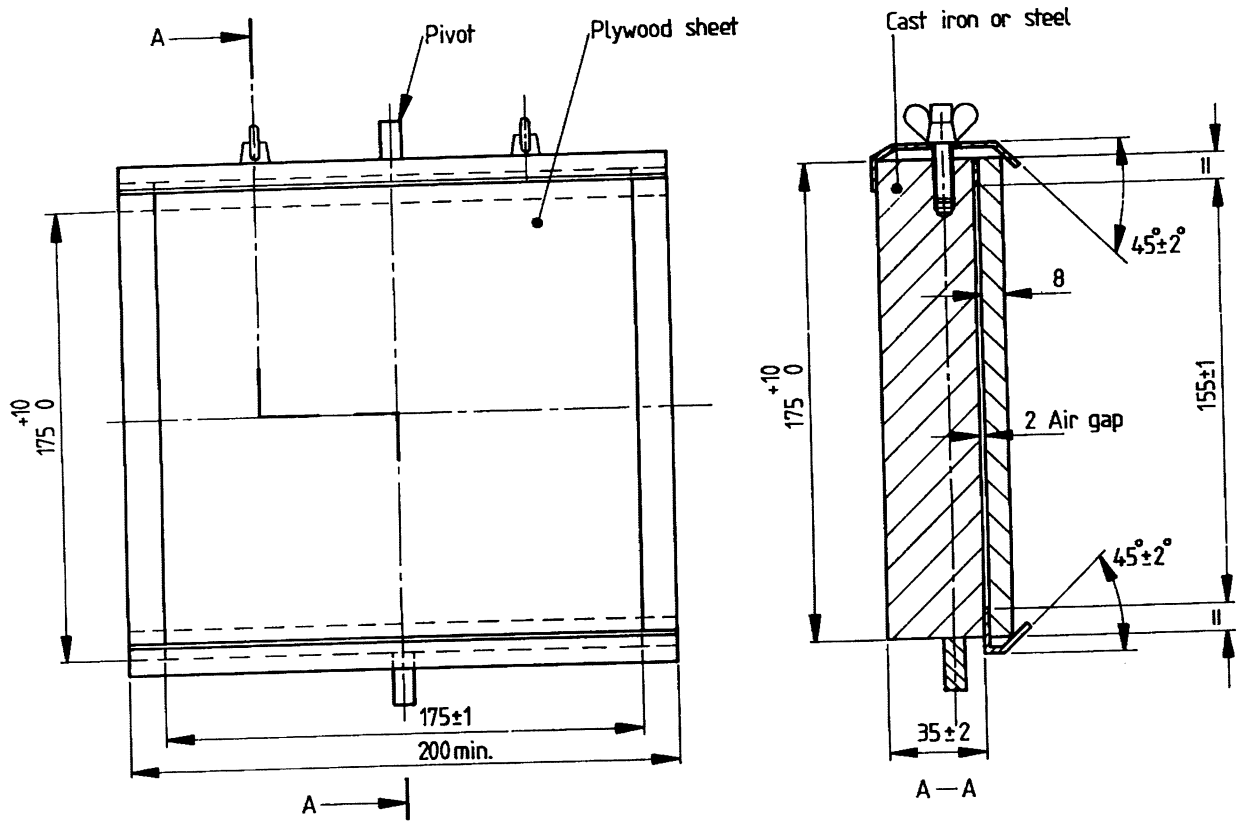


Materials

1 : polyamide
2, 3, 4 and 5 : steel

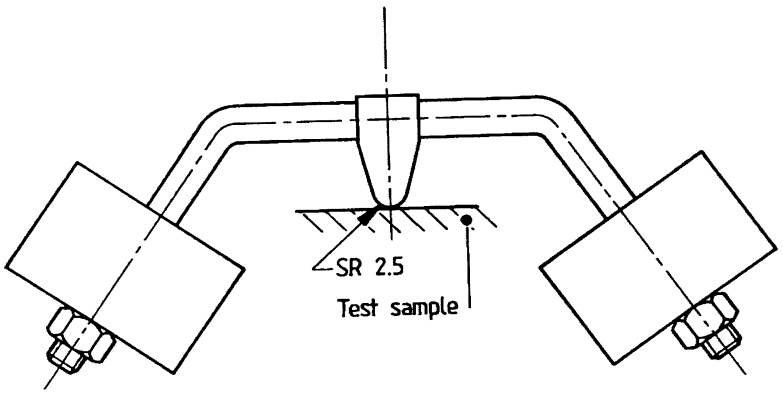
NOTE This drawing is not intended to govern design except as regards the dimensions and specific requirements shown. All dimensions are in millimetres.

Figure 12 — Constructional details of striking element



NOTE This drawing is not intended to govern design except as regards the dimensions and specific requirements shown.
All dimensions are in millimetres.

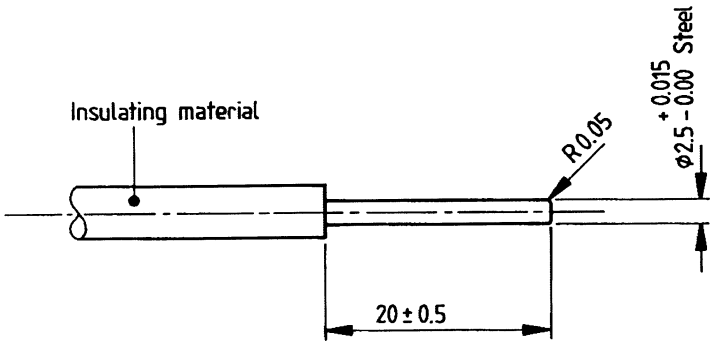
Figure 13 — Constructional details of mounting support for test samples



All dimensions are in millimetres.

Figure 15 — Ball-pressure apparatus

Figures 14, 16, 17 and 18 of the IEC Standard are not appropriate and have been omitted.



All dimensions are in millimetres.

Figure X — Probe to check access to live parts via drain hole

Publications referred to

BS 1224, *Specification for electroplated coatings of nickel and chromium.*

BS 1706, *Specification for electroplated coatings of cadmium and zinc on iron and steel.*

BS 1872, *Specification for electroplated coatings on tin.*

BS 2782, *Methods of testing plastics.*

BS 2782-3, *Mechanical properties.*

BS 2782:Method 365C, *Determination of Rockwell hardness.*

BS 3042, *Specification for standard test fingers and probes for checking protection against electrical, mechanical and thermal hazard.*

BS 4662, *Specification for boxes for the enclosure of electrical accessories.*

BS 4714, *Method for laboratory determination of density or relative density of crude petroleum and liquid petroleum products (hydrometer method).*

BS 5490, *Specification for classification of degrees of protection provided by enclosures.*

BS 5518, *Specification for electronic variable control switches (dimmer switches) for tungsten filament lighting.*

BS 5901, *Method of test for determining the comparative and the proof tracking indices of solid insulating materials under moist conditions.*

BS 6458, *Fire hazard testing for electrotechnical products.*

BS 6458-2, *Methods of test.*

BS 6458-2.1, *Glow-wire test.*

BS 6500, *Specification for insulated flexible cords and cables.*

IEC 669-1, *Switches for household and similar fixed-electrical installations — Part1: General requirements*[3)].

IEC 719, *Calculation of the lower and upper limits for the average outer dimensions of cables with circular copper conductors and of rated voltages up to and including 450/750 V.*

[3)] Referred to in the foreword only.

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