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घरेलू और समान कार्यों के लिए स्विच — विशिष्टि

(दूसरा पुनरीक्षण)

Indian Standard

**SWITCHES FOR DOMESTIC AND SIMILAR
PURPOSES — SPECIFICATION**

(Second Revision)

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(Including Amendment Nos. 1, 2, 3 & 4)

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FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Electrical Wiring Accessories Sectional Committee had been approved by the Electrotechnical Division Council.

This standard was first published in 1966 and first revised in 1986. This revision has been undertaken to bring it in-line with IEC publication 669 - 1 'Specification for switches for household similar fixed electrical installation : part 1 General requirements' issued by the International Electrotechnical Commission (IEC).

While revising the standard, the domestic switches have been classified according to the contact opening, degree of protection against electrical shock and water and additional types of switches (*see 1.3*) have been included.

This standard also applies to switches incorporating pilot lights, remote control switches and combination of switches and other functions where as earlier only manually operated switches for household use with a rated voltage not exceeding 250 V and a rated current up to 32A were covered.

IS 4949 : 1968 Covering switches rated 2 Ampere will be withdrawn because the switches have been included in this standard. While using the wiring by cables of aluminium conductor procedures given in Annex C of IS 732 : 1989 are recommended.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the results of a test, shall be rounded off in accordance with IS 2:1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

AMENDMENT NO. 1 APRIL 2000
TO
IS 3854 : 1997 SWITCHES FOR DOMESTIC AND
SIMILAR PURPOSES — SPECIFICATION
(Second Revision)

(*Second cover, Foreword*) — Insert the following after the fourth para:

‘In order to facilitate the manufacturer to install the test facilities as per this revised standard, alternative test method as given in IS 1988 version of this standard has been incorporated with regard to following tests:

- a) Making and breaking capacity,
- b) Normal operation, and
- c) Resistance to abnormal heat and fire.

The alternative methods will be in force up to 31 March 2001. However, manufacturers have the option to follow the new test methods in respect of the above tests and information to this effect shall be furnished to the testing authority by the manufacturer for the purpose of reproducibility and repeatability of test results.’

(*Page 1, clause 1.6*) — Substitute the following for the existing:

‘This standard does not apply to circuit breakers for household and similar installations, to switches for appliance, to (in-line) cord switches and switches incorporated in cable reels.’

(*Page 1, clause 2*) — Insert the following IS No. and its Title after IS 1068 : 1993:

<i>‘IS No</i>	<i>Title</i>
1137 : 1990	Thickness of sheet and diameters of wire (<i>first revision</i>)’

(*Page 4, clause 7.1.5*) — Substitute the word ‘Tumbler’ for ‘Tumpler’.

(*Page 5, clause 8.2, line 10*) — Substitute ‘I’ for ‘1.’

Amend No. 1 to IS 3854 : 1997

(*Page 6, clause 8.3, line 4*) — Insert the following after the word 'reference' :

'(optional)' .

(*Page 6, clause 8.6, para 3, line-4*) — Substitute the word 'incorrect' for 'correct'.

(*Page 7, clause 9, title*) — Substitute the following for the existing:

'CHECKING OF DIMENSIONS (OPTIONAL)

Note – Drawings shall be supplied on demand subject to agreement between the supplier and the buyer.'

(*Page 18, clause 14.3, last para*) — Substitute the following for the existing entries:

"During the test, no sustained arcing shall occur nor there shall be any spark when the switch is in 'ON' and/or 'OFF' position."

(*Page 23, Table 14, col 1*) — Delete the words 'Area of Conductors.'

(*Page 24, clause 18.2*) — Insert the following 'Note' at the end :

'NOTE — The test of 18.1 and 18.2 may be carried out by the alternative method given in Annex D. However, the method shall not be applicable after 31 March 2001.'

(*Page 25, clause 19.1, lines 2 and 3 after Table 16*) — Substitute the following for the existing entries:

"The 'ON' period shall be 25 percent +5 percent of the total cycle and the 'OFF' period 75 percent 0 percent." 0

-5

(*Page 27, clause 19.2*) — Insert the following 'Note' at the end:

'NOTE — The test of 19.1 and 19.2 may be carried out by the alternative method given in Annex E. However, the method shall not be applicable after 31 March 2001.'

(*Page 37, Annex C*) — Insert the following Annexures at the end:

Amend No. 1 to IS 3854 : 1997

ANNEX D
(Clause 18.2)

TEST FOR MAKING AND BREAKING CAPACITY

D-1 Switches when new and also after half the specified number of operations of the test for normal operation (see Annex E) shall be capable of making and breaking a current 130 percent of the rated current, at a voltage not less than 110 percent of the rated voltage, 10 times in succession, at intervals of 30 seconds, without becoming unserviceable. For the purpose of this test, the covers, if any, of the switches shall be in position.

NOTE — As an acceptance test, this test is carried out on switches when new only.

D-2 During these tests, all metal parts normally connected to earth in service shall be earthed through a fine wire fuse of minimum length 75 mm. This fuse element shall be copper wire not greater than 0.125 mm in diameter (see IS 1137 : 1990) which shall remain intact throughout the test.

ANNEX E
(Clause 19.2)

TEST FOR NORMAL OPERATION

E-1 Switches shall be capable of making and breaking an electrical circuit at the rated voltage and rated current for 20 000 switch cycles (40 000 operations) for switches having a rated current of 6A and 16A and 10 000 cycles (20 000 operations) for switches having a rated current above 16A up to and including 63 A at a rate not exceeding 6 cycles per minute at regular intervals. The 'ON' and 'OFF' period of each cycle shall be approximately equal.

E-2 The characteristics of the test circuit shall be such that the voltage across the load may be the rated voltage of the switch under test when the required test current is flowing and not more than 110 percent of the rated voltage on open circuit.

E-3 During these tests, all metal parts normally connected to earth in service shall be earthed through a fine wire fuse of minimum length 75 mm. This fuse element shall be copper wire not greater than 0.125 mm in diameter which shall remain intact throughout the complete test.

Amend No. 1 to IS 3854 : 1997

E-4 The switches suitable for ac inductive circuits shall be capable of making and breaking not less than 125 percent of the rated current at a voltage not less than 110 percent at rated voltage at 0.3 power factor (lagging) 100 times at a rate of approximately 7.5 switch cycle per minute without becoming unserviceable.

During the test, all metal parts normally connected to earth in service shall be earthed through a fine wire fuse of minimum length 75 mm. This fuse element shall be copper wire not greater 0.125 mm dia (see IS 1137 : 1990) which shall remain intact throughout the complete test.

(Page 46, figure 14, line 5) — Substitute ' R_3 ' for ' R ' and ' 0.25 ohm ' for ' $0.25 R_3$ '.

(ETD 14)

**AMENDMENT NO. 2 MAY 2002
TO
IS 3854 : 1997 SWITCHES FOR DOMESTIC AND
SIMILAR PURPOSES — SPECIFICATION**

(Second Revision)

[*Second cover page, Foreword, para 4 (see also Amendment No. 1)*] —
Insert the following after the para:

'The standard presently covers switches of rated voltages of 110V, 240V 230V, 250V, 400V, 415V, and 440V. However, the rated voltage of 240V, 250V, 415V and 440V shall be phased out after 31 December 2003.'

(*Page 1, clause 1.1.1, line 1*) — Substitute '16 A' for '10 A'.

(*Page 1, clause 1.2, excluding Note*) — Substitute the following for the existing:

'1.2 The standard also applies to boxes for switches which are an integral part of it. It does not however apply to mounting boxes for flush type switches.'

(*Page 1, clause 1.2, Note 1*) — Delete and renumber the subsequent Notes.

(*Page 1, clause 1.2, Note 3, last line*) — Substitute 'IS 14772 : 2000' for 'IS 5133 (Part 1) and IS 5133 (Part 2)'.

(*Page 1, clause 1.3*) — Substitute the following for the existing matter:

'1.3 This standard also applies to switches such as:

- Switches incorporating pilot lights.
- Electromagnetic remote control switches (particular requirements will be covered in a separate standard).
- Switches incorporating time delay device (particular requirements will be covered in a separate standard).
- Combination of switches and other functions (with the exception of switches combined with fuses.
- Electronic switches (particular requirements will be covered in a separate standard).'

Amend No. 2 to IS 3854 : 1997

- (Page 1, clause 1.6)** — Substitute the following for the existing matter:
- 'ref'** **'1.6'** This standard does not apply to circuit breakers for household and similar installations, to switches for appliances, in-line cord switches and switches incorporated in cable reels.'
- 'cor'** **(Page 1, clause 1.6)** — Insert the following new clause 1.7:
- 'CE'** **'1.7'** This standard does not include requirements and tests for switches with protection against solid foreign bodies. These are under consideration.'
- (Page 1, clause 2)** — Delete the entries of 'IS 5133 (Part 1) : 1969 and IS 5133 (Part 2) : 1969' along with their titles, and insert the following IS No. at the end:
- exis** **'IS 14772 : 2000 'Enclosures for accessories for household and similar fixed electrical installation'.**
- (Page 3, clause 3.28, line 2)** — Substitute the word 'lot' for 'test'.
- (Page 3, clause 5.2, second sentence)** — Delete.
- (Page 3, clause 5.4, para 3, line 1)** — Substitute '24.2' for '24'.
- (Page 3, clause 5.4, para 3)** — Insert the following new para after para 3:
- 'For the test of 12.3.2, three additional specimens are necessary.'**
- (Page 4, clause 5.5)** — Substitute the following for the existing:
- fol** **'5.5'** The specimens are subjected to all the relevant tests and the requirements are satisfied if all the tests are met. If one specimen does not satisfy a test due to an assembly or a manufacturing fault, that test and any preceding one which may have influenced the results of the tests shall be repeated and also the tests which follow shall be made in the required sequence on another full set of specimens, all of which shall comply with the requirements.'
- ..T** **(Page 4, clause 5.5, Note 1)** — Substitute the following for the existing
- peri** **Note:**
- '1. The manufacturer may submit, together with a number of specimens specified in 5.4, the additional set of specimens which may be wanted, should one specimen fail. The testing authority will then, without further request test additional specimens and will reject only if a further failure occurs. If the additional set of specimens is not submitted at the same time, the failure of one specimen will entail rejection.'**

Amend No. 2 to IS 3854 : 1997

(Page 4, clause 6.1, Note) — Delete.

(Page 4, clause 6.2, para 3) — Substitute the following for the existing para:

‘Switches intended for fluorescent lamp circuits shall have rated current not exceeding 16A, except for switches of pattern number 3 and 03 and momentary contact switches.’

(Page 5, clause 8.1, first dash item, line 2) — Substitute ‘AX’ for ‘ax’.

(Page 5, clause 8.1, fifth dash item) — Substitute the following for the existing:

— Type reference, which may be a catalogue number (optional)’. .

(Page 5, clause 8.1, seventh dash item) — Insert the following after the 7th dash item:

— Country of manufacture’.

(Page 6, clause 8.5, para 2, line 1) — Insert the symbol ‘ $\frac{1}{2}$ ’ at the end of the line.

(Page 6, clause 8.6, para 7) — The contents of the para shall be read as NOTE 2 as follows.

‘2 It is not necessary to have such indication for push button switches.’

(Page 7, clause 10.1, para 1) — Substitute the following for the existing para:

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

(Page 7, clause 10.1, para 5, line 4) — Substitute ‘ $35\pm 5^{\circ}\text{C}$ ’ for ‘ $35\pm 2^{\circ}\text{C}$ ’.

(Page 7, clause 10.2, para 3) — Substitute the following for the existing para:

‘NOTE — This requirement does not apply to removable keys or intermediate keys on intermediate parts; such as chains or rods.’

(Page 8, clause 10.4, Note, line 2) — Substitute ‘23’ for ‘24’.

Amend No. 2 to IS 3854 : 1997

- 'ref'** (Page 9, clause 12.1, para 2, line 3) — Insert the word 'may' after the word 'they'.
- (Page 9, clause 12.1, para 2, line 3) — Insert the word 'or' for 'of'.
- 'con'** (Page 9, clause 12.1, para 3, line 2) — Substitute '15.1' for '15'.
- (Page 10, clause 12.2.5, last para) — Insert the following note after the last para:
- 'CI'** 'NOTE — The test may be carried out by alternative method given in Annex F.'
- (Page 10, Table 3, col 6, first row) — Substitute '4.0 up to 6.0 inclusive' for '0 up to 6.0 inclusive'.
- exis** (Page 10, Table 4, col 2, row 3) — Substitute '1×1.78' for '1×2.78'.
- (Page 12, clause 12.3.1, Note, line 1 of first dash item) — Substitute the word 'fixing' for 'testing'.
- (Page 13, Table 7) — Insert the following matter at the end:
- | Rated
Current | Test
Current | Cross-Sectional Area
of the Conductors |
|------------------|-----------------|---|
| 16 | 22 | 2.5 |
- fol** (Page 15, Table 8, col 1, row 2) — Substitute 'above 6 up to and including 16' for '10'.
- 'T'** (Page 18, clause 13.15.2, last para, line 1) — Substitute '13.15.1' for '13.5.1'.
- per** (Page 20, clause 15.2.3, para 2) — Substitute the following for the existing para:
- 'Immediately after the test specified in 15.2.2 and 15.2.3 of IS 12063, the specimen shall withstand an electric strength test as specified in 16.2 and inspection shall show that water has not entered the samples to any appreciable extent and has not reached live parts.'
- (Page 20, clause 15.3, Note 3) — Insert the following new Note 4 at the end:
- '4 For the purpose of acceptance test, the humidity treatment is subjected for 24 h.'

Amend No. 2 to IS 3854 : 1997

(Page 22, clause 16.2, Notes 1 and 2) — Substitute '200 mA' for '100 mA'.

(Page 24, clause 18.1, para 1, second sentence) — Substitute the following for the existing sentence:

'They are subjected to 200 operations at a uniform rate, 'ON' and 'OFF' period being almost equal.'

(Page 24, clause 18.1, para 6) — Substitute the following for the existing para:

'The metal support of the switch, if any, on which the switch is mounted and the accessible metal parts of the switch, if any, shall be earthed through a fuse which shall not blow during the test. The fuse shall consists of a copper of 0.1 mm diameter and not less than 50 mm in length.'

(Page 24, clause 18.1, para 7) — Substitute the following for the existing para:

'For switches of pattern No. 6, 6/2 and 7, the selector switch 'S' shown in Fig. 13 is moved after the fraction of the total number of operations indicated in Table 15.'

(Page 24, Table 15) — Substitute the following for the existing table:

Table 15

Pattern Number	Type of Switch	Fraction of Switches
1, 2, 4 or 5	Rotary, both directions and other types	—
3 or 03	Rotary, both directions and other types	—
6, 6/2 or 7	Rotary, both directions and	1/4 and 3/4
	Other types	1/2

(Page 24, clause 18.2, paras 1, 2 and 3, including Note) — Substitute the following for the existing matter:

'Test is carried out using a number of tungsten filament lamps at a load current not less than 1.2 times the rated current of the switch at a voltage not less than 95 percent of the voltage.'

(Page 24, clause 18.2, last line) — Substitute '14.4 → 15' for '14.4 → 15'.

Amend No. 2 to IS 3854 : 1997

(Page 25, clause 19.1, para 2, lines 2 and 3):

- a) Substitute 'S' for 'S1 and S2'.
- b) Substitute '18' for '18.1'.

(Page 25, clause 19.1, para 7, line 3) — Substitute 'S' for 'S1'.

(Page 31, clause 22.2, para 2) — Delete the words 'by measurement and by manual test'.

(Page 31, clause 22.5, para 3, third dash item, line 2) — Substitute '0.12 percent' for '0.09 percent'.

(Page 34, clause 25, para 3, line 3) — Insert the following words at the end of the line:

'and a relative humidity not less than 90 percent'

[Page 37, Annex E (see also Amendment No. 1)] — Insert the following new Annex after Annex E:

ANNEX F
(Clause 12.2.5, Note)

**ALTERNATIVE TEST METHOD FOR TEST ON SCREW TYPE
TERMINALS**

F-1 Screw type terminals shall be so designed and constructed that they clamp the conductors(s) without undue damage to the conductor(s).

F-2 Compliance is checked by the following test:

The terminal is placed in the test apparatus according to Fig. 26 and fitted with rigid (solid or stranded) conductor(s) according to Table 21, first with the smallest and then with the largest cross-sectional area, the clamping screw(s) or nut(s) being tightened with the torque according to Table 5.

The length of the test conductor shall be 75 mm longer than the height (*H*) specified in the following table:

Amend No. 2 to IS 3854 : 1997

Table 21 Test Values for Flexion Pull Out for Copper Conductors
(Clause F-2)

Conductor Cross-Sectional Area ¹⁾ mm ²	Diameter of Bushing Hole ¹⁾ mm	Height ²⁾ H mm	Mass of Conductor kg
0.5	6.5	260	0.3
0.75	6.5	260	0.4
1.0	6.5	260	0.4
1.5	6.5	260	0.4
2.5	9.5	280	0.7
4.0	9.5	280	0.9
6.0	9.5	280	1.4
10.0	9.5	280	2.0
16.0	13.0	300	2.9
25.0	13.0	300	4.5

¹⁾ If the bushing hole diameter is not large enough to accommodate the conductor without binding, bushing having the next higher hole size may be used.

²⁾ Tolerance on height $H = \pm 15$ mm.

The end of the conductor is passed through an appropriate bushing in a planten positioned at a height (H) below the equipment as given in the above table. The bushing is positioned in a horizontal plane so that its central line describes a circle of 75 mm diameter, concentric with the centre of the clamping unit in the horizontal plane; the planten is then rotated at a rate 10 ± 2 rev/min.

The distance between the mouth of the clamping unit and the upper surface of the bushing shall be within ± 15 mm of the height (H) as given in Table 21. The bushing may be lubricated to prevent binding, twisting or rotation of the insulated conductor.

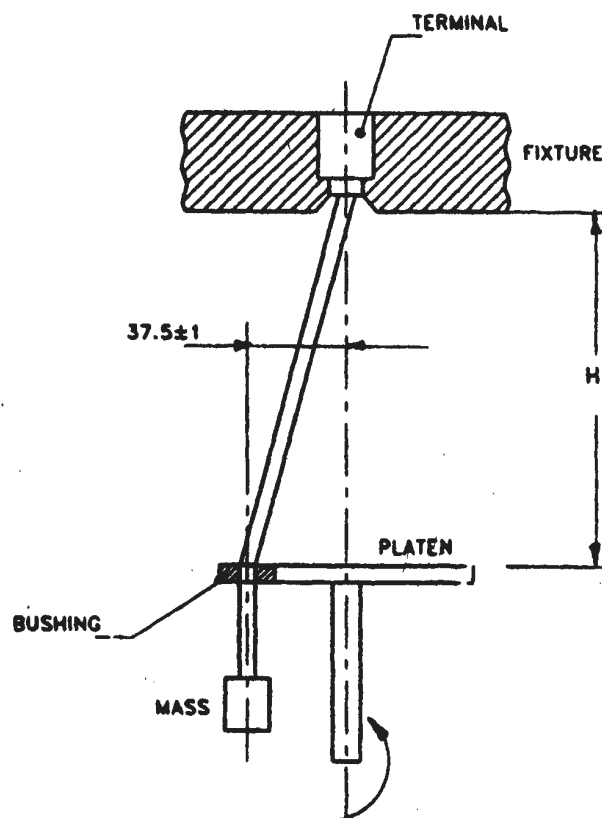
A mass as specified in the above table is suspended from the end of the conductor. The duration of the test is approximately 15 min.

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

The test shall be repeated with rigid solid conductors in the case they exist in the relevant Indian Standard (see IS 694:1990). If the first test has been made with rigid stranded conductors. In the case where rigid stranded conductors do not exist, the test may be made with rigid conductors only.'

Amend No. 2 to IS 3854 : 1997

(Page 45, Fig. 13) — Substitute the following for the existing figure:



The arrows indicating the connection of the phase conductors are shown as an example only.

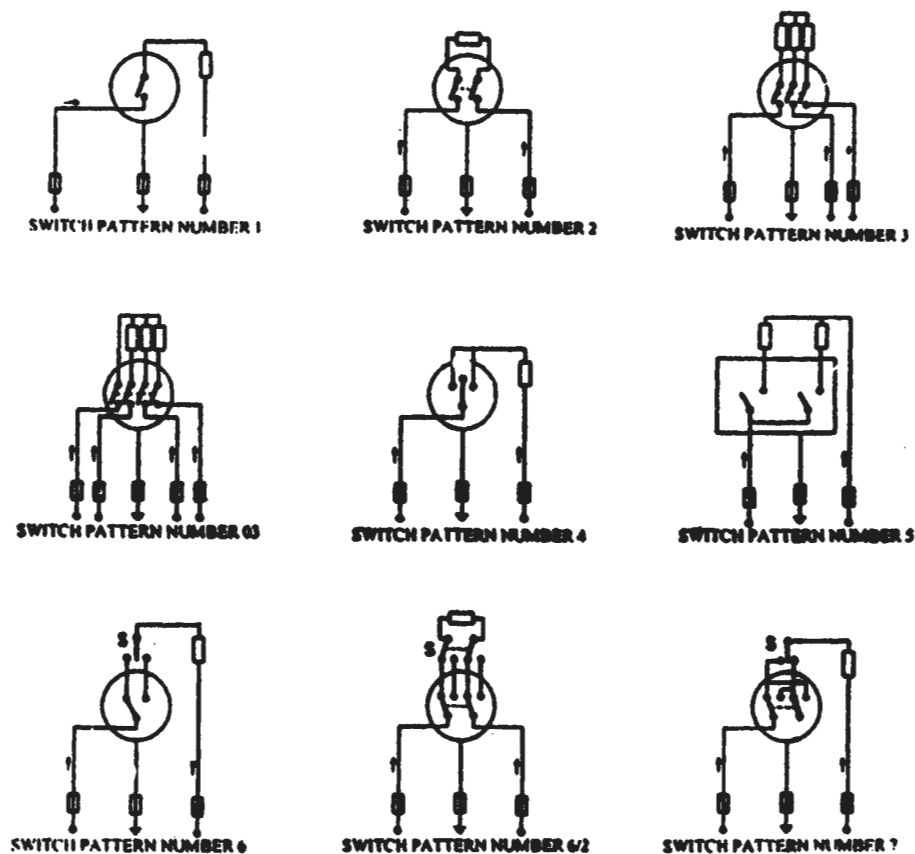
When the marking made by the manufacturer indicates other connections, this marking shall be followed.

FIG. 13 CIRCUIT DIAGRAMS FOR MAKING AND BREAKING CAPACITY AND NORMAL OPERATION

Amend No. 2 to IS 3854 : 1997

(Page 52, Fig. 23) — Substitute '100 MIN' for '10 MIN'.

(Page 52, Fig. 25) — Insert the following new Fig. 26 after Fig. 25:



NOTE — Care should be taken that the bushing hole is made in a way which ensures that the force extended to the cable is a pure pulling force and that the transmission of any torque to the connection in the clamping means is avoided.

FIG. 26 TEST APPARATUS FOR CHECKING DAMAGE TO CONDUCTORS

(ETD 14)

**AMENDMENT NO. 3 JUNE 2003
TO
IS 3854 : 1997 SWITCHES FOR DOMESTIC AND
SIMILAR PURPOSES —SPECIFICATION
(*Second Revision*)**

[*Page 34, clause 26.2(b)*] — Substitute the following for the existing:

- b) Resistance to harmful ingress of water and to humidity (*see 15.2 and 15.3*)'.

(ET 14)

**AMENDMENT NO. 4 APRIL 2007
TO
IS 3854 : 1997 SWITCHES FOR DOMESTIC AND
SIMILAR PURPOSES — SPECIFICATION**

(Second Revision)

***[Second cover page, Foreword, para 5 (see also Amendment
No. 1)] — Delete.***

(ET 14)

Indian Standard

SWITCHES FOR DOMESTIC AND SIMILAR PURPOSES — SPECIFICATION

(Second Revision)

1 SCOPE

1.1 This standard applies to manually operated general purpose switches with a rated voltage not exceeding 440 V and a rated current not exceeding 63 A, intended for household and similar fixed-electrical installations either indoors or outdoors.

1.1.1 The rated current is limited to 10 A for switches provided with screwless terminals.

1.2 The standard applies to boxes for switches with the exception of flush mounting boxes for flush-type switches.

NOTES

- 1 The extensions of rated current values to 16 A is under consideration for switches provided with screwless terminal.
- 2 An extension of the scope to switches for rated voltages higher than 440 V is under consideration.
- 3 In this standard specific requirements are given for boxes, while the general requirements for ordinary flush-type switch boxes are given in IS 5133 (Part 1) and IS 5133 (Part 2).
- 4 Additional requirement to flush type non ordinary switches are under consideration.

1.3 This standard also applies to switches such as:

- Switches incorporating pilot lights.
- Electromagnetic remote control switches.
- Switches incorporating a time delay device.
- Combinations of switches and other functions (with the exception of switches combined with fuses).
- Electronic switches (particular requirement will be covered under a separate standard).

1.4 Switches complying with this standard are suitable for use at ambient temperatures not normally exceeding 35°C, but occasionally reaching 45°C.

NOTE — Switches complying with this standard are suitable only in incorporating in equipment in such a way and in such a place that it is unlikely that the surrounding reaches a temperature exceeding 45°C.

1.5 It does not cover switches for 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.

1.6 This standard does not apply to circuit-breakers for household and similar installations, to switches for appliances and to (in-line) cord switches.

2 REFERENCES

The following Indian Standards are necessary adjuncts to this standard:

IS No.	Title
302 (Part 1) : 1979	Safety of household and similar electrical appliances: Part 1 General requirements (<i>fifth revision</i>)
694 : 1990	PVC insulated cables for working voltages up to and including 1 100 V (<i>third revision</i>)
1068 : 1993	Electroplated coatings of nickel plus chromium and copper plus nickel plus chromium (<i>third revision</i>)
1359 : 1992	Electroplated coating of tin (<i>third revision</i>)
1573 : 1986	Electroplated coating of zinc on iron and steel (<i>second revision</i>)
2824 : 1975	Method for determining the comparative tracking index of solid insulating materials under moist conditions (<i>first revision</i>)
5133 (Part 1) : 1969	Boxes for enclosure of electrical accessories Steel and cast iron boxes
(Part 2) : 1969	Boxes made of insulating material
7358 : 1974	Thermocouples (<i>first revision</i>)
9968 (Part 1) : 1988	Elastomer insulated cables: Part 1 For working voltages up to and including 1 100 V (<i>first revision</i>)
10462 (Part 1) : 1983	Fictitious calculation method for determination of dimensions of protective coverings of cables: Part 1 Elastomeric and thermoplastic insulated cables

IS 3854 : 1997

<i>IS No.</i>	<i>Title</i>
11000 (Part 2/Sec 1) : 1984	Fire hazard testing: Part 2 Test methods, Section 1 Glow-wire test and guidance
12063 : 1987	Classification of degree of protection provided by enclosures of electrical equipment

3 TERMINOLOGY

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

For the purpose of this standard, the following definitions shall apply.

3.1 Switch

A device designed to make or break the current in one or more electric circuit.

3.2 One Operation

The transfer of the moving contacts from one operating positions to another.

3.3 Terminal

The conductive part of one pole composed of one or more clamping unit(s) and insulation if necessary.

3.4 Terminal with Screw Clamping

Terminal intended for the connections, by clamping only, of external rigid or flexible conductors.

3.5 Pillar Terminal

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 Fig. 4.

3.6 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 Fig. 5.

3.7 Stud Terminal

Terminal with screw clamping in which the conductor is clamped under a nut. The clamping pressure may be applied directly by a suitable 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 Fig. 5.

3.8 Saddle Terminal

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 Fig. 6.

3.9 Lug Terminal

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 Fig. 7.

3.10 Mantle Terminal

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 suitable 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 Fig. 8.

3.11 Screwless Terminal

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 dismantled, the connection being made directly or indirectly, by means of springs, parts of angled, eccentric or conical form, etc. without special preparation of the conductor concerned other than removal of insulation.

3.12 Mechanical Time-Delay Device

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

3.13 Base

Part of the switch retaining current-carrying parts and in general, the mechanism in position.

3.14 Rated Voltage

Voltage assigned to the switch by the manufacturer.

3.15 Rated Current

Current assigned to the switch by the manufacturer.

3.16 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 of the palm of hand, having stored energy return, for instance spring.

3.17 Momentary Contact Switch

Switching device returns automatically to the initial state after operation.

NOTE — Momentary contact switches are intended to operate bells, electromagnetic remote control switches or time-delay switches.

3.18 Momentary Push-Button Switch

Push button which returns automatically to the initial state after operation.

3.19 Cord-Operated Switch

Switch the operating means of which is a cord which has to be pulled in order to change its contact state.

3.20 Switch of Mini-Gap Construction

Switch construction having a clearance between the contacts which is less than 3 mm but is atleast 1.2 mm.

NOTE — Switches of mini-gap construction are for functional purposes and they are not intended to be used for safety isolation purposes.

3.21 Clamping Unit

Part or parts of a terminal necessary for the mechanical clamping and the electrical connection of conductor(s).

3.22 Thread-Forming Screw

Tapping screw having an uninterrupted thread which by screwing in, forms a thread by displacing material.

NOTE — An example of a thread-forming screw is shown in Fig. 11.

3.23 Thread-Cutting Screw

Tapping screw having an interrupted thread which, by screwing in, forms a thread by removing material.

NOTE — An example of a thread-cutting screw is shown in Fig. 12.

3.24 Operating Member

Part of cord-operated switch which connects the internal mechanism with a pull cord. It is usually attached to the actuating member of switch.

3.25 Pole (of a Switch)

Part of a switch associated with one conductive path (way) of its circuit(s) provided with contacts intended to connect and disconnect the circuit itself and excluding those portions which provide a means for connecting and operating the poles together.

A conducting path may be constituted by portions common to other conducting paths of the switch.

3.26 Safety Extra-Low Voltage

Voltage not exceeding 32 V between conductors and between conductors and earth, the no load voltage not exceeding 38V.

3.27 Routine Tests

Tests carried out on each item to check the essential requirements which are likely to vary during production.

3.28 Acceptance Tests

Tests carried out on samples taken from a lot for the purpose of acceptance of the test.

3.29 Type Tests

Tests carried out to prove conformity with the requirements of the standard. These are intended to prove the general qualities and design of a given type of appliances.

4 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.

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

5 GENERAL NOTES ON TESTS

5.1 Tests according to this standard are type tests. Schedule of routine, acceptance and type tests are given in 26.

5.2 Unless otherwise specified, the specimens are tested as delivered and under normal conditions of use. Flush-type switches which do not comply with any accepted standard sheet are tested together with their corresponding boxes.

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

In case of doubt, the tests are made at an ambient temperature of $27 \pm 2^\circ\text{C}$.

5.4 For switches which are marked with one rated voltage and one rated current, nine samples are necessary.

Three specimens are subjected to all the relevant tests except the test of 19.2 where another set of three specimens are used (or two further sets for switches of pattern number 2), and the tests of 24 where another three specimens are used.

For the tests of 24 three additional samples may be required.

For each of the tests of 13.15.1 and 13.15.2 three additional specimens of separate membranes, or of switches incorporating membranes, are required.

For the tests of 12.3.11 additional samples of switches having in total atleast five screwless terminals are required.

For the tests of 12.3.12 three additional specimens of switches are necessary in each specimen, one clamping unit is tested.

For cord-operated switches-three further specimens are used for the test of 20.9.

For switches marked with two rated voltages and corresponding rated currents, 15 specimens are necessary.

For each of the two combinations of rated voltages and rated currents marked on the switch, three specimens are subjected to all the relevant tests except the test of 19.2 where another two (or four for switches of pattern Number 2) further sets of three specimens are used.

A switch marked 250/415 V is tested as a 415 V switch. Momentary contact switches intended to operate bells, electromagnet remote control switches or time-

IS 3854 : 1997

delay switches are not to be submitted to the test of 18.2 and 19.2.

NOTE — A table showing the number of specimens needed for the test is given in Annex A.

5.5 Switches are deemed not to comply with this standard if sustained arcing occurs on any specimens during any of the tests of 18, if any specimens does not pass the test of 24.1 and if there are more failures than that of one specimen in any of the other tests.

If sustained arcing has not occurred during any of the tests of 18 and no specimen has failed during the test of 24.1 but one sample has failed in another way during any of the tests of 18 or during any other test, the test which caused the failure and those preceding which may have influenced the result of that test, are repeated on another set of specimen of the number specified in 5.4 all of which shall then comply with the repeated tests.

NOTES

1 In general, it will be necessary only to repeat the test which caused the failure unless the specimen fails in the test of 19.1 in which case the test are repeated from that of 18 onwards.

2 The applicant may submit, together with the number of specimen specified in 5.4, the additional set of specimen which may be required, should one specimen fail. The testing station will then without further request test the additional specimen and will reject only if a further failure occurs. If the additional set of specimen is not submitted at the same time, a failure of one specimen will entail a rejection.

6 RATINGS

6.1 Switches shall preferably have rated voltage of 110 V, 230 V, 240 V and 250 V, 400 V, 415 V 440 V. For momentary contact switches intended to operate bells, electromagnetic remote control switches or time-delay switches, the standard rated voltages are 110 V and 250 V.

NOTE — The rated voltage of 240 V, 250 V, 415 V and 440 V shall be discontinued after 3 years from the date of publication of this standard.

6.2 Switches shall preferably have rated currents of 6 A, 10 A, 16 A, 20 A, 25 A, 32 A, 40 A and 63 A. The rated current shall be not less than 6 A, except that rated current 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.

Switch with a rated current not exceeding 16 A, except switches of pattern numbers 3 and 03 and momentary contact switches, should have fluorescent lamp current rating equal to the rated current.

For switches with a rated current above 16 A and up to 25 A inclusive, the test with fluorescent lamp can be carried out optionally.

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

7 CLASSIFICATION

7.1 Switches are classified.

7.1.1 According to the possible connections (see Fig. 1):

	Pattern No.
— Single-pole switches	1
— Double-pole switches	2
— Three-pole switches	3
— Three-pole-plus switched neutral switches	03
— Two-way switches	6
— Two-circuit switches with a common incoming	5
— Two-way switches with one off-position	4
— Two-way double-pole switches	6/2
— Two-way double-pole reversing switches	7

NOTES

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

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

7.1.2 According to the contact opening:

- Switches of normal gap construction
- Switches of mini-gap construction (only for a.c.)

7.1.3 According to the degree of protection against electric shock:

- Unenclosed switches
- Enclosed switches

NOTE — For unenclosed switches, the protection against electric shock is given by the enclosure in which the switches is intended to be mounted. For enclosed switches, the protection against electric shock is provided by compliance with the requirements of 10.

7.1.4 According to the degree of protection against harmful ingress of water:

- Ordinary switches having no special protection against harmful ingress of water; IPX0
- Splash-proof switches with degree of protection IPX4
- Jet-proof switches with degree of protection IPX5

NOTES

1 For the purpose of this standard the term ordinary applies only to the degree of protection against harmful ingress of water.

2 For an explanation of IP code, see IS 12063 : 1987.

7.1.5 According to the method of activating the switch:

- Rotary
- Tumbler
- Rocker
- Push-button
- Cord-operated

7.1.6 According to the method of application:

- Surface-type
- Flush-type
- Semi flush-type
- Panel-type
- Architrave-type

7.1.7 According to the method of installation, as a consequence of the design:

- Switches where the cover or cover plate can be removed without displacement of the conductors (Design A).
- Switches where the cover or cover plate cannot be removed without displacement of the conductors (Design B).

NOTE —If a switch has a base which cannot be separated from the cover or cover plate, and requires an intermediate plate which can be removed for redecorating the wall, it is considered to be of design A, provided the intermediate plate meets the requirements specified for covers and cover plates.

7.1.8 According to type of terminals:

- Switches with screw-type terminals,
- Switches with screwless terminals for rigid conductors only, and
- Switches with screwless terminals for rigid and flexible conductors only.

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

Table 1

Rated Current A	Number of Poles	
	Rated Voltage from 120 V to 250 V Inclusive	Rated Voltage Over 250 V
1, 2 and 4	1	—
6	1	1
	2	2
10	1	1
	2	2
		3
16, 20, 25, 32 40 and 63		4
	1	1
	2	2
	3	3
	4	4

8 MARKING

8.1 Switches shall be marked with:

- Rated current in amperes (A) or rated fluorescent lamp current in amperes (ax), or a combination of both if the two ratings are different (see 6.2 and example of marking in 8.2);
- Rated voltages in volts;

- Symbol for nature of supply;
- Manufacture or responsible vendor's name trade-mark or identification mark;
- Type reference, which may be a catalogue number;
- Symbol for mini-gap construction, if applicable; and
- Symbol for degree of protection against harmful ingress of water, if applicable.

NOTES

1 Marking of the pattern number given in 7.1.2 is recommended if the connections are not clear from an inspection of the switch; this pattern number may be a part of the type reference.

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

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.

8.2 When symbols are used they shall be as follows:

Amperes (Flourescent lamp current)	AX
(other current)	A
Volts	V
Alternating current	~
Neutral	N
Line	L
Earth	$\frac{1}{\perp}$
'Off' position	0
'On' position	1
Mini-gap construction	m
Splash-proof construction	IPX4
Jet-proof construction	IPX5

NOTES

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

2 In the IP code the letter 'X', concerning protection against ingress of solid object replaced by the relevant number.

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

For marking with flourescent lamp current, the symbol 'AX' may be replaced by the symbol 'X'. For marking with rated current and rated voltage the figures may be used alone.

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

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

10 A × 250 V ~	OR	10 × 250 ~	OR	10 × 250
20 A 16A × 250 V ~	OR	20-16 × 250 ~	OR	20-16 × 250
10 A × 400 V ~	OR	10 × 400 ~	OR	10 × 400
25 A × 400 V ~	OR	25 × 400 ~	OR	25 × 400
25 A × 250 V ~	OR	25 × 250 ~	OR	25 × 250
25 A × 440 V ~	OR	25 × 440 ~	OR	25 × 440

IS 3854 : 1997

8.3 The marking for rated current, rated voltage, nature of supply, maker's or responsible vendor's name, trade-mark or identification mark and type reference and symbol for mini-gap construction (if applicable) shall be on the main part of the switch.

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 and type reference.

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

The marking shall be clearly visible with normal or corrected vision, without additional magnification, marked either on the front of the switch or on the inner part of its associated enclosure, or on the main part of the switch so that it is easily legible on removal of any cover or cover plate which may be present when the switch is mounted and wired as in normal use. These markings shall not be placed on parts which can be removed without the use of a tool.

NOTES

- 1 Additional type references may be marked on the main part, or on the outside or the inside of the associated enclosure.
- 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.

8.4 Terminals intended for the connection of phase conductors (supply conductors) shall be identified unless the method of connection is of no importance, is self-evident or is indicated on a wiring diagram. Such identification may take the form of a letter *L* or, in the case of more than one such terminals, the letters *L*₁, *L*₂, *L*₃, 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.

NOTES

- 1 The wiring diagram may be an instruction sheet which accompanies the switch.
- 2 'Easily removable parts' are those parts which can be removed during the normal installation of the switch.

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

Earthing terminals shall be indicated by the symbol. These markings shall not be placed on screws, or any other easily removable part.

8.6 Switches of pattern numbers 2, 3 and 03 and switches having a rated voltage exceeding 250 V or a rated current exceeding 16 A shall be so marked that the direction of movement of the actuating member to its different positions or that the actual switch position is clearly indicated. For switches having more than one actuating member, this marking shall indicate, for each of the actuating members, the effect achieved by its operation.

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

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

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

NOTES

- 1 Other suitable means for the indication of the switch position may be used, for example indicator lamps.

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

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

- 2 It is not necessary to have such indications for push button switches.

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

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

8.8 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 8.7 and 8.8 is checked by inspection.

NOTES

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

2 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:

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

8.9 Marking shall be durable and easily legible.

Compliance is checked by inspection and by the following test:

The test is made by rubbing the marking by hand for 15 s with a piece of cloth soaked with water and again for 15 s with a piece of cloth soaked with petroleum spirit.

NOTES

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

2 It is recommended that the petroleum spirit used consists of a solvent hexane with an aromatic content of maximum 0.1 percent in volume percentage, a kauributanol value of approximately 29, an initial boiling point of approximately 65°C, a dry point of approximately 69°C and density of approximately 0.68 g/cm³.

8.10 The switches may also be marked with the Standard Mark.

8.10.1 The use of the standard mark is governed by the provisions of *Bureau of Indian Standards Act, 1986* and the Rules and Regulation made thereunder. The details of conditions under which the licence for the use of the standard mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

9 CHECKING OF DIMENSIONS

Switches and boxes shall comply with the manufacturers drawing.

Compliance is checked by measurement.

10 PROTECTION AGAINST ELECTRIC SHOCK

10.1 Switches shall be so designed that, when they are mounted and wired as in normal use, live parts are not accessible.

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

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

The standard test finger shown in Fig. 2, 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 1 minute to a force of 75 N, applied through the tip of straight enjoined test finger of the same dimensions as the standard test finger.

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

During this test, switches with their associated mounting means shall not deform to such an extent that live parts can be touched with the unjoined test finger.

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

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

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

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

10.3 Accessible parts of ordinary switches having a rated current not exceeding 16 A, shall be made 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 10.2.
- c) The covers and cover plates of metal which comply with the requirements of 10.3.1 or 10.3.2.

10.3.1 The covers or cover plates of metal shall be protected by additional insulation made by insulating linings or insulating barriers. The insulating linings or insulating barriers shall:

- either be fixed to the covers or cover plates or the body of the switches in such a way that they cannot be removed without being permanently damaged.
- or are so designed that:
they cannot be replaced in an incorrect position;

IS 3854 : 1997

- if they are omitted, the accessories are rendered inoperable or manifestly incomplete;
- there is no risk of accidental contact between live parts and metal covers or cover plates, for example, through their fixing screws, even if a conductor should come away from its terminals; and
- precautions are taken in order to prevent creepage distances or clearances becoming less than the values specified in 23.

Compliance is checked by inspection.

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

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

10.3.2 The metal covers or cover plates are automatically connected through a low resistance connection, to earth during fixing of the cover or the cover plate itself.

NOTE — Fixing screws or other means are allowed.

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

10.4 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 enclosure.

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

Compliance is checked by inspection, 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 24.

10.5 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 flush-type 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 23, or, as an alternative, if they are reliably connected to earth.

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

NOTES

1 When checking the inaccessibility of metal parts of the mechanism of unenclosed switches or architrave type switches

the protection provided by the normal way of mounting of the switch is taken into account.

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

10.6 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 23.

Compliance is checked by inspection and, if necessary, by measurement.

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

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

Compliance is checked by inspection.

11 PROVISION FOR EARTHING

11.1 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.

NOTES

1 This requirement does not apply to the metal cover plates mentioned in 10.3.1.

2 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.

11.2 Earthing terminals shall be terminals with screw clamping and shall comply with the appropriate requirements of 12.

They shall be of the same size as the corresponding terminals for the supply conductors except that any additional external earthing terminals shall be at least of size 6 mm².

11.3 Switches other than ordinary with an enclosure of insulating material having more than one cable inlet, 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 11.1 to 11.3 is checked by inspection and by the test of 12.

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

Compliance is checked by the following test:

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 terminals and each of the accessible metal parts in turn.

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

In no case shall the resistance exceed 0.05 ohm.

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.

12 TERMINALS

12.1 General

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

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

All the tests on terminals, with the exception of the test of 12.3.11 shall be carried out after the test of 15.

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

12.2 Terminals with screw clamping for external copper conductors.

12.2.1 Switches shall be provided with terminals which shall allow the proper connection of copper

conductors having nominal crosssectional areas as shown in Table 2.

The conductor space shall be at least that specified in Fig. 4, 5, 6, 7 and 8.

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

12.2.2 Terminals with screw clamping shall allow the conductor to be connected without special preparation. Compliance is checked by inspection.

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

12.2.3 Terminals with screw clamping shall have adequate mechanical strength.

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

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

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

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

12.2.4 Terminals with screw clamping shall be resistant to corrosion.

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

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

Table 2
(Clause 12.2.1)

Ranges of Rated Currents	Rigid Conductor (Solid or Stranded) ¹⁾	
	Nominal Cross- Sectional Area mm ²	Diameter of Largest Conductor mm
A		
Up to and including 4 ²⁾		
Above 4 up to and including 6	From 0.75 up to 1.5 inclusive	1.45
Above 6 up to and including 10 ³⁾	From 1 up to 2.5 inclusive	2.13
Above 10 up to and including 16 ³⁾	From 1.5 up to 4 inclusive	2.72
Above 16 up to and including 25	From 2.5 up to 6 inclusive	3.34
Above 25 up to and including 32	From 4 up to 10 inclusive	4.34
Above 32 up to and including 40	From 6 up to 16 inclusive	5.46
Above 40 up to and including 63	From 10 up to 25 inclusive	6.85

¹⁾ The use of flexible conductors is permitted.

²⁾ For special purposes such as extra-low voltage applications, where flexible conductors are used (from 0.5 mm² up to 1 mm² inclusive).

³⁾ Each supply terminal of switches, other than those of pattern numbers 3, 03 and 7, shall allow the connection of two 2.5 mm² conductors. For switches having a rated voltage not exceeding 250V, a round hole is sufficient for the connection of two 2.5 mm² conductors.

IS 3854 : 1997

Compliance is checked by the following test:

The terminals is fitted with 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 Fig. 3, 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 pull having a value shown in Table 3.

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

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

The test is repeated with rigid solid conductors, in the case where they exist in the relevant Indian Standard, if the first test has been made with rigid Stranded conductor. In the case where rigid Standard conductors do not exist, the test is made with rigid solid conductors only.

12.2.6 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 stranded conductors of the smallest and largest cross-sectional areas specified in Table 2, the terminals 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 conductors, the appropriate pull is applied consecutively to each conductor.

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

The test is repeated with rigid solid conductors in the case where they exist in the relevant Indian Standard, if the first test has been made with rigid stranded conductors. In the case where rigid stranded conductors do not exist, the test is made with rigid solid conductors only.

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

This requirement does not apply to lug terminals.

Compliance is checked by the following test:

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.

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

Table 4
(Clause 12.2.7)

Cross-Sectional Area mm ²	Number of Wires and Nominal Diameter of Wires mm	
	Solid Conductor	Stranded Conductor
1	1 × 1.13	7 × 0.42
1.5	1 × 1.38	7 × 0.52
2.5	1 × 2.78	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
25		7 × 2.14

Before insertion into the clamping means of the terminals, 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.

The conductor is inserted into the clamping means of the terminal for the minimum distance prescribed or,

Table 3
(Clauses 12.2.5 and 12.2.6)

Cross Section of Conductor Accepted by Terminals (mm ²)	0.5 up to 0.75 inclusive	0.75 up to 1.5 inclusive	1.5 up to 2.5 inclusive	2.5 up to 4.0 inclusive	0 up to 6.0 inclusive	6.0 up to 10.0 inclusive	10.0 up to 16.0 inclusive	16.0 up to 25.0 inclusive
Pull (N)	30	40	50	50	60	80	90	100

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 clamping unit.

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

NOTES

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

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

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

—the effectiveness of the sealing compound or resin is not impaired by temperatures attained by the terminal under the most unfavourable conditions specified in this 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.

Screw 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 Fig. 4 to 7, whichever is the highest.

Table 5
(Clauses 12.2.5 to 12.2.8)

Nominal Diameter of Thread (mm)	Torque (Nm)					
	1	2	3	4	5	6
Up to and including 2.8	0.2	—	0.4	—	0.4	—
Over 2.8 up to and including 3.0	0.25	—	0.5	—	0.5	—
Over 3.0 up to and including 3.2	0.3	—	0.6	—	0.6	—
Over 3.2 up to and including 3.6	0.4	—	0.8	—	0.8	—
Over 3.6 up to and including 4.1	0.7	1.2	1.2	1.2	1.2	—
Over 4.1 up to and including 4.7	0.8	1.2	1.8	1.8	1.8	—
Over 4.7 up to and including 5.3	0.8	1.4	2.0	2.0	2.0	—
Over 5.3 up to and including 6.0	—	1.8	2.5	3.0	3.0	—
Over 6	—	—	—	—	—	0.8

NOTE — The above values are provisional.

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

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

NOTES

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

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

3 The screw and nuts must not be tightened in jerks.

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

Compliance is checked by manual test.

In general, the designs of terminals shown in Fig. 4, 5, 6, 7 and 8, provide sufficient resiliency to comply with this requirement:

for other designs, special provisions, such as the use of an adequately resilient part which is not likely to be removed inadvertently, may be necessary.

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

IS 3854 : 1997

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 enclosure, when the screw or nut shall be of brass or other metal no less resistant to corrosion.

If the body of the earthing terminal is a part of a frame or enclosure of aluminium alloy, precautions shall be taken to avoid the risk of corrosion 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.

12.2.11 For pillar terminals, the distance between the clamping screw and the end of the conductor, when fully inserted, shall be at least that specified in Fig. 4.

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 Fig. 8.

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

12.2.12 Lug terminals shall be used only for switches having a rated current of 40 A 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.

12.3 Screwless terminals for external copper conductors.

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

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

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

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

12.3.2 Screwless terminals shall be provided with clamping units which allow the proper connection of

rigid or of rigid and flexible copper conductors having nominal cross-sectional areas as shown in Table 6.

Table 6
(Clause 12.3.2)

Rated Current A	Conductors		
	Nominal Cross-Sectional Areas mm ²	Diameter of Largest Rigid Conductor ¹⁾ mm	Diameter Largest Flexible Conductor ¹⁾ mm
4	0.75-1	1.19	—
6	1-1.5	1.45	1.73
10 ²⁾	1.5-2.5	2.13	2.21

The diameters shown in the table are 5 percent larger than the diameters according to IS 10462 (Part 1) 1983, for the conductors with the largest nominal cross-sectional area.

¹⁾ Each supply terminals of switches other than those of pattern numbers 3, 03 and 7 shall allow the connection of two 2.5 mm² conductors. In such a case terminal for rated current 10 A with separate independent clamping means for each conductor shall be used.

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

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

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

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

Compliance is checked by inspection and by chemical analysis.

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

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

The conductor shall be clamped between metal surfaces.

Compliance is checked by inspection and by the test of 12.3.10

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

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

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

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

- during the insertion, the operation of the clamping means of one of the conductors is independent of the operation of that of the other conductors(s)
- during the disconnection, the conductors can be disconnected either at the same time or separately
- 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.

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

NOTE — 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 terminals may be put on the switch or given in an instruction sheet which accompanies the switch.

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

12.3.9 Screwless terminal shall be properly fixed to the switch. They shall not work loose when the conductors are connected or disconnected during installations.

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

Covering of 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.

12.3.10 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 specimen, using a new specimen for each test.

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

Conductors are connected and disconnected five times, new conductors being used each time, except for the fifth time, when the conductors used for the

fourth connection are clamped at the same place. For each connection the conductors are either pushed as far as possible into the terminal or are connected so that adequate connection is obvious.

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

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

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

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

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

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

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

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

Both tests are carried out with new copper conductors.

- a) The test is carried out loading the screwless terminals for 1 h with an alternating current as specified in Table 7, 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 7

Rated Current	Test Current	Cross-Sectional Area of the Conductor
A	A	mm ²
4	9	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.

IS 3854 : 1997

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 manufacturer, care shall be taken not to affect the behavior 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 of Item (a) are tested as follows:

During the test, a current equal to the test current value given in Table 7 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, continuously each cycle having a duration of approximately 1 h and being carried out as follows:

- the current is flowing for approximately 30 min, and
- for a further 30 min approximately no current is flowing.

The voltage drop in each screwless terminal is determined as prescribed for the test of (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 two times the value measured after the 24th cycle, whichever is the smaller.

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

Furthermore, the mechanical strength test according to 12.3.10 is repeated and all samples shall withstand this test.

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

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

The test apparatus, the principle of which is shown in Fig. 9 A, shall be so constructed that:

A specified conductor properly inserted into a terminal is allowed to be deflected in any of the 12 directions differing from each other by 30° , with a tolerance referred to each direction of $\pm 5^\circ$.

The starting point can be varied by 10 and 20 from the original point.

NOTE — A reference point need not be specified.

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

The deflecting device shall be so designed that:

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

Provision shall be made so that the voltage drop across the clamping unit under test can be measured when the conductor is connected, as shown for example in Fig. 9 B.

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

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

NOTES

- 1 If necessary, the inserted conductor may be permanently bent around obstacles, so that these do not influence the results of the test.
- 2 In some cases, with the exception of the case of guidance for the conductor, it may be advisable to remove those parts of the samples which do not allow the deflection of the conductor corresponding to the force to be applied.

A clamping unit is fitted as for normal use with a rigid solid copper conductor having the smallest cross-sectional area specified in Table 8 and is submitted to a first test sequence; the same clamping unit is submitted to a second test sequence using the conductor having the largest cross-sectional area, unless the first test sequence has failed.

The force for deflecting the conductor is specified in table 9, the distance of 100 mm being measured from the extremity of the terminal, including the guidance,

if any, for the conductor, to the point of application of the force to the conductor.

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

Table 8
(Clause 12.3.12)

Rated Current of the Switch A	Cross-sectional Area of the Test Conductor mm ²	
	1st Test Sequence	2nd Test Sequence
≤ 6	1.0	1.5
10	1.5	2.5

A test current equal to the rated current of the switch is passed through the clamping unit under test. A force according to Table 9 is applied to the test conductor inserted in the clamping unit under test in the direction of one of the 12 directions shown in Fig. 9 A and the voltage drop across this clamping unit is measured. The force is then removed.

Table 9
(Clause 12.3.12)

Cross-sectional Area of the Test Conductor mm ²	Force for Deflecting the Test Conductor ¹⁾ N
1.0	0.25
1.5	0.5
2.5	1.0

¹⁾ The forces are chosen so that they stress the conductors close to the limit of elasticity.

The force is then applied successively in each of the remaining 11 direction shown in Fig. 9 A following the same test procedure.

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

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

13 CONSTRUCTIONAL REQUIREMENTS

13.1 Insulating lining, 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 20.

13.2 Switches shall be so constructed as to permit:

- easy introduction and connection of the conductors in the terminals
- correct positioning of the conductor
- easy fixing of the switch to a wall as in a box
- 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 switches, the insulation 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 switches shall be constructed so that the fixing means do not damage the insulation of the cables during the installation.

NOTES

- 1 This requirement does not imply that the metal parts of the terminals are necessarily protected by insulating barriers or insulating shoulders, to avoid contacts, due to incorrect installation of terminal metal parts with the insulation of the conductor.
- 2 For surface-type switches, mounted on a mounting plate, wiring channel may be needed to comply with this requirement.

In addition, switches classified as design A shall permit 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, for the relevant range of rated currents in Table 2.

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

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

NOTES

- 1 It is recommended that the fixing of covers, cover plates or actuating members be captive. The use of tight fitting washers of cardboard or the like is deemed to be an adequate method for securing screws intended to be captive.
- 2 Non-earthed metal part separated from live parts in such a way that creepage distances and clearances have values specified in Table 19, are not considered as accessible if the requirements of this sub-clause are met.

IS 3854 : 1997

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

Compliance with the requirements of safety and construction is checked according to 13.3.1, 13.3.2 or 13.3.3.

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

- by inspection only.

13.3.2 For covers, cover plates or actuating members whose fixing is not dependent on screws and whose removal is obtained by applying a force in a direction approximately perpendicular to the mounting/supporting surface (see Table 10).

- when their removal may give access, with the standard test finger, to live parts the test of 20.4
- when their removal may give access, with the standard test finger, to non-earthed metal parts separated from live parts in such a way that creepage distances and clearances have the values shown in Table 19
- by the test of 20.5
- when their removal may give access, with the standard test finger, only to
 - insulating parts, or
 - earthed metal parts, or
 - metal parts separated from live parts in such a way that creepage distances and clearances have twice the values shown in Table 19, or
- live parts of SELV circuits not greater than 25 V a.c.: by the test of 20.6.

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

- by the same tests of 13.3.2 except that the covers, cover plates, actuating members or parts of them need not come out when applying a force not exceeding 120 N in directions perpendicular to the mounting/supporting surface.

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

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

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

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

The knob is subjected for 1 min 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 detached.

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

13.7 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.

Table 10
(Clause 13.3.2)

Accessibility With the Test Finger After Removal of Covers, Cover Plates or Parts of Them	Test According to	Force to be Applied N			
		Switches Complying with 20.7 and 20.8		Switches not Complying with 20.7 and 20.8	
		Shall not come off	Shall come off	Shall not come off	Shall come off
To live parts	20.4	40	120	80	120
To non-earthed metal parts separated from live parts by creepage distances according to Table 19	20.5	10	120	20	120
To insulating parts, earthed metal parts, the live parts of SELV ≤ 25 V a.c. or metal parts separated from live parts by creepage distances and by clearances twice those according to Table 19	20.6	10	120	10	120

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

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

13.8 Accessories combined with switches shall comply with the relevant standards, if any, unless a standard exist for the combination.

13.9 Switches other than ordinary shall be totally enclosed when fitted with screwed conduits or with polyvinyl chloride (P.V.C.) 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 mm² in area with a width and a length of at least 3 mm.

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

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

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

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

13.10 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, for the relevant current rating, in Table 2.

13.11 Surface type switches, other than ordinary, of pattern numbers 1, 5 and 6 with an enclosure having more than one inlet opening shall be provided for maintaining the continuity of a second current-carrying conductor either with a fixed additional terminal complying with the appropriate requirements of 12 or with an adequate space for a floating terminal.

Compliance is checked by inspection and by the relevant tests of 12.

13.12 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 enclosure.

In surface-type switches, the inlet opening for conduit entries, 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 or a combination of at least two of any of these sizes not exceeding two of the same size.

Compliance is checked by inspection during the test of 13.10 and by measurement.

In surface type switches the inlet opening for cable entries shall preferably be capable of accepting cables having the dimensions specified in Table 11 or be so as specified by the manufacturer.

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

13.13 If ordinary surface-type switches are intended for back entry from a conduit they shall be so designed that they have provision for back entry from a conduit perpendicular to the mounting surface of the switch.

Compliance is checked by inspection.

13.14 If the switch is provided with membranes or the like for inlet openings they shall be replaceable. Compliance is checked by inspection.

13.15 Requirements for membranes in inlet openings.

13.15.1 Membranes shall be reliable fixed and shall not be displaced by the mechanical and 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 15.1.

The switches are then placed for 2 h in a heating cabinet as described in 15.1, the temperature being maintained at $40 \pm 2^\circ\text{C}$.

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 of the same dimensions as the standard test finger shown in Fig. 2.

During these tests, the membranes shall not deform to such an extent that the 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.

IS 3854 : 1997

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

13.15.2 It is recommended that membranes be so designed and made of such material that the introduction of the cables into the switch is permitted 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 $-15 \pm 2^\circ\text{C}$.

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 13.5.1 and 13.15.2, the membranes shall show no harmful deformation, cracks or similar damage which would lead to non-compliance with this standard.

14 MECHANISM

14.1 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.

14.2 Switches shall be so constructed that the moving contacts can come to rest only in the "on" and "off" positions, an intermediate position being, however, permissible if it corresponds to the intermediate position of the actuating member, and if the insulation between the fixed and the moving contacts is then adequate.

If necessary, the insulation between the fixed and the moving contact, when in an intermediate position, is checked by an electric strength test as specified in 16.2, the test voltage being applied between the relevant terminals without removing the cover or cover plate of the switch.

Compliance with the requirements of 14.1 and 14.2 is checked by inspection and by manual test.

14.3 Switches shall be so constructed that undue arcing cannot occur when the switch is operated slowly.

Compliance is checked at the end of the test of 19, breaking the circuit a further ten times, the actuating member being, however, moved steadily by hand over a period of 2 s and moving contacts being stopped, if possible, in an intermediate position, the actuating member being then released.

During the test, no sustained arcing shall occur.

Table 11
(Clause 13.12)

Rated Current A	Cross-Sectional Area of Conductors mm ²	Number of Conductors	Limits of External Diameters or Dimensions of Cables mm	
			Min	Max
6	0.75 up to and including 1.5	2	3.2x5.2 5.2	3.9x6.4 11.5
10	1 up to and including 2.5	2	6.4	13.5
		3		14.5
		4		15.5
16	1.5 up to and including 4	2	7.4	15
		3		16
		4		18
20-25	2.5 up to and including 6	2	8.9	18.5
		3		20
		4		22
32	4 up to and including 10	2	10.5	24
		3		25.5
		4		28
40	6 up to and including 16	2	11.5	27.5
		3		29.5
		4		32
63	10 up to and including 25	2	14.5	31.5
		3		34
		4		37.5

NOTE — The limits of external dimensions of cables specified in this table are based on IS 694 : 1990 and IS 9968 (Part 1) : 1988.

14.4 Switches of pattern No. 2, 3, 03 and 6/2 shall make and break all poles substantially simultaneously except that for switches of pattern No. 03, the neutral shall not make after or break before the other poles. Compliance is checked by inspection and by manual test.

14.5 The action of the mechanism if the cover plates are removable for installation purposes shall be independent of the presence of the cover or cover plate.

NOTE — The actuating member, in some constructions, may constitute the cover.

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

During the test the lamp shall not flicker.

14.6 Cord-operated switches shall be capable of effecting a change from the "off" position by application and removal of a steady pull not exceeding 45 N applied vertically and 65 N applied at $45 \pm 5^\circ$ to the vertical and in a plane perpendicular to the mounting surface when the switches are mounted as in normal use.

Compliance is checked by manual test.

NOTE — The wording 'as in normal use' implies that the switch is mounted as specified by the manufacturer.

15 RESISTANCE TO AGEING, TO HARMFUL INGRESS OF WATER AND TO HUMIDITY

15.1 Resistance to Ageing

Switches shall be resistant to ageing.

Compliance is checked by the following test:

Switches and boxes, mounted as for 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 15.2

The temperature in the cabinet is $70 \pm 2^\circ\text{C}$.

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

The use of an electrically heated cabinet is recommended.

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

After the treatment, the specimens are removed from the cabinet and kept at room temperature and at a relative humidity between 45 percent and 55 percent for at least four days (96 h).

The specimens shall show no crack visible with normal or correct vision without additional magnification, nor

shall the material have become sticky or greasy, this being judged as follows:

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

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

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

NOTE — The force of 5 N can be obtained in the following way:

The specimen 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 specimen plus 500 g.

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

15.2 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 following test.

15.2.1 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 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 enclosures 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 20.3.

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

Glands are not filled with sealing compound or the like.

15.2.2 Splash-proof switches are subjected to the test specified for the degree of protection IPX4 according to the requirements of IS 12063.

15.2.3 Jet-proof switches are subjected to the test specified for the degree of protection IPX5 according to the requirements of IS 12063.

IS 3854 : 1997

Immediately after the tests specified in 15.2.2 and 15.2.3, the specimens shall withstand an electric strength test as specified in 16.2 and inspection shall show that water has not entered the samples to any appreciable extent and has not reached live parts.

15.3 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 16.

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 percent and 95 percent.

The temperature of the air in which the specimens are placed is maintained within ± 1 K of any convenient value between 15°C and 35°C.

Before being placed in the humidity cabinet, the specimens are brought to a temperature between t and $t + 4$ K.

The specimens are kept in the cabinet for:

- 2 days (48 h) for ordinary switches
- 7 days (168 h) for switches other than ordinary

NOTES

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

2 A relative humidity between 91 percent and 95 percent can be obtained by placing in the humidity cabinet a saturated solution of sodium sulphate (Na_2SO_4) or potassium nitrate (KNO_3) in water having a sufficient large contact surface with the air.

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 specimens shall show no damage within the mean of this standard.

16 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 15.3 in the humidity cabinet or in the room in which the specimens were brought to the prescribed temperature, after reassembly of those parts which can be removed without the aid of tool and were removed for the test.

16.1 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 12 the switch positions and the connections necessary for items 1, 2 and 3 (see Table 13) being as shown in Table 12.

IS 3854 : 1997

Table 12
(Clause 16.1)

Pattern Number	Diagrams of Connections	Position	Application of Voltage ^{*)}	
			terminal n ^o	between and body (B) together with terminal 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

^{*)} - denotes an existing electrical connection.

+ denotes an electrical connection made for the test.

IS 3854 : 1997

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* 10.4).

For the measurements according to Items 1 and 2, the metal foil is applied in such a way that sealing compound is effectively tested.

The test according to Item 5 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 13.

NOTE— 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 the standard test finger shown in Fig. 2.

16.2 The insulation is subjected for 1 min to a voltage of substantially sine wave form, having a frequency of 50 Hz. The value of the test voltage and the points of application are shown in Table 13.

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.

NOTES

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 100 mA.

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

3 Care is taken that the r.m.s. value of the test voltage applied is measured within ± 3 percent.

4 Glow discharges without drop in voltage are neglected.

16.3 Flash Test

As a routine test, the high voltage test may be carried out in the form of flash test, an ac voltage of 2 000 V rms being applied for a period of 1 second between the parts specified in Table 13.

Table 13
(Clauses 16.1 to 16.3)

Sl No.	Insulation to be Tested	Minimum Value of Insulation Resistance	Test Voltage V	
			Switches Having a Rated Voltage not Exceeding 110 V	Switches Having a Rated Voltage Exceeding 110 V
		M		
i)	Between all poles connected together and the body with the switch in the 'on' position	5	1 250	2 000
ii)	Between each pole in turn and all other poles connected to the body, with the switching the 'on' position	2	1 250	2 000
iii)	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	2 000
iv)	Between metal parts of the mechanism, when insulated from live parts, and			
	— live parts	5	1 250	2 000
	— metal foil in contact with the surface of the knob or a similar actuating member	5	1 250	2 000
	— the key of key-operated switches, if insulation is required (<i>see</i> 10.6)	5	1 250	2 000
	— the point of anchorage of the cord, chain or rod if the switches operated by such means, if insulation is required (<i>see</i> 10.6)	5	1 250	2 000
	— accessible metal parts, including fixing screws, of the base, if insulation is required (<i>see</i> 10.5)	5	1 250	2 000
v)	Between any metal enclosure and metal foil in contact with the inner surface of its insulation linings if any ¹⁾	5	1 250	2 000
vi)	Between live parts and accessible metal parts, if the metal parts of the mechanism are not insulated from live parts	—	1 250	3 000
vii)	Between live parts and parts of the mechanism:			
	— if the latter parts are not insulated from accessible metal parts (<i>see</i> 10.5)	—	1 250	3 000
	— if the latter parts are not insulated from the point of contact with a removable key or operating cord, chain or rod (<i>see</i> 10.2)	—	1 250	3 000
viii)	Between live parts and metal knobs, push buttons and the like (<i>see</i> 10.2)	—	1 250	4 000

¹⁾

This test is made only if any insulation is necessary.

17 TEMPERATURE RISE

17.1 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 P.V.C. insulated copper conductors as specified in Table 14, the terminal screws or nuts being tightened with a torque equal to two-thirds of that specified in Table 5.

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

NOTE — 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 14.

Table 14
(Clause 17.1)

Rated Current Area of Conductors A	Test Current A	Nominal Cross-Sectional Area of Conductors mm ²
1	1.5	0.5
2	3	0.75
4	5	1.0
6	8	1.5
10	13.5	2.5
16	20	4.0 ¹⁾
20	25	4.0
25	32	6.0
32	38	10.0
40	46	16.0
63	75	25.0

¹⁾For switches having a rated voltage not exceeding 250 V, other than those of pattern numbers 3 and 03, and when terminals of rated current 10 A are used, the test shall be carried out with conductors having a cross-sectional area of 2.5 mm².

NOTE — The test currents for switches having other rated currents are determined by interpolation between the next lower and higher ratings.

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

Flush-mounted switches are mounted in flush-mounted boxes. The box is placed, in a block of pinewood filled around the box with plaster, so that the front edge of the box does not protrude and is not more than 5 mm below the front surface of the pinewood block.

NOTE — The test assembly should be allowed to dry for at least 7 days when first made.

The size of the pinewood block, which may be fabricated from more than one piece, shall be such that there is at least 25 mm of wood surrounding the plaster, the plaster having a thickness between 10 mm and 15 mm around the maximum dimensions of the sides and rear of the box.

NOTE — The sides of the cavity in the pinewood block may have a cylindrical shape.

The cables connected to the switch shall enter through the top of the box, the point(s) of entry being sealed to prevent the circulation of air. The length of each conductor within the box shall be 80 mm ± 10 mm.

Surface-type switches shall be mounted centrally on the surface of a wooden block, which shall be at least 20 mm thick, 500 mm wide and 500 mm high.

Other types of switches shall be mounted according to the manufacturer's instructions or, in the absence of such instructions, in the position of normal use considered to give the most onerous conditions.

The test assembly shall be placed in a draught-free environment for the test.

The temperature is determined by means of melting particles, colour changing indicators or thermocouples, 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 rise necessary to perform the test of 21.3 shall be determined.

NOTES

- 1 Undue oxidation of the contacts may be prevented by sliding action or by the use of silver or silver-faced contacts.
- 2 Pellets of beeswax (melting-point 65° C or) with a diameter of 3 mm may be used as melting particles.
- 3 In case of combination of switches, the test is carried out separately on each switch.

18 MAKING AND BREAKING CAPACITY

Switches shall have adequate making and breaking capacity.

Compliance is checked by the test of 18.1 and for, switches having a rated current not exceeding 16 A and having a rated voltage up to and including 250 V, and for switches of pattern No. 3 and No. 03 and rated voltage over 250 V, by the additional tests of 18.2.

Cord-operated switches shall be tested mounted as in normal use and with a pull of a value adequate to operate the cord-operated switch, but not exceeding 50 N, on the cord throughout the test, at 30 ± 5° to the vertical in a plane perpendicular to the mounting surface.

The tests are made by means of an apparatus the principle of which is as shown in Fig. 10.

IS 3854 : 1997

The connections are as shown in Fig. 13.

Switches are fitted with conductors as for the test of 17.

18.1 Switches are tested at 1.1 times rated voltage and 1.25 times rated current. They are subjected to 200 operations at a uniform rate of:

- 30 operations per minute, if the rated current does not exceed 10 A
- 15 operations per minute, if the rated current exceeds 10 A, but is less than 25 A
- 7.5 operations per minute, if the rated current is 25 A or more

For rotary switches intended to be operated in either direction, the actuating member is turned in one direction for half the total number of operations and in the reverse direction for the remainder.

Switches for a.c. only are tested with a.c. ($\cos \Phi 0.3 \pm 0.05$). Resistors and inductors are not connected in parallel, except that, if an air-core inductor is used a resistor taking approximately 1 percent of the current through the inductor is connected in parallel with it.

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

For three-phase tests, three-core inductors are used.

The selector switch S_1 , connecting the metal support and accessible metal parts of the switch to the pole, is moved after the fractions of the total number of operations indicated in Table 15.

For switches of pattern numbers 6, 6/2 and 7, the selector switch S_2 shown in Fig. 13, is moved after the fraction of the total number of operations indicated in Table 15.

Table 15

Pattern Number	Type of Switch	Fractions for Switch S_1	Fractions for Switch S_2
1, 2, 4 or 5	Rotary, both directions	1/4 & 3/4	—
	Other types	1/2	—
3 or 03	Rotary, both directions	1/6, 2/6, 3/6, 4/6, & 5/6	—
	Other types	1/3 & 2/3	—
6.6/2 or 7	Rotary, both directions	1/8, 3/8, 5/8 & 7/8	1/4 & 3/4
	Other types	1/4 & 3/4	1/2

Switches of pattern number 5 with a single mechanism are operated 200 times with one circuit loaded with rated current (I_n) and the other with 0.25 I_n . In and 200 times with each circuit loaded with 0.625 I_n .

Switches of pattern number 5 with two independent mechanisms are tested as two switches of pattern number 1, the tests being made consecutively.

While testing one part, the other part is in the 'off' position.

During the test no sustained arcing shall occur.

After the test, the samples shall show no damage which may impair their further use.

Breakage of the replaceable pull cord, not involving the part entering the cord operated switch, shall not be considered a failure to pass the test.

NOTES

1 Care is taken that the test apparatus causes the actuating member of the switch to operate smoothly and does not interfere with the normal action of the switch mechanism and the free movement of the actuating member.

2 During the test, the specimens are not lubricated.

Switches are normally tested at rated voltage and 1.2 times the rated current.

18.2 The test is carried out by using a number of 200 W tungsten filament lamps.

If filament lamps with rated voltage equal to the rated voltage of the switch are not available, filament lamps with the nearest lower voltage shall be used.

NOTE — It is recommended that the rated voltage of the filament lamps be not lower than 95 percentage of the rated voltage of the switch.

The test voltage shall be the rated voltage of the lamps. The number of lamps shall be the smallest number giving a test current not less than 1.2 times the rated current of the switch.

Available short-circuit current shall be at least 1 500 A. The other conditions shall be as specified in 18.1.

During the test no sustained arcing shall occur.

NOTE — Sticking of the contacts, which does not prevent the next operation of the switch is not considered as welding.

After the test, the sample shall show no damage which may impair its further use.

NOTE — Example: 10 A 250 V switches have to be tested.

The largest available rated voltage of 200 W tungsten filament lamps is 240 V.

The test voltage shall then be 240 V and the number of lamps:

$$240 \times 1.2 \times 10/200 = 14.4 - 15$$

19 NORMAL OPERATION

19.1 Switches shall withstand, without excessive wear or other harmful effect, the mechanical, electrical and thermal stresses occurring in normal use.

Compliance is checked by the following test:

The switches are tested at rated voltage and rated current in the apparatus and with the connections specified in 18.1. The tolerances for the test voltage is $+5_0$ percent.

The circuit details and the manner of operation of the selector switches S1 and S2 are as described in 18.1 unless otherwise specified.

The number of operations is as shown in Table 16.

Table 16

Rated Current	Number of Operations
Up to and including 16 A, for switches having a rated voltage not exceeding 250 V a.c. except pattern numbers 3 and 03.	40 000
Up to and including 16 A, for switches having a rated voltage exceeding 250 V a.c. and for pattern numbers 3 and 03	20 000
Over 16 A up to and including 40 A	10 000
Over 40 A	5 000

The rate of operations is as specified in 18.1.

The period shall be 25 percent $+5_0$ percent of the total cycle and the off period 75 percent on $+5_0$ percent.

For rotary switches of pattern number 5 intended to be operated in either direction, the actuating member is turned in one direction for half the total number of operations and in the reverse direction for the remainder.

For rotary switches of pattern numbers 1, 2 and 4 intended to be operated in either direction, the selector switch S1 is moved after 3/8 and 7/8 of the total number of operations.

For other rotary switches intended to be operated in either direction, 3/4 of the total number of operations is effected in the clockwise direction, and the remainder in the reverse direction.

Cord operated switches shall be tested mounted as in normal use and with a pull of a value adequate to operate the cord-operated switch but not exceeding 50 N, on the cord through out the test at $30 \pm 5^\circ$ to the vertical and in a plane perpendicular to the surface.

Switches are tested with a.c. ($\cos \Phi$ 0.6 \pm 0.05).

Switches of pattern No. 2 are tested for the first set of three specimens with the poles connected in series.

For the second set of three specimens only one pole is tested at full load at half the number of operations. If the two poles are not identical, the test has to be repeated for the other pole.

The two poles of switches of pattern No. 4 and No. 5 are tested as two switches of pattern No. 1. If the two poles are identical, only one pole needs to be tested.

For switches of pattern No. 5 with a single mechanism, each circuit is loaded with 0.5 times rated current.

Switches of pattern No. 6 shall be tested for half the number of operations on one pole and half the number of operations for the other pole.

Switches of pattern No. 6/2 are tested as one switch of pattern No. 6. if the two pairs of poles are identical. Otherwise, as two switches of pattern No. 6.

Switches of pattern No. 7 are tested as a double switch of pattern No. 6 while testing one part, the other part is in the 'off' position.

The test specimens shall be connected to the test circuit with cables of length 0.3 ± 0.015 m so that the temperature rise measurement can be made without disturbing the terminals.

During the test, the specimens shall function correctly.

After the test, the specimens shall withstand an electric strength test as specified in 16, the test voltage of a nominal 4 000 V being reduced by a nominal 1 000 V, and the other test voltages by a nominal 500 V, and a temperature rise test as specified in 17, the test current being however reduced to the value of the rated current.

Specimen shall then not show:

- Wear impairing their further use;
- discrepancy between the position of the actuating member and that of the moving contacts, if the position of the actuating member is indicated;
- deterioration of enclosures, insulating linings or barriers to such an extent that the switch can not be further operated or that the requirements of 10 are no longer complied with;
- loosening of electrical or mechanical connections;
- seepage of sealing compound; and
- relative displacement of the moving contacts of switches of pattern numbers 2,3 or 03, 6/2.

NOTES

1 The humidity treatment as per 16.2 is not repeated before the electric strength test of this sub-clause.

2 During the test, the samples are not lubricated.

The test is followed by the test of 14.3.

19.2 Switches intended for fluorescent lamp loads shall withstand, without excessive wear or other harmful effect, the electrical and thermal stresses occurring when controlling fluorescent lamp circuits with power factor correction, with load inserted between the test circuit terminals as indicated in Fig. 14.

Compliance is checked by the following test.

For the test, new specimens are used.

The switches, except switches of pattern No. 3 and 03, are tested at rated voltage and rated current in the apparatus and with the connections specified in 18.1.

IS 3854 : 1997

The tolerance for the test voltage is $+5_0$ percent and for test current is $+5_0$ percent. The circuit details and the manner of operations of the selector switches S_1 and S_2 are as described in 18.1, unless otherwise specified. However, for rotary switches of pattern No. 1, 2 and 4 intended to be operated in either direction, the selector switch S_1 is moved after $3/8$ and $7/8$ of the total number of operations.

The number of operations is as follows.

For switches with a rated fluorescent lamp current of 6 A up to and including 10 A : 10 000 operations with 30 operations per minute.

For switches with rated current above 10 A up to and including 20 A : 5 000 operations with 15 operations per minute.

For rotary switches of pattern No. 5 intended to be operated in either direction, the actuating member is turned in one direction for half the total number of operations and in the reverse direction for remainder.

For other rotary switches intended to be operated in either direction, $3/4$ of the total number of operations is effected in the clockwise direction, and the remainder in the reverse direction.

Cord-operated switches shall be tested mounted as in normal use and with a pull of a value adequate to operate the cord-operated switch but not exceeding 50 N, on the cord throughout the test at $30 \pm 5^\circ$ to the vertical and in a plane perpendicular to the mounting surface.

Switches of pattern No. 2 are tested for the first set of three specimens with the poles connected in series.

For the second set of three specimens only one pole is tested for the full load at half the number of operations.

If the two poles are not identical the test has to be repeated for the other pole.

The two poles of switches of pattern No. 4 and 5 are tested as two switches of pattern No. 1. If the poles are identical, only one pole needs to be tested.

Switches of pattern No. 6 shall be tested for half the number of operations on one pole and half of the number of operations for the other pole.

Switches of pattern No. 6/2 are tested as one switch of pattern No. 6. If the two pairs of poles are identical. Otherwise, as two switches of pattern No. 6.

Switches of pattern No. 7 are tested as a double switch of pattern No. 6.

The sample shall be connected to the test circuit with cables of length 0.3 ± 0.015 m so that the temperature rise measurement can be made without disturbing the

terminals. The load shall be as specified in Fig. 14, load A.

The load shall, after the specified number of operations, be substituted by load B in Fig. 14 and the switches shall be tested with 100 operations in that circuit at the rated voltage.

All the conductive parts of the switch normally earthed in service, including the metal support on which the switch is mounted or any accessible part shall be connected to one supply conductor for half the number of operations and the other supply conductor for the rest.

This connection shall include a copper wire, F, of 0.1 mm nominal diameter and not less than 50 mm in length for the detection of the fault current, and, if necessary, a resistor R_1 limiting the value of the prospective fault current to about 100 A.

During this test, the switch shall be operated so that the test apparatus does not interfere with the normal action of the switch mechanism and the free movement of the actuating member. There shall be no forced actuation. The on-period shall be 25^{+5}_0 percent of the total cycle and the off-period 75^{+5}_0 percent.

During the test the copper wire, F, shall not melt and the specimens shall function correctly. No sustained arcing nor welding of the contacts shall occur.

Sticking of contacts is permitted if the contacts can be separated with a force applied to the actuator of a value which does not damage the switch mechanically.

After the test, without disturbing the connections of the specimen under test, a temperature rise measurement is performed as specified in 17, using a test current with a value equal to the value of the rated current. The temperature rise of the terminals shall not exceed 45 K. After the tests, it shall also be possible to make and break the switch by hand in the test circuit and the specimen shall not show:

- wear impairing further use
- discrepancy between the position of the actuating member and that of the moving contacts, if the position of the actuating member is indicated
- deterioration of the enclosures, insulating lining or barriers to such an extent that the switch cannot be further operated or that the requirements of 10 are no longer complied with
- loosening of electrical or mechanical connections
- seepage of sealing compound
- relative displacement of the moving contacts of switches of pattern No. 2, 3 or 6/2

- breakage of the replaceable pull cord, not involving the part entering the cord-operated switch, shall not be considered a failure to pass the test

20 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:

For switches 20.1 and 20.2

For boxes 20.1

For screwed glands of switches other than ordinary 20.3

NOTE — Combinations of switches or of switches and socket-outlets shall be tested in the following way:

- in case of one common cover, like a single product, and
- in case of separate covers, like separate products.

20.1 The samples are subjected to blows by means of an impact-test apparatus as shown in Fig. 15, 16, 17 and 18.

The striking element has hemispherical face of 10 mm radius, made of polyamide having a Rockwell hardness of HR 100, 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 $1\ 000 \pm 1$ mm above the axis of the striking element.

The Rockwell hardness of the polyamide striking element is determined by using a ball having a diameter of 12.700 ± 0.0025 mm, the initial load being 100 ± 2 N and the extra load 500 ± 2.5 N.

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 specimen 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 rigid frame by means of pivots. The frame is fixed to a solid wall.

The designs of the mounting is such that:

- the specimen can be so placed that the point of impact lies in the vertical plane through the axis of the pivot

- the specimen can be removed horizontally and turned about an axis perpendicular to the surface of the plywood
- the plywood can be turned 60° in both direction 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.

For flush-type switches the specimen is mounted in a recess provided in a block of hornbeam or similar material, which is fixed to a sheet of plywood and not in its relevant mounting box. If wood is used for the block, the direction of the wood fibres shall be perpendicular to the direction of the impact.

Flush-type screw fixing switches shall be fixed by means of screws to lugs recessed in the hornbeam block. Flush-type claw fixing switches shall be fixed to the block 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 specimen 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 which is specified in Table 17:

Table 17

Height of Fall mm	Parts of Enclosures to be Subjected to the Impact	
	Ordinary Accessory	Other Accessory
100	A and B	—
150	C	A and B
200	D	C
250	—	D

where:

- A = Parts on the front surface, including the parts which are recessed;
- B = Parts which do not project more than 15 mm from the mounting surface (distance from the wall) after mounting as in normal use, with the exception of the above parts A;
- C = Parts which project more than 15 mm and not more than 25 mm from the mounting surface (distance from the wall) after mounting as in normal use, with the exception of the above parts A; and
- D = Parts which project more than 25 mm from the mounting surface (distance from the wall) after mounting as in normal use, with the exception of the above parts A.

NOTE — The impact energy determined by the part of the specimen which projects most from the mounting surface is applied on all parts of the specimen, with the exception of its parts A.

IS 3854 : 1997

Parts of accessories exclusively intended for mounting in panel board are submitted to impacts which are obtained by allowing the striking element to fall from height of 100 mm, impacts shall only be applied on parts which are accessible after mounting the accessory in the panel board.

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 axis of the steel tube of the pendulum and the striking element and perpendicular to the plane through both axes meets the surface.

NOTE — 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 specimen are subjected to nine blows, which are evenly distributed over the sample. The blows are not applied to knock out areas. The following blows are applied:

- for parts A five blows: one blow in the centre, after the specimen has been moved horizontally, on each on the unfavourable point between the centre and the edges, and then, after the specimen has been turned 90° about its axis perpendicular to the plywood, one each on similar points
- for parts B (as far as applicable), C and D, four blows:
 - a) two blows on each of the two sides of the specimen on which blows can be applied after the plywood sheet has been turned 60° in each of the opposite directions
 - b) two blows on each of the other two sides of the specimen on which blows can be applied after the specimen has been turned 90° about its axis perpendicular to the plywood sheet and the plywood sheet has been turned 60° in each of the opposite directions

If inlet openings are provided, the specimen 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 cover plates or covers of single switches.

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 specimen shall show no damage within the meaning of this standard. In particular live parts shall not become accessible.

After the test on a lens (window) for pilot lights the lens may be cracked and/or dislodged, but it shall not be possible to touch live parts with:

- the standard jointed test finger under the conditions stated in 10.1
- the standard unjointed test finger under the conditions state in 10.1, but with a force of 10 N

In case of doubt, it is verified that it is possible to remove and to replace external parts, such as boxes, enclosures, 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 — Damage to the finish, small dents which do not reduce creepage distances below the value specified in 23.1 and small chips which do not adversely affect the protection against electric shock are neglected.

Cracks not visible to the naked eye and surface cracks in fibre-reinforced moulding 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 tests after removal of the decorative cover.

20.2 The bases of ordinary surface-type switches are first fixed to a cylinder of rigid steel sheet having a radius equal to 4.5 times the distance between fixing holes, but in any case not lower than 20 cm.

The axes of the holes are in a plane perpendicular to the axis of the cylinder and parallel to the radius through the centre of the distance between the holes.

The fixing screws are gradually tightened, the maximum torque applied being 0.5 Nm for screws having a thread diameter up to and including 3 mm and 1.2 Nm for screws having a larger thread diameter.

The bases are then fixed in a similar manner to a flat steel sheet.

After the tests, the bases shall show no damage impairing their further use.

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

The glands are then tightened by means of a suitable spanner the torque shown in Table 18 being applied to the spanner for 1 min.

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

Table 18

Diameter of Test Rod (mm)	Torque (Nm)	
	Metal Glands	Glands of Moulded Material
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

20.4 When testing the force necessary for covers, cover plates or actuating members to come off or not come off, the switches are mounted as for normal use. Flush-type switches are fixed in appropriate mounted boxes, which are installed as for normal use so that the rims of the boxes are flush with the walls, and the covers, cover plates or actuating members are fitted. If they are provided with locking means which can be operated without the aid of a tool, these means are unlocked.

Compliance is then checked by the tests of 20.4.1 and 20.4.2.

20.4.1 Verification of the non-removal of covers, cover plates or actuating members.

Forces are gradually applied in directions perpendicular to the mounting surfaces, in such a way that the resulting force acting on the centre of the covers, cover plates, actuating members or parts of them is respectively:

- 40 N, for covers, cover plates, actuating members or parts of them complying with the tests of 20.7 and 20.8; or
- 80 N, for other covers, cover plates, actuating members or parts of them

The force is applied for 1 min. The covers, cover plates, or actuating members shall not come off.

The test is then repeated on new specimens, the cover or cover plate being fitted on the wall after a sheet of hard material, 1 mm \pm 0.1 mm thick has been fitted around the supporting frame, as shown in Fig. 19.

NOTE — The sheet of hard material is used to simulate wall paper and may consist of a number of pieces.

After the test the specimens shall show no damage within the meaning of this standard.

20.4.2 Verification of the removal of covers, cover plates of actuating members

A force not exceeding 120 N is gradually applied, in directions perpendicular to the mounting/supporting surfaces, to covers, cover plates, actuating members or parts of them by means of a hook placed in turn in each

of the grooves, holes, spaces or the like, provided for removing them.

The covers, cover plates or actuating members shall come off.

The test is made ten times on each separable part the fixing of which is not dependent on screws (equally distributing as far as practicable the application points), the removal force is applied each time to the different grooves, holes or the like provided for removing the separable part.

The test is then repeated on new specimens, the cover, cover plate, or actuating member being fitted on the wall after a sheet of hard material, 1 mm \pm 0.1 mm thick has been fitted around the supporting frame, as shown in Fig. 19.

After the test, the specimens shall show no damage within the meaning of this standard.

20.5 The test is made as described in 20.4, but applying for 20.4.1, the following forces:

- 10 N, for covers or cover plates or actuating members complying with the test of 20.7 and 20.8
- 20 N, for other covers or cover plates and actuating members

20.6 The test is made as described in 20.4, but applying, for 20.4.1, the force of 10 N for all covers, cover plates, or actuating members.

20.7 The gauge shown in Fig. 20 is pushed toward each side of each cover, cover plate or actuating member which is fixed without screws on a mounting or supporting surface, as shown in Fig. 21. The face *B* resting on the mounting/supporting surface, with the face *A* perpendicular to it the gauge is applied at right angles to each side under test.

In the case of a cover or cover plate fixed without screws to another cover or cover plate or to a mounting box, having the same outline dimensions, the face *B* of the gauge shall be placed at the same level as the junction; the outline at the cover or cover plate shall not exceed the outline of the supporting surface.

The distances between the face *C* of the gauge and the outline of the side under test, measured parallel to face *B*, shall not decrease (with the exception of grooves, holes, reverse tapers or the like, placed at a distance less than 7mm from a plane including face *B* and complying with the test of 20.8) when measurements are repeated starting from point *X* in the direction of the arrow *Y* (see Fig. 22).

20.8 A gauge according to Fig. 23, applied with a force of 1 N, shall not enter more than 10 mm from the upper part of any groove, hole or reverse taper or

IS 3854 : 1997

the like when the gauge is applied parallel to the mounting/supporting surface and at right angles to the part under test, as shown in Fig. 24.

NOTE — The verification whether the gauge according to Fig. 23 has entered more than 1.0 mm is made with reference to a surface perpendicular to face B and including the upper part of the outline of the grooves, holes, reverse tapers or the like.

20.9 The operating member of a cord-operated switch shall have adequate strength.

Compliance is checked on a new specimen by the following test:

The switch is mounted on a support as in normal use.

A pull of 100 N is applied for 1 min on the operating member as in normal use, after which a pull of 50 N is applied for 1 min in the most unfavourable direction within a conical surface with the centre being the operating cord and the angles not exceeding 80° to the vertical.

After the test the switch shall show no damage within the meaning of this standard. The operating member shall not have broken and the cord-operated switch shall still operate.

21 RESISTANCE TO HEAT

Switches and boxes shall be sufficiently resistant to heat.

Compliance is checked by:

- a) for surface mounting boxes, separable covers, separate cover plates and separate frames by the test of 21.3;
- b) for switches, with the exception of the parts, if any, covered by the previous Items (a) by the tests of 21.1, 21.2 and with the exception for the switches made from natural or synthetic rubber or a mixture of both by the test of, 21.3.

21.1 The samples are kept for 1 h in a heating cabinet at a temperature of $100 \pm 2^\circ\text{C}$.

During the test, they shall not undergo any change impairing their further use and sealing compound, if any, shall not flow to such an extent that live parts are exposed.

After the test and after the specimens 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 specimens are mounted as in normal use, even if the standard test finger is applied with a force not exceeding 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.

21.2 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 Fig. 25, except that insulating parts necessary to retain the earthing terminals in a box shall be tested as specified in 21.3.

NOTE — When it is not possible to carry out the test on the specimen, the test should be carried out on a specimen of the material at least 2 mm thick. If this is not possible, up to and including four layers each, cut out of the same specimen, may be used, in which case the total thickness of the layers should not be less than 2.5 mm.

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 load and the supporting means shall be placed within the heating cabinet for a sufficient time to ensure that they have attained the stabilized testing temperature before the test commences.

The test is made in heating cabinet at a temperature of $125 \pm 2^\circ\text{C}$. After 1 h, the ball is removed from the specimen 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.

21.3 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 21.2, but the test is made at a temperature of $75 \pm 2^\circ\text{C}$, or $40 \pm 2^\circ\text{C}$, plus the highest temperature rise determined for the relevant part during the test of 17, whichever is the higher.

22 SCREWS, CURRENT-CARRYING PARTS AND CONNECTIONS

22.1 Connections, electrical or mechanical shall withstand the mechanical stresses occurring in normal use.

Mechanical connections to be used during installations of accessories may be made using thread-forming screws or threadcutting screws and when the screws are supplied together with the piece in which they are intended to be inserted. In addition thread cutting screws intended to be used during installation shall be captive with the relevant part of accessory.

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 installations by the following test.

NOTE — The requirements for the verifications of terminals are given in 12.

The screws or nuts are tightened and loosened:

- 10 times for screws in engagement with a thread of insulating material
- 5 times in all other cases

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 screw driver or suitable tool, applying a torque as specified in 12.2.8.

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

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, threads, washers, or stirrups.

NOTE — 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.

Screwed connections are considered as partially checked by the tests of 19 and 20.

22.2 Screws in engagement with a thread of insulating material and which are operated when mounting of the switches during installation, their correct introduction into the screw hole or nut shall be ensured.

Compliance is checked by inspection, by measurement and by manual test.

NOTE — The requirement with regard to correct introduction is met if introduction of the screw in 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.

22.3 Electrical connections shall be so designed that contact pressure is not transmitted through insulating material other than ceramic, pure mica or other material with characteristics no less suitable, unless there is sufficient resiliency in the metallic parts to compensate for any possible shrinkage or yielding of the insulating material.

Compliance is checked by inspection, and by manual test.

NOTE — The suitability of the material is considered in respect of the stability of the dimensions.

22.4 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.

NOTES

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

22.5 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:

- copper;
- an alloy containing at least 58 percent copper for parts made from cold rolled sheet, or at least 50 percent copper for other parts; or
- Stainless steel containing at least 13 percent chromium and not more than 0.09 percent carbon
- Steel provided with an electroplated coating of zinc according to IS 1573, the coating having a thickness of at least:
 - 5µm, for ordinary equipment
 - 12.5µm, for drip-proof and splash-proof equipment
 - 25µm, for jet-proof and watertight equipment
- steel provided with an electroplated coating of nickel and chromium according to IS 1068, the coating having a thickness of at least:
 - 20µm, for ordinary equipment
 - 30µm, for drip-proof and splash-proof equipment
 - 40µm, for jet-proof and watertight equipment
- steel provided with an electroplated coating of tin according to IS 1359, the coating having a thickness of at least:
 - 12µm, for ordinary equipment
 - 20µm, for drip-proof and splash-proof equipment
 - 30µm, for jet-proof and watertight equipment

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

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.

IS 3854 : 1997

Compliance is checked by a test which is under consideration.

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

22.6 Contacts which are subjected to sliding action in normal use shall be of a metal resistant to corrosion.

Compliance with the requirements of 22.5 and 22.6 is checked by inspection and by chemical analysis.

22.7 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.

NOTE — The use of thread-cutting screws which are operated when mounting the switch during installations is under consideration.

23 CREEPAGE DISTANCES, CLEARANCES AND DISTANCES THROUGH SEALING COMPOUND

23.1 Creepage distances, clearances and distances through sealing compound shall be not less than the values shown in Table 19.

Compliance is checked by measurement.

The measurement are made on the switch fitted with conductors of the largest cross-sectional area specified in 12 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 the straight unjointed test finger having the same dimensions as the standard test finger of Fig. 2, but is not pressed into openings.

The conductor shall be inserted into the terminal and so connected that the core insulation touches the metal part of the clamping unit or, if the core insulation is prevented by construction from touching the metal part, the outside of the obstruction.

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 13.11.

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

NOTES

1 Any metal part in contact with a metal part of the mechanism is considered to be a metal part of the mechanism.

2 In double-break switches, the creepage distance mentioned under Item 1 or the clearance mentioned under Item 6 in Table 19 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.

3 The contribution to the creepage distance of any groove less than 1 mm wide is limited to its width.

4 Any air-gap less than 1 mm wide is ignored in computing the total clearance.

5 The surface on which the base of 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.

23.2 Insulating sealing compound shall not protrude above the edge of the cavity in which it is contained. Compliance is checked by inspection.

24 RESISTANCE OF INSULATING MATERIAL TO ABNORMAL HEAT, TO FIRE AND TO TRACKING

24.1 Resistance to Abnormal Heat and to Fire

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 accessory, shall not be unduly affected by abnormal heat and by fire.

24.1.1 Glow-wire Test

The test is performed according to IS 11000 (Part 2 /Sec 1) under the following conditions:

- For parts of insulating material necessary to retain current-carrying parts, and parts of the earthing circuit, in position, by the test made at a temperature of 850 °C; and
- For parts of insulating material not necessary to retain current-carrying parts and parts of the earthing circuit in position, even they are 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 tests.

The tests are not made on parts of ceramic material.

NOTES

1 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 from the tested part falling down on to the pinewood board covered with tissue paper.

If possible, the specimen should be a complete switch.

2 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 specimen shall be stored for 24 h at standard ambient atmospheric conditions before the test.

The test is made applying the glow-wire once.

Table 19
(Clauses 13.3 and 23.1)

SI No.	Description	mm
Creepage distances		
i)	Between live parts which are separated when the contacts are open	3
ii)	Between live parts of different polarity	4 ¹⁾
iii)	Between live parts and <ul style="list-style-type: none"> — accessible surfaces of parts of insulating material — earthed metal parts, including the earthing circuit — metal frames supporting the base of flush-type switches — screws or devices for fixing bases, covers or cover-plates — metal parts of the mechanism, if required to be insulated from live parts (see 10.4) 	3
iv)	Between metal parts of the mechanism, if required to be insulated from accessible metal parts (see 10.5), and <ul style="list-style-type: none"> — screws or devices for fixing bases, covers or cover-plates — metal frames supporting the base of flush-type switches — accessible metal parts 	3
v)	Between live parts and accessible unearthed metal parts, with the exception of screws and the like	6 ²⁾
vi)	Between live parts which are separated when the contacts are open	3 ³⁾
vii)	Between live parts of different polarity	3
viii)	Between live parts and: <ul style="list-style-type: none"> — accessible surfaces of insulating material — earthed metal parts, including the earthing circuit, — not mentioned under items 9 and 11 — metal frames supporting the base of flush-type switches — screws or devices for fixing bases, covers, or cover-plates — metal parts of the mechanism, if required to be insulated from live parts (see 10.4) 	3
ix)	Between live parts and <ul style="list-style-type: none"> — exclusively earthed metal boxes⁴⁾ with the switch mounted in the most unfavourable position — unearthed metal boxes, without insulating lining with the switch mounted in the most unfavourable position 	3 4.5
x)	Between metal parts of the mechanism, if required to be insulated from accessible metal parts (see 10.5), and <ul style="list-style-type: none"> — screws or devices for fixing bases, covers or cover-plates — metal frames supporting the base of flush-type switches — accessible metal parts when the base is fixed directly on the wall 	3
xi)	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
xii)	Between live parts and the bottom of the space, if any, for external conductors, for surface-type switches	3
xiii)	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 ¹⁾
xiv)	Between the parts covered with at least 2 mm of sealing compound and the bottom of the space, if any, for external conductors, for surface-type switches	2.5

¹⁾This value is reduced to 3 mm for switches having a rated voltage up to and including 250 V.

²⁾This value is reduced to 4.5 mm for accessories having a rated voltage up to and including 250 V.

³⁾This value is reduced to 1.2 mm, when the contacts are open, for live parts of switches of mini-gap construction, which are moved during the separation of the contacts.

⁴⁾Exclusively earthed metal boxes are those suitable only for use in installations where earthing of metal boxes.

The specimen shall be positioned during the test in the most unfavourable position of its intended use (with the surface tested in 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.

During the application time of the glow-wire and during a period of 30 s from the end of the application time, the sample and the surrounding parts, including the layer under the sample, shall be observed.

The time when the ignition of the sample occurs and/or the time when the flames extinguish during or after the application time shall be measured and recorded.

IS 3854 : 1997

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

- there is no visible flame and sustained glowing
- 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.

3 The test may be carried out by the alternative method given in Annex B. However the method shall not be applicable after 3 years from the date of publication of this standard.

24.2 Resistance to Tracking

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

Compliance is checked according to IS 2824.

Ceramic parts are not tested.

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

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

No flashover or breakdown between electrodes shall occur before a total of 50 drops have fallen.

25 RESISTANCE TO RUSTING

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 carbontetrachloride, trichloroethane or an equivalent degreasing agent for 10 min. The parts are then immersed for 10 min in a 10 percent solution of ammonium chloride in water at a temperature of $27 \pm 5^\circ\text{C}$.

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 $27 \pm 5^\circ\text{C}$.

After the parts have been dried for 10 min in heating cabinet at a temperature of $100 \pm 5^\circ\text{C}$, their surfaces shall show no signs of rust.

NOTES

1 Traces or rust on sharp edges and any yellowish film removable by rubbing is ignored.

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.

26 TESTS

26.1 Type Tests

The following shall be carried out as type tests on selected samples of switches being drawn preferably at random from a regular lot of production:

- a) Rating (*see* 6);
- b) Classification (*see* 7);
- c) Marking (*see* 8);
- d) Checking of dimensions (*see* 9);
- e) Protection against electric shock (*see* 10);
- f) Provision for earthing (*see* 11);
- g) Terminals (*see* 12);
- h) Constructional requirements (*see* 13);
- j) Mechanism (*see* 14);
- k) Resistance to ageing, to harmful ingress of water and to humidity (*see* 15);
- m) Insulation resistance and electric strength (*see* 16);
- n) Temperature rise (*see* 17);
- p) Making and breaking capacity (*see* 18);
- q) Normal operation (*see* 19);
- r) Mechanical strength (*see* 20);
- s) Resistance to heat (*see* 21);
- t) Screws, current carrying parts and connections (*see* 22);
- u) Creepage distances, clearances and distance through sealing compound (*see* 23);
- v) Normal operation for fluorescent lamp circuits (*see* 19.2);
- w) Resistance to abnormal heat and fire (*see* 24.1);
- x) Resistance to tracking (*see* 24.2); and
- y) Resistance to rusting (*see* 25)

26.1.1 Number of specimen and the sequence of testing shall be as given in Annex A.

26.1.1.1 Criteria for acceptance

The specimens subjected to the type tests shall pass the test for providing conformity with the requirements of this standard. If one or more failures occurs, the testing authority at its discretion, may call for twice the original number of specimens and subject them to all tests or to those in which the failure occurred. No single failure shall be permitted on the repeat test(s).

26.2 Acceptance Tests

The following shall constitute acceptance tests:

- a) Marking (*see* 8);
- b) Resistance to ageing, to harmful ingress of water and to humidity (*see* 15);
- c) Insulation resistance and electric strength (*see* 16);
- d) Temperature rise (*see* 17);
- e) Making and breaking capacity (*see* 18); and
- f) Mechanical strength (*see* 20).

26.2.1 A recommended sampling procedure for acceptance test is specified in Annex C.

26.3 Routine Tests

The following shall constitute routine tests:

- a) Marking (*see* 8); and
- b) Electric strength (Flash test) (*see* 16.3).

ANNEX A
(Clauses 5.4 and 26.1.1)
Survey of Specimens Needed for Tests

The number of specimens needed for tests according to 5.4 are as follows:

<i>Clauses and Subclauses</i>	<i>Number of Specimens</i>	<i>Number of Additional Specimens for Dual Current Rating</i>
6 Ratings	A	
7 Classification	A	
8 Markings	A	
9 Checking of dimensions	ABC	
10 Protection against electric shock	ABC	
11 Provision for earthing	ABC	
12 Terminals ¹⁾	ABC	
13 Constructional requirements ²⁾	ABC	JKL
14 Mechanism	ABC	
15 Resistance to ageing, to harmful ingress of water and to humidity	ABC	
16 Insulation resistance and electric strength	ABC	
17 Temperature rise	ABC	
18 Making and breaking capacity	ABC	JKL
19.1 Normal operation ³⁾	ABC	JKL
19.2 Normal operation for fluorescent lamp circuits	DEF	MNO
20 Mechanical strength ⁴⁾	ABC	JKL
21 Resistance to heat	ABC	
22 Screws, current-carrying parts and connections	ABC	
23 Creepage distances, clearances and distances through sealing compound	ABC	
24.1 Resistance to abnormal heat and fire	GHI	
24.2 Resistance to tracking ⁵⁾	GHI	
25 Resistance to rusting	GHI	
TOTAL	9	6

¹⁾ Five extra screwless terminals are used for the test of 12.3.11 and one extra set of specimens is used for the test of 12.3.12.

²⁾ An extra set of membranes are needed for each of the tests of 13.15.1 and 13.15.2.

³⁾ For switches of pattern No. 2 one extra set of specimens are used.

⁴⁾ One extra set of specimens of cord-operated switches is needed for the test of 20.9.

⁵⁾ One extra set of specimens may be needed.

IS 3854 : 1997

ANNEX B

(Clause 24.1.1)

TEST FOR RESISTANCE TO ABNORMAL HEAT AND FIRE

B-1 The test shall be carried out in an oven as shown in Fig. 18 of IS 302 (Part 1). The oven is heated by passing a suitably regulated electric current through a nichrome resistance wire surrounding the heating tube.

B-2 The opening at the top of the oven shall be in the form of a square with 25 mm sides and the inlet at the bottom of the oven shall be in the form of nine 3 mm diameter holes giving approximately 65 mm². The gas flame shall be of 16 to 22 mm high and fixed so that its base is immediately above the centrally placed over the top opening of the oven. The temperature of the oven shall be measured with a thermocouple situated at the level of the centre of the basket containing the specimens and equidistant from the inner surface of the heating tube and the basket which is suspended centrally in the chamber with its top 25 mm below the base of the pilot flame. The wire sizes shall be as given IS 7358.

B-3 The samples of the material to be tested shall be broken from the specimen into small pieces and a cylindrical wire mesh basket shall be used and the following conditions shall be complied with:

- a) Size of basket — 19 mm diameter, 51 mm long with 2 mm × 2 mm openings.
- b) Size of sample — Just large enough to be retained in the basket. The total weight of the samples being approximately 6 g.

B-4 The heat chamber shall be raised to 300°C and the basket with specimens shall be inserted from the top and suspended as specified in B-2. The temperature shall then be readjusted to 290 ± 10°C within a period of 3 minutes and this temperature shall be maintained until a period of 5 minutes has elapsed from the time of insertion of the basket. At the end of the period of 5 minutes the basket shall be removed from the chamber.

B-5 The specimen shall be subjected for not less than 18 h to a controlled atmosphere of 75 percent relative humidity, at a temperature of 15 to 25°C. Every specimen shall be tested as soon as possible after removal from the controlled atmosphere and in any case before three minutes have elapsed.

The specified relative humidity may be obtained by the use of lumps of sodium chloride, which shall be

sprinkled occasionally with water. The surface of the salt shall be moist, care being taken that the lumps are not flooded with water, and shall be large per unit volume of air space, or the rate of attainment of equilibrium will be very slow.

Sulphuric acid shall not be used for obtaining the specified relative humidity.

In order to ensure that the relative humidity of the controlled atmosphere is maintained at the correct value, it is necessary either that the temperature be kept very constant or that the air be circulated within the chamber.

The following method has been found satisfactory for maintaining constant relative humidity of the controlled atmosphere.

The specimens are placed on a shelf half-way up in a cubical box with sides of 0.6 m long. The floor of the box is nearly covered by a dish containing lumps of salt. Air is circulated by means of a small fan over the salt up through holes cut at two corners of the shelf, over the samples and down through holes at the opposite corners of the shelf.

The humidity of the air may be measured by wet and dry bulb thermometers. If the velocity of the air past the thermometers is greater than 3m/sec, the humidity attains a constant value in about three minutes after the box has been closed and the fan has been started, unless the prevailing conditions are extreme.

As an alternative to wet and dry bulb thermometers, which may require a known air velocity, a dew point thimble may be inserted in the box and used when the fan is working. With either method a window is necessary to avoid opening the box.

B-6 The material shall be deemed to have passed the test if it has not, during the test period, given off vapours in sufficient quantity to ignite at the pilot flame. Any form of halo occurring during the specified time shall be ignored. Three tests on each material shall be carried out.

NOTES

1 It is recommended that a light stirrup of nichrome wire, supported by a length of nichrome wire, be used for supporting the basket which may also be made of this material.

2 It is not necessary to perform this test on materials, that are obviously resistant to abnormal heat and fire, for example, ceramic or metal parts.

ANNEX C

(Clause 26.2.1)

SAMPLING PROCEDURE

C-1 LOT

C-1.1 In any consignment, all samples of the same type, designation, rating and manufactured by the same factory under essentially similar conditions of production shall be grouped together to constitute a lot.

C-1.2 From each lot, a certain number of switches as specified in Table 20 shall be selected at random and subjected to tests specified in 26.2.

C-2 CRITERION FOR CONFORMITY

C-2.1 In Table 20, N_1 is the size of the first sample. If the number of failures found in this sample is less than or equal to C_1 , the lot shall be considered to be conforming to this standard and accepted. If the number of failures is greater than or equal to C_2 , the lot shall be rejected. If the number of failures is between C_1 and C_2 , further sample of N_2 pieces shall be taken and subjected to all tests.


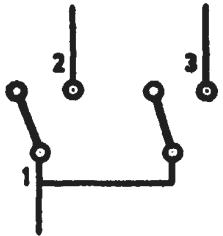
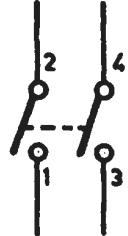

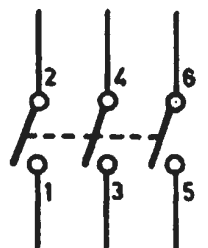
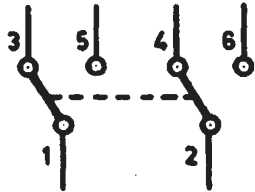
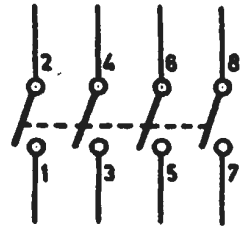
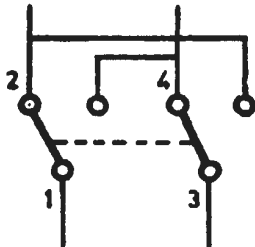

C-2.1.1 If the number of failures in the two samples combined is less than C_2 , the lot shall be accepted, otherwise rejected.

Table 20 Sampling Plan
(Clauses C-1.2 and C-2.1)

Lot Size (1)	N_1 (2)	N_2 (3)	$(N_1 + N_2)$ (4)	C_1 (5)	C_2 (6)
51 to 100	10	20	30	0	3
101 to 200	13	26	39	0	5
201 to 300	20	40	60	1	5
301 to 500	25	50	75	1	6
501 to 800	35	70	105	2	7
801 to 1 300	50	100	150	3	10
1 300 and above	75	150	225	5	12

NOTE — The plan recommended in this table assures that lots with defectives 4 percent or less would be accepted most of the time, and lots with defectives 25 percent and above would be rejected most of the time. The exact consumers risk depends on the lot size and it would be minimum when the lot size is maximum.

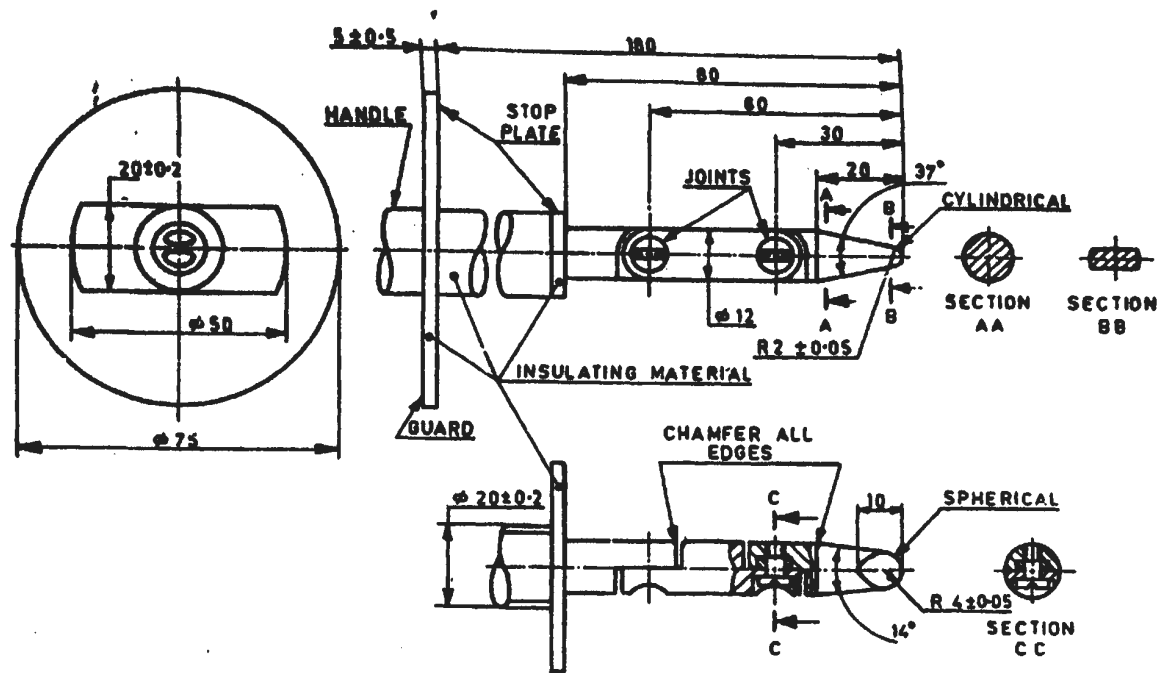
IS 3854 : 1997

<i>Pattern Number</i>	<i>Number of Poles</i>	<i>Possible Connections</i>	<i>Pattern Number</i>	<i>Number of Poles</i>	<i>Possible Connections</i>
1	1		5	1	
2	2		6	1	
3	3		6/2	2	
03	4		7	1	
4	1				

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

FIG. 1 CLASSIFICATION ACCORDING TO CONNECTIONS

IS 3854 : 1997



All dimensions in millimetres.

Tolerances on dimensions without specific tolerance:

on angles: 0
 -10°

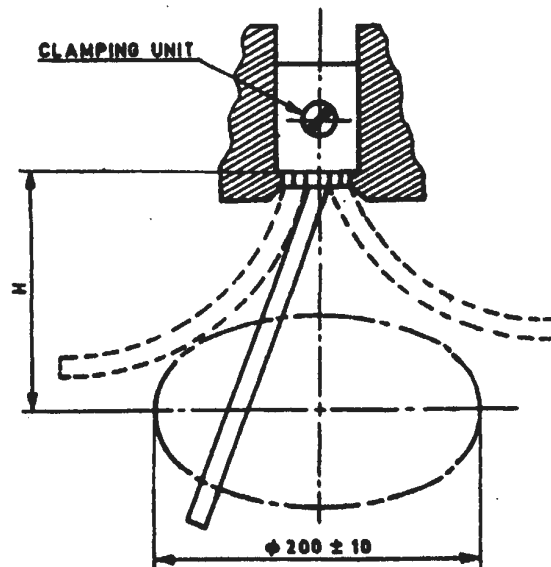
on linear dimensions: up to 25 mm: 0
 -0.05
over 25 mm: ± 0.2

Material of finger: for example heat-treated steel

Both joints of this finger may be bent through an angle of 90^{+10}_0 but in one and the same direction only.

Using the pin and groove solution is only one of the possible approaches in order to limit the bending angle to 90° . For this reason dimensions and tolerances of these details are not given in the drawing. The actual design must ensure a 90° bending angle with a 0 to 10° tolerance.

FIG. 2 STANDARD TEST FINGER

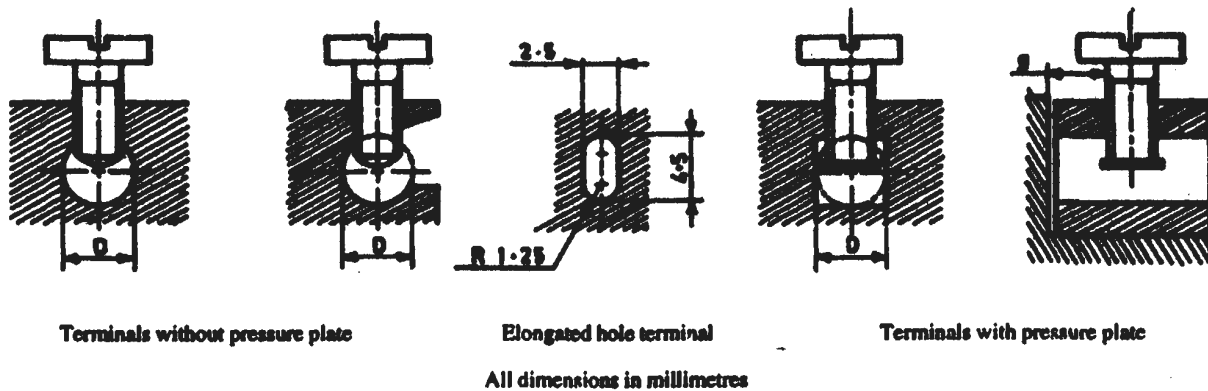


All dimensions in millimetres.

Conductor Cross-sectional Area mm ²	H mm
≤ 4	250 ± 10
5 ≤ 16	500 ± 10
25 ≤ 35	750 ± 10

FIG. 3 ARRANGEMENT FOR CHECKING DAMAGE TO CONDUCTORS

IS 3854 : 1997



Cross-section of Conductor Accepted by the Terminal	Minimum Diameter D (or Minimum Dimensions) of Conductor Space	Minimum Distance x Between Clamping Screw and End of Conductor When Fully Inserted mm		Torque Nm					
				1 ¹⁾		3 ¹⁾		4 ¹⁾	
				One Screw	Two Screws	One Screw	Two Screws	One Screw	Two Screws
Up to 1.5	2.5	1.5	1.5	0.2	0.2	0.2	0.4	0.4	0.4
2.5 (circular hole)	3.0	1.5	1.5	0.25	0.2	0.5	0.4	0.5	0.4
2.5 (elongated hole)	2.5 × 4.5	1.5	1.5	0.25	0.2	0.5	0.4	0.5	0.4
4	3.6	1.8	1.5	0.4	0.2	0.8	0.4	0.7	0.4
6	4.0	1.8	1.5	0.4	0.25	0.8	0.5	0.8	0.5
10	4.5	2.0	1.5	0.7	0.25	1.2	0.5	1.2	0.5
16	5.5	2.5	2.0	0.8	0.7	2.0	1.2	2.0	1.2
25	7.0	3.0	2.0	1.2	0.7	2.5	1.2	3.0	1.2

¹⁾ The values specified apply to the screws covered by the corresponding columns in Table 5.

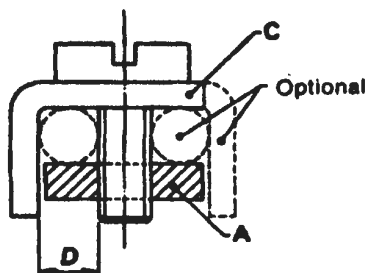
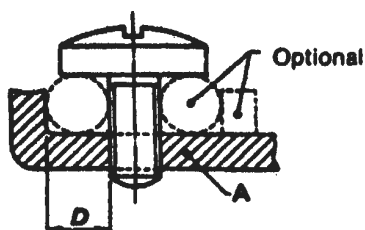
The part of the terminal containing the threaded hole and the part of the terminal against which the conductor is clamped by the screw may be two separate parts, as in the case of terminals provided with a stirrup.

The shape of the conductor space may differ from those shown provided that a circle with a diameter equal to the minimum specified for D or the minimum outline specified for the elongated hole accepting cross-sections of conductors up to 2.5 mm² can be inscribed.

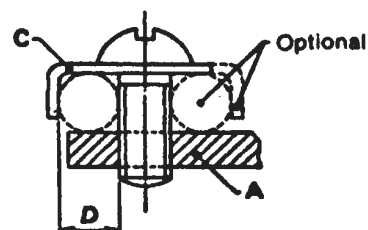
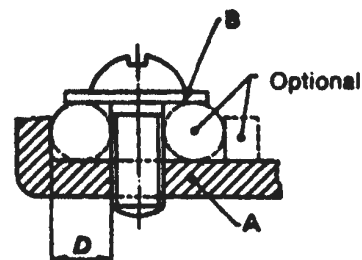
FIG. 4 PILLAR TERMINALS

IS 3854 : 1997

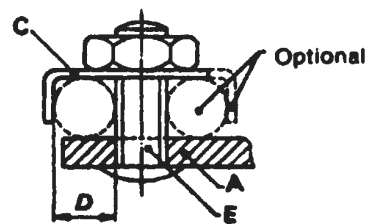
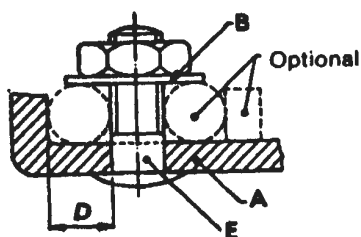
Screw not requiring washer or clamping plate



Screw requiring washer or clamping plate



Screw terminals



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

Cross-Section of Conductor Accepted by the Terminal mm ²	Minimum Diameter D of Conductor Space mm	Torque Nm			
		3 ¹⁾		4 ¹⁾	
		One Screw	Two Screws	One Screw or Stud	Two Screws or Studs
Up to 1.5	1.7	0.5	—	0.5	—
Up to 2.5	2.0	0.8	—	0.8	—
Up to 4	2.7	1.2	0.5	1.2	0.5
Up to 6	3.6	2.0	1.2	2.0	1.2
Up to 10	4.3	2.0	1.2	2.0	1.2
Up to 16	5.5	2.0	1.2	2.0	1.2
Up to 25	7.0	2.5	2.0	3.0	2.0

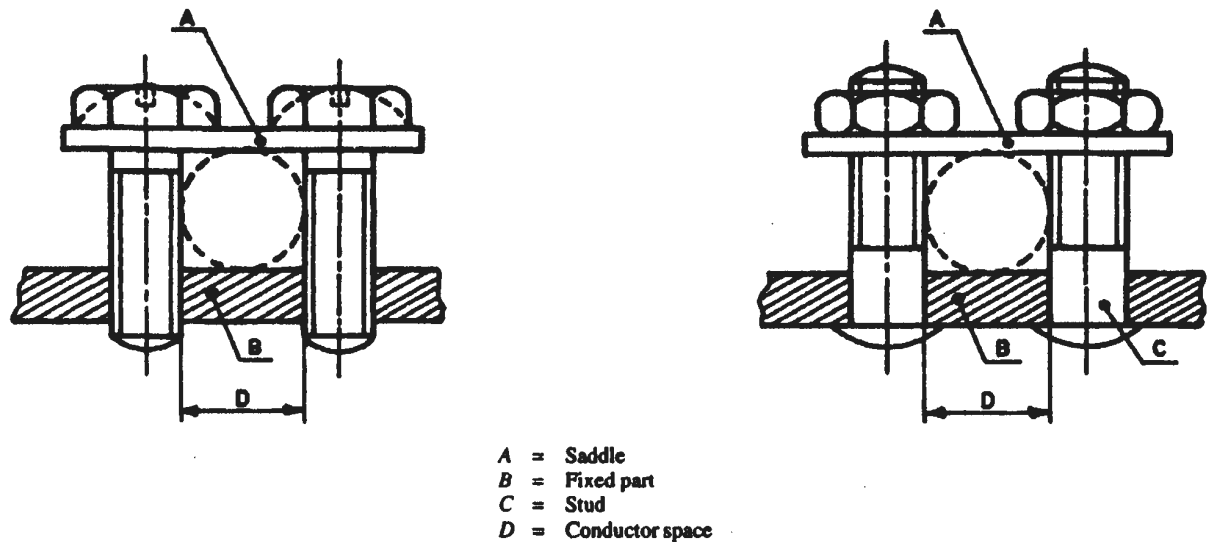
¹⁾ The values specified apply to the screws covered by the corresponding columns in Table 5.

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.

The second optional space for the terminal accepting cross-sections of conductors up to 2.5 mm² may be used for the connection of the second conductor, when it is required to connect two 2.5 mm² conductors.

FIG. 5 SCREW TERMINALS AND STUD TERMINALS

IS 3854 : 1997

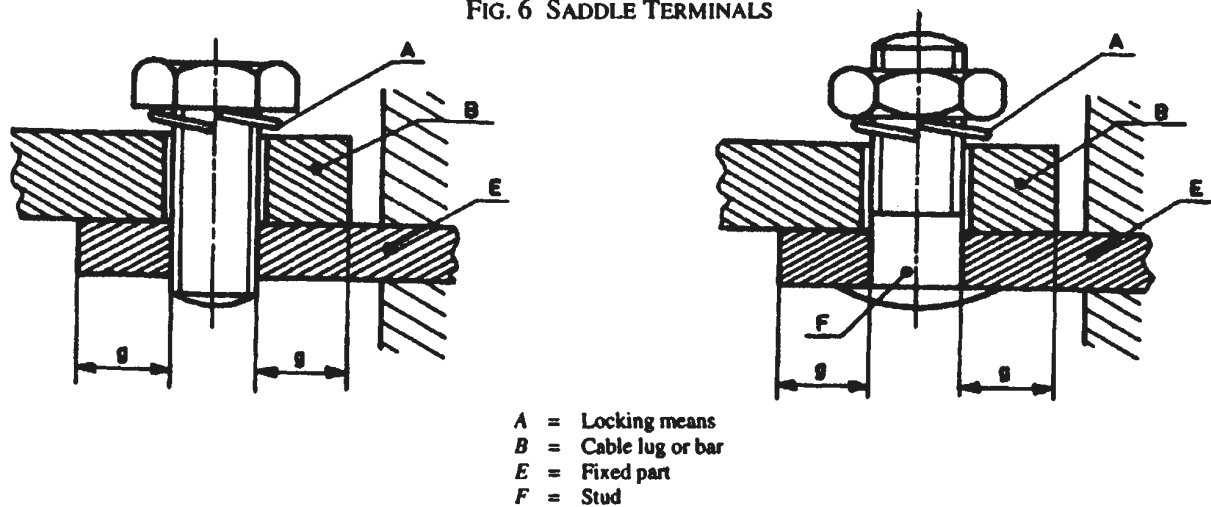


Cross-Section of Conductor Accepted by the Terminal mm ²	Minimum Diameter D of Conductor Space mm	Torque	
		Nm	
Up to 4	3.0	0.5	
Up to 6	4.0	0.8	
Up to 10	4.5	1.2	
Up to 16	5.5	1.2	
Up to 25	7.0	2.0	

The shape of the conductor space may differ from that shown in the figure, provided that a circle with a diameter equal to the minimum value specified for D can be inscribed.

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.

FIG. 6 SADDLE TERMINALS



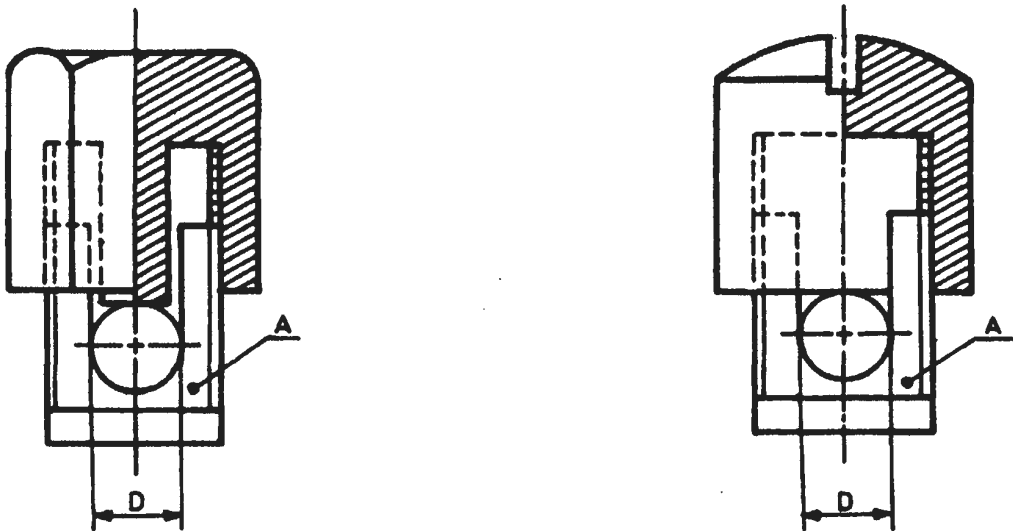
Cross-Section of Conductor Accepted by the terminal mm	Minimum Distance g Between Edge of Hole and Side of Clamping Area mm	Torque Nm	
		3 ¹⁾	4 ¹⁾
Up to 16	7.5	2.0	2.0
Up to 25	9.0	2.5	3.0

¹⁾ The values specified apply to the studs washer or equally effective locking means shall be provided and the surface within the clamping area shall be smooth.

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.

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

FIG. 7 LUG TERMINALS

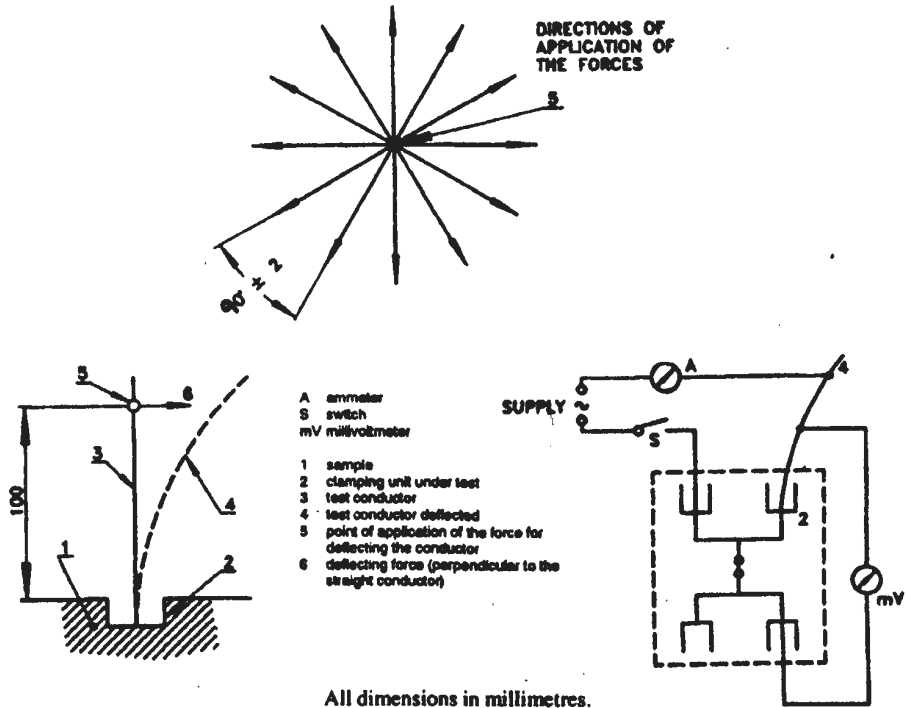


A = Fixed part
D = Conductor space¹⁾

Cross-section of Conductor Accepted by the Terminal	Minimum Diameter D of Conductor Space	Minimum Distance Between Fixed Part and End of Conductor When Fully Inserted
mm ²	mm	mm
Up to 1.5	1.7	1.5
Up to 2.5	2.0	1.5
Up to 4	2.7	1.8
Up to 6	3.6	1.8
Up to 10	4.3	2.0
Up to 16	5.5	2.5
Up to 25	7.0	3.0

¹⁾ The bottom of the conductor space must be slightly rounded in order to obtain a reliable connection.
The value of the torque to be applied is that specified in Col 2 or 4 of Table 5, as appropriate.

FIG. 8 MANTLE TERMINALS



All dimensions in millimetres.

9A PRINCIPLE OF THE TEST APPARATUS FOR DEFLECTING TESTS ON SCREWLESS TERMINAL

9B EXAMPLE OF TEST ARRANGEMENT TO MEASURE THE VOLTAGE DROP DURING DEFLECTING TEST ON SCREWLESS TERMINAL

IS 3854 : 1997

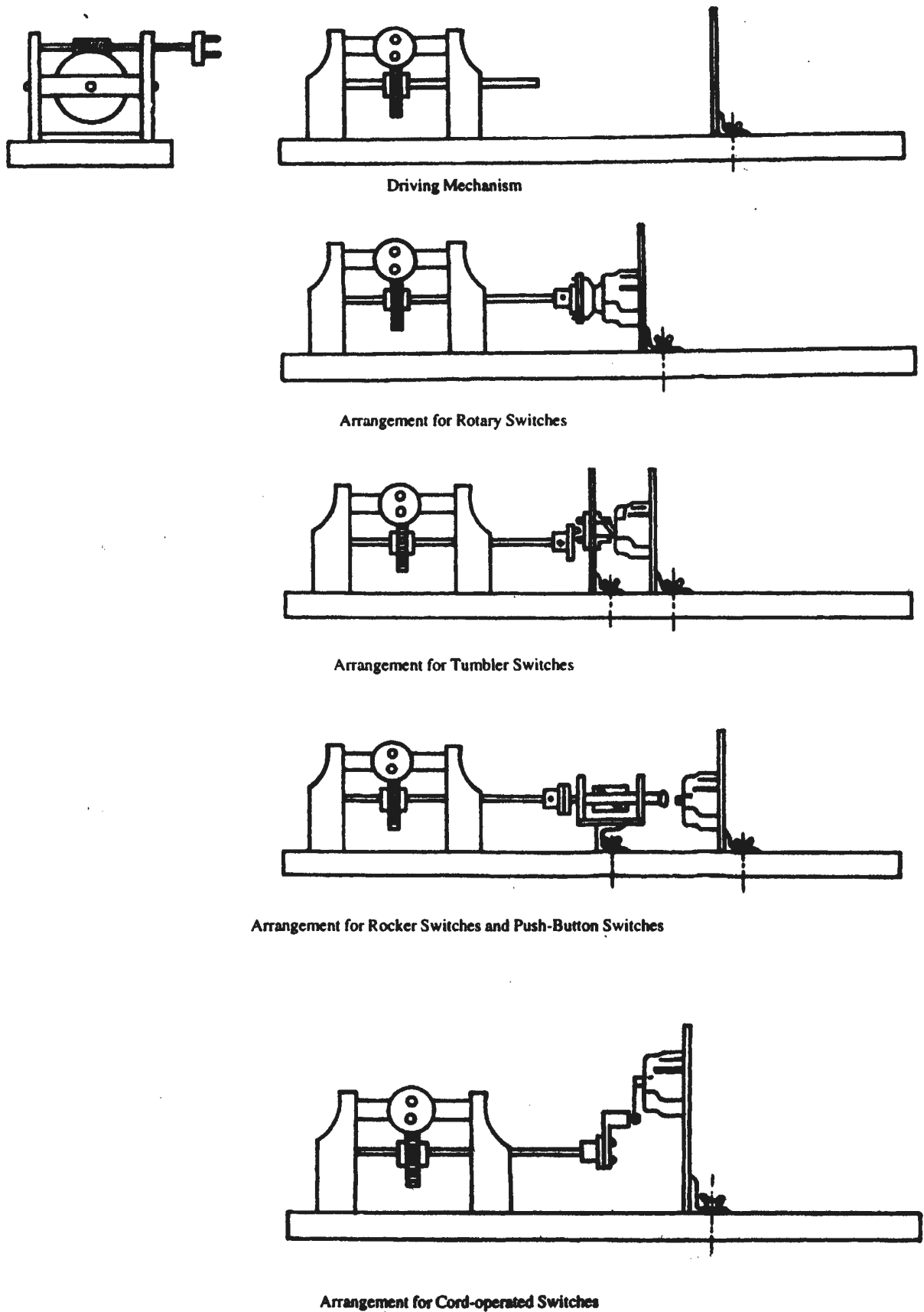


FIG. 10 APPARATUS FOR MAKING AND BREAKING CAPACITY AND NORMAL OPERATION TESTS

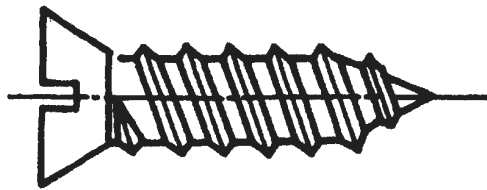


FIG. 11 THREAD-FORMING SCREW

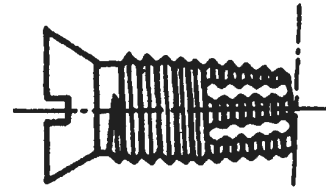
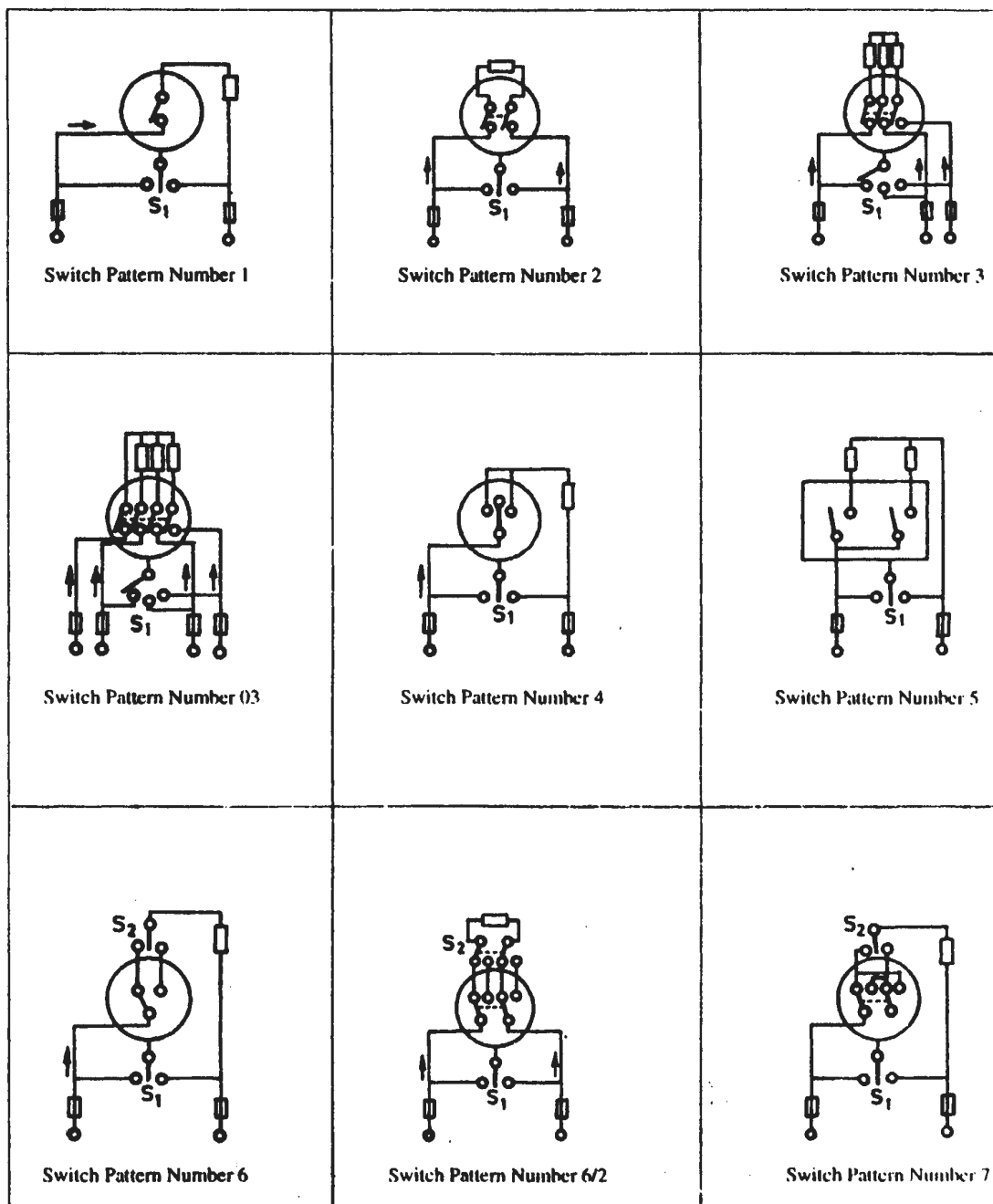


FIG. 12 THREAD-CUTTING SCREW

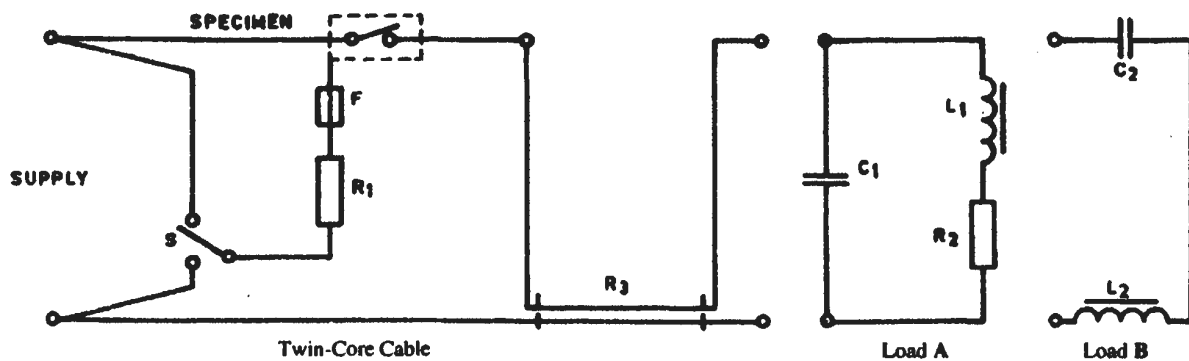


The arrows indicating the connection of phase conductors are shown as examples only.

When the marking made by the manufacturer indicates other connections, this marking shall be followed.

FIG. 13 CIRCUIT DIAGRAMS FOR MAKING AND BREAKING CAPACITY AND NORMAL OPERATION TESTS

IS 3854 : 1997



The prospective short-circuit current of the supply shall be between 3 and 4 kA at $\cos \phi = 0.9 \pm 0.05$ (lagging).

F is a copper-wire fuse of 0.1 mm nominal diameter.

R_1 is a resistor limiting the current to about 100 A.

S is a switch connecting the copper wire fuse, F , to either the phase or the neutral conductor.

The twin-core cable shall have a suitable length to give a resistance R equal to $0.25 R_3$ in the test circuit to the load. It shall have a cross-sectional area of 1.5 mm^2 when switches with rated current up to and including 10 A are being tested and 2.5 mm^2 when switches with rated current over 10 A up to and including 20 A are being tested.

Load A shall consist of:

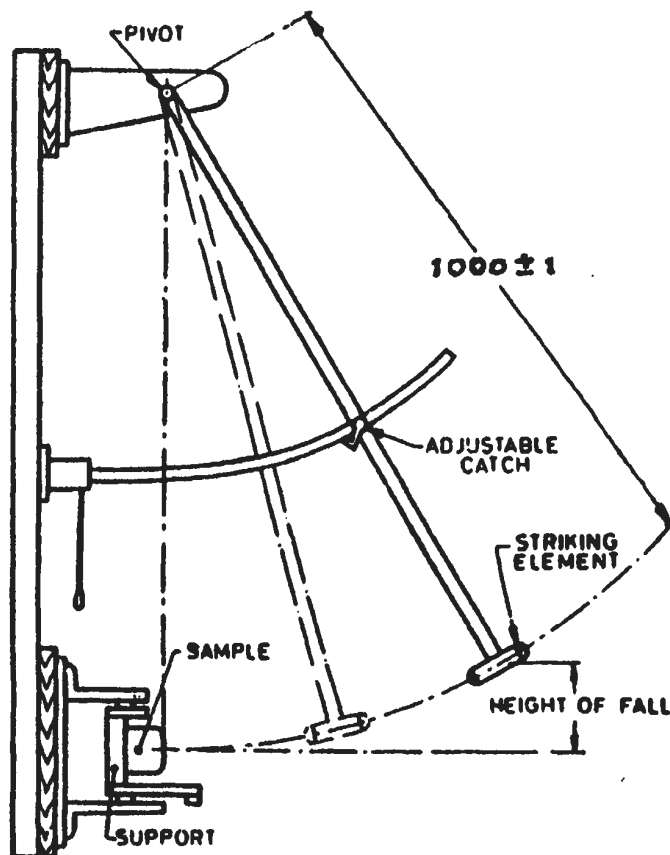
- a capacitor bank, C , giving the capacitance $70 \mu\text{F} \pm 10$ percent for 6 A switches and $140 \mu\text{F} \pm 10$ percent for other switches. The capacitors shall be connected with the shortest possible length of 2.5 mm^2 conductors;
- an inductor, L , and a resistor, R , adjusted to give the power factor 0.9 ± 0.05 (lagging) and the test current I_n $\begin{smallmatrix} +5 \\ 0 \end{smallmatrix}$ percent through the specimen.

Load B shall consist of:

- a capacitor, C_2 , of $7.3 \mu\text{F} \pm 10$ percent ;
- and inductor, L_2 , of $0.5 \text{ H} \pm 0.1 \text{ H}$ having a resistance of not more than 15Ω measured using d.c.

NOTE — The circuit parameters have been chosen to represent the fluorescent lamp loads used in most practical applications.

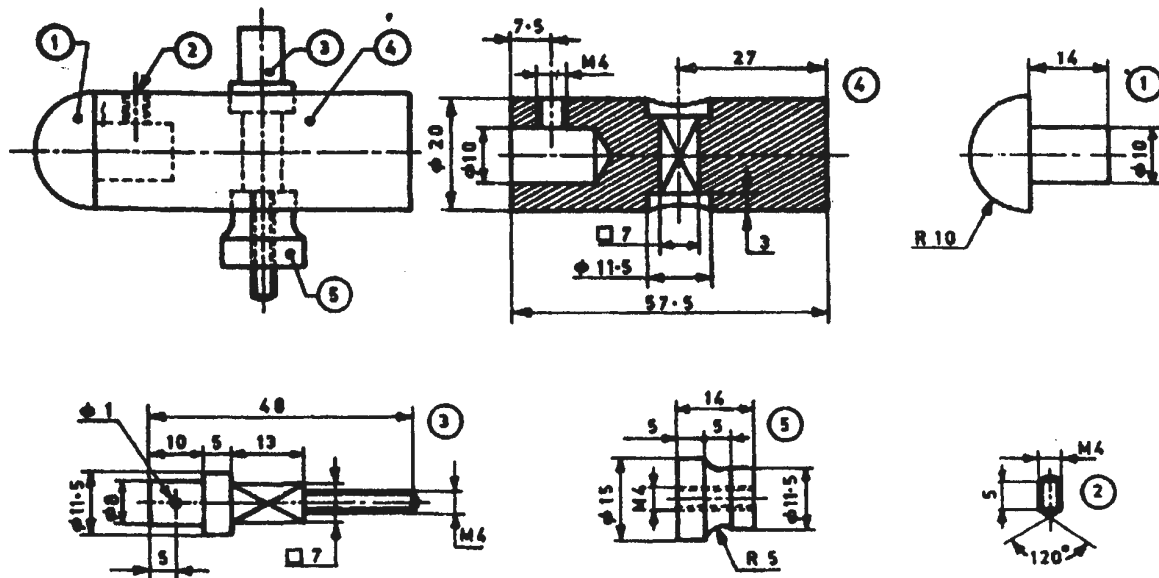
FIG. 14 CIRCUIT DIAGRAMS FOR TESTING SWITCHES FOR USE ON FLUORESCENT LAMP LOADS



All dimensions in millimetres.

FIG. 15 IMPACT TEST APPARATUS

IS 3854 : 1997



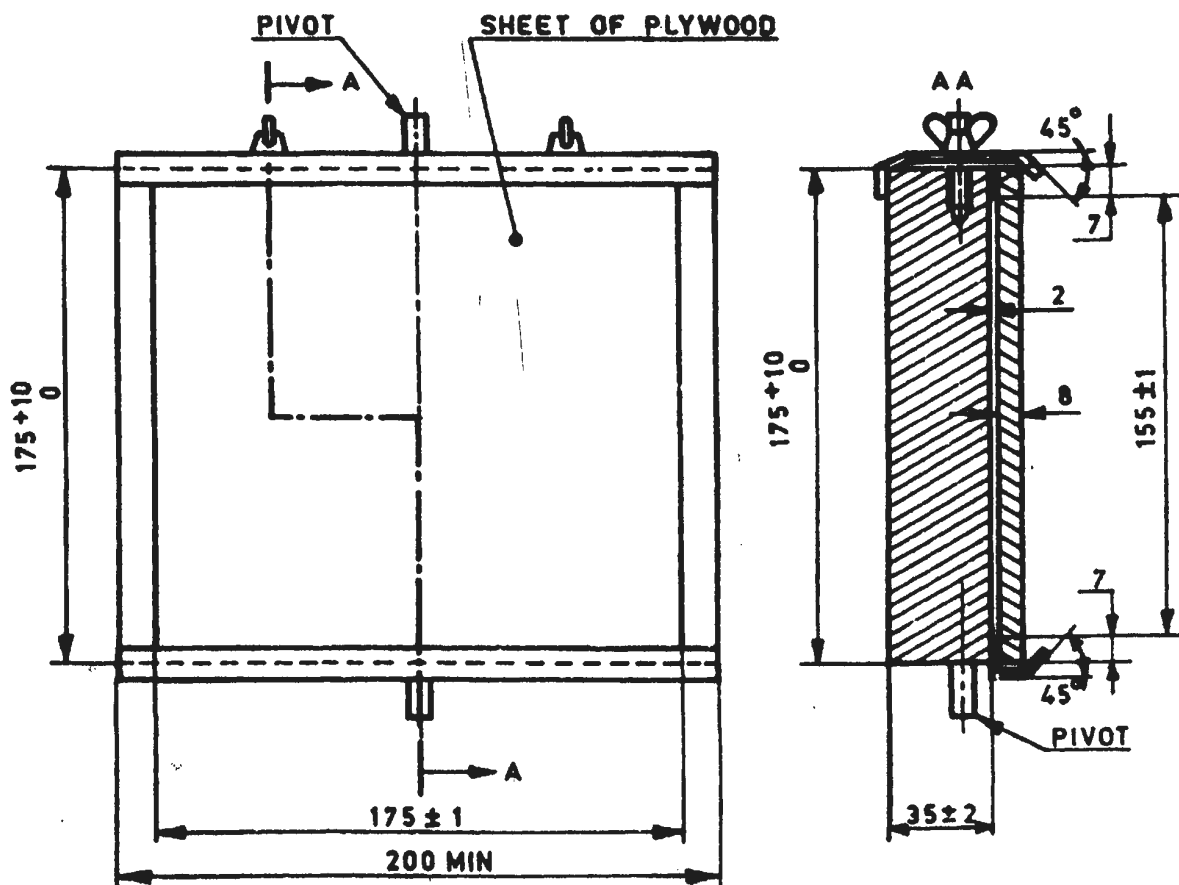
All dimensions in millimetres.

Material of the parts:

1: Polyamide

2, 3, 4, 5: Steel Fe 360

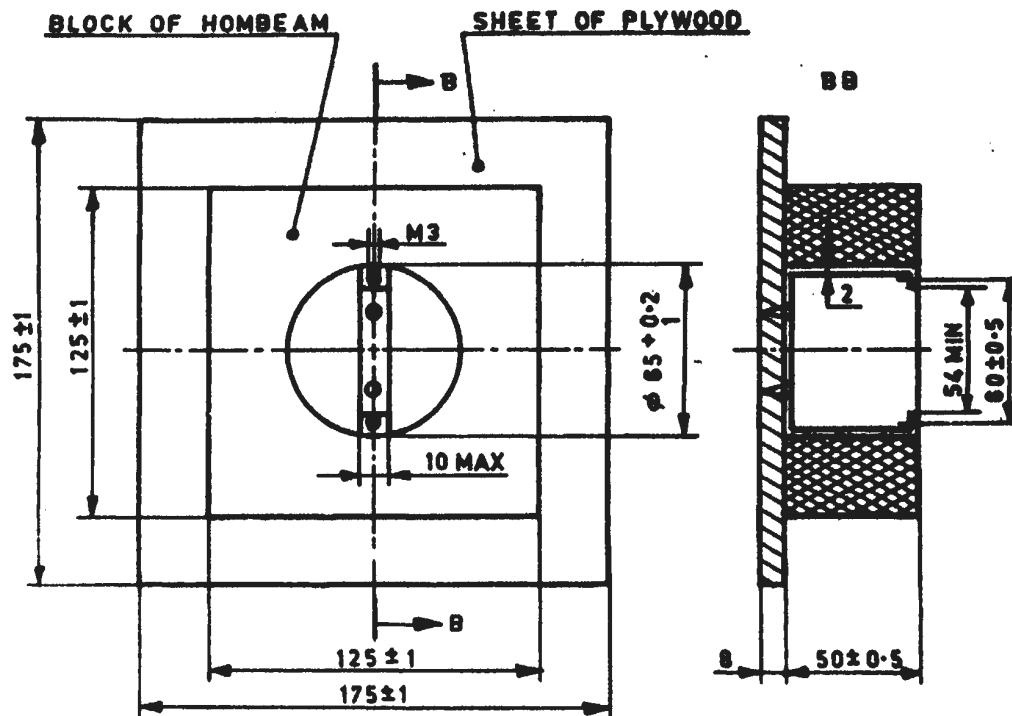
FIG. 16 PENDULUM IMPACT TEST APPARATUS (STRIKING ELEMENT)



All dimensions in millimetres.

FIG. 17 MOUNTING SUPPORT FOR SAMPLE

IS 3854 : 1997



All dimensions in millimetres.

The dimensions of the recess in the block of hornbeam, or similar material, are given as an example.

FIG. 18 MOUNTING BLOCK FOR FLUSH-TYPE SWITCHES

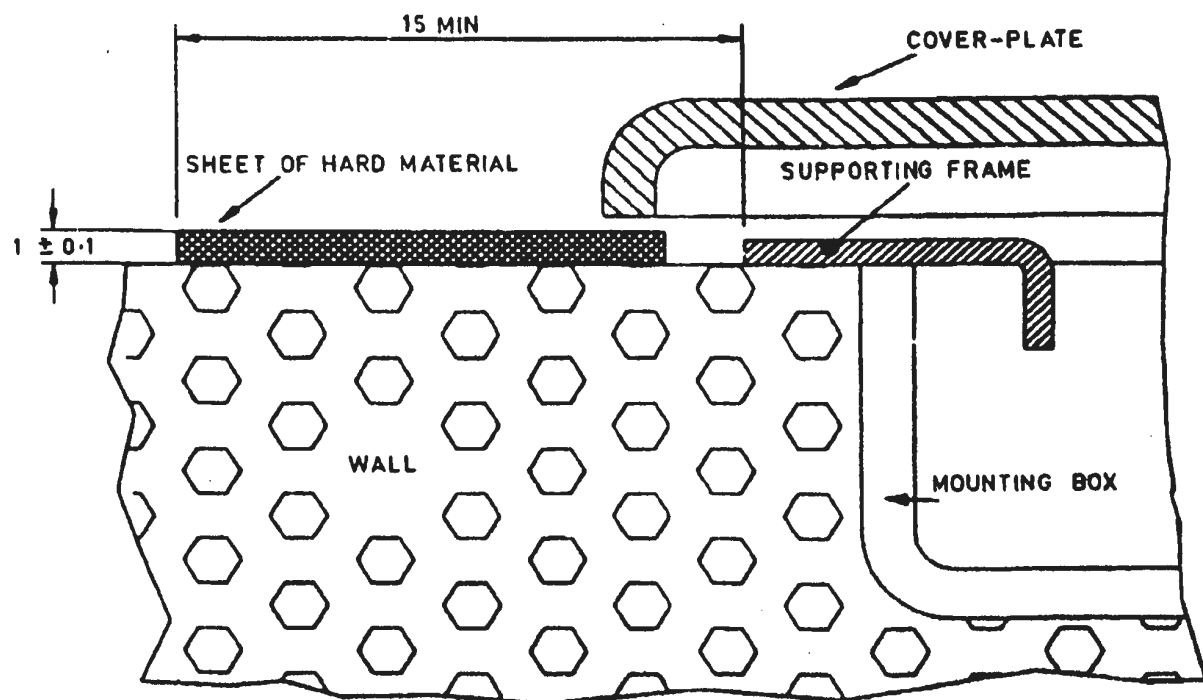


FIG. 19 ARRANGEMENT FOR TEST ON COVER-PLATES

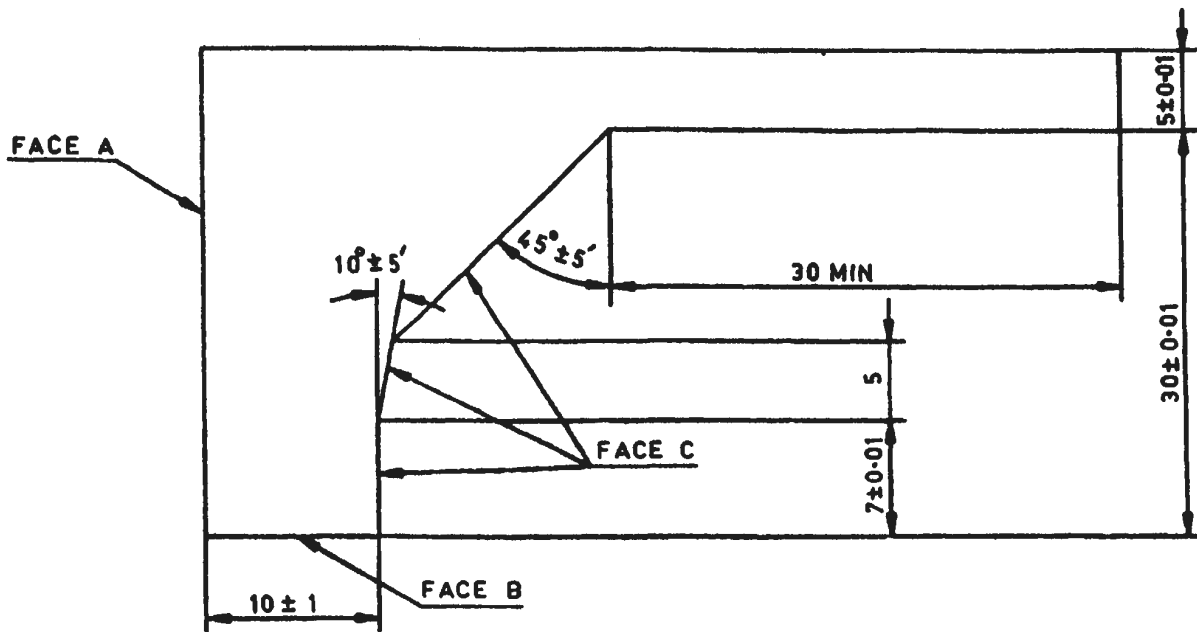
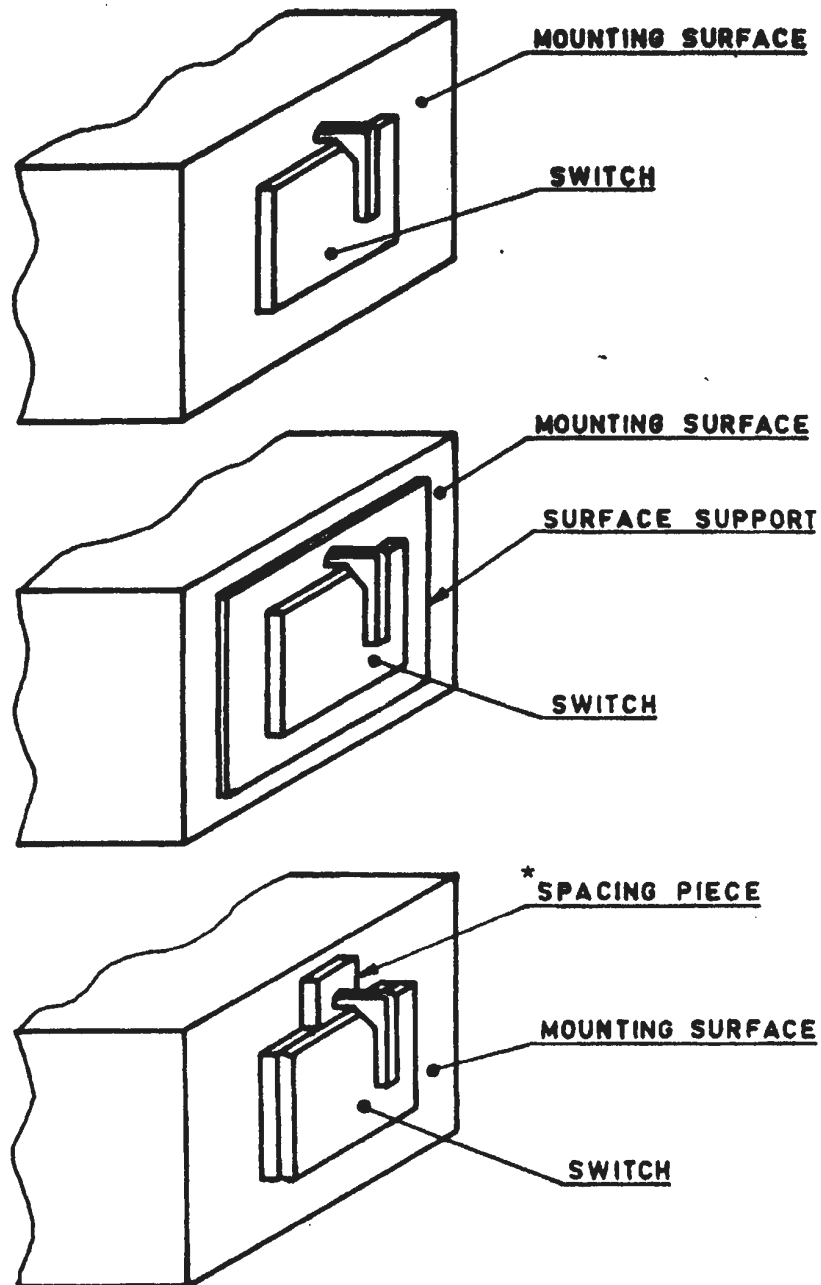


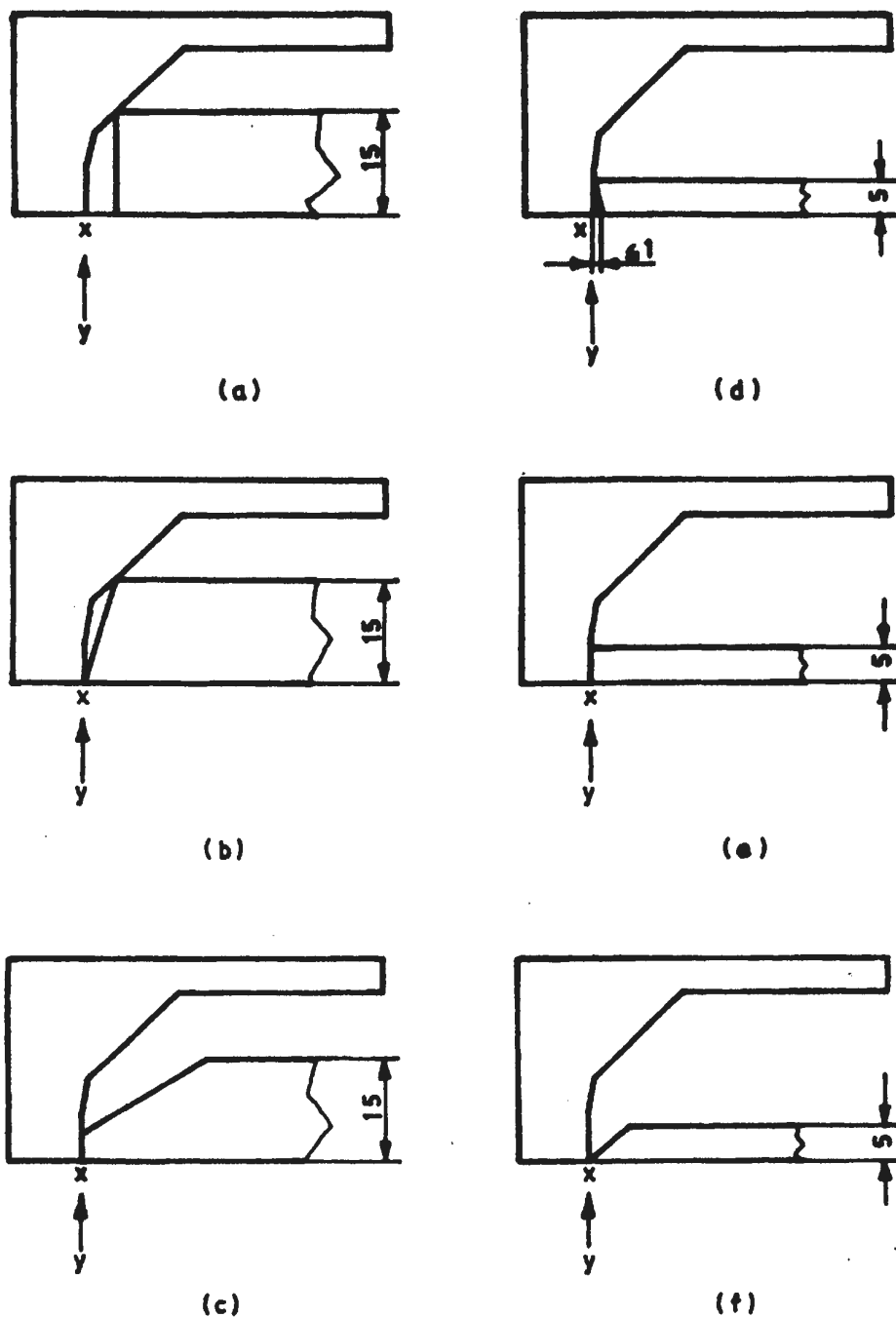
FIG. 20 GAUGE (THICKNESS: ABOUT 2 mm) FOR THE VERIFICATION OF THE OUTLINE OF COVERS, COVER-PLATES OR ACTUATING MEMBERS

IS 3854 : 1997



* Spacing piece having the same thickness as the supporting part.

FIG. 21 EXAMPLE OF APPLICATION OF THE GAUGE OF FIG. 20 ON COVERS FIXED WITHOUT SCREWS ON A MOUNTING SURFACE OR SUPPORTING SURFACE



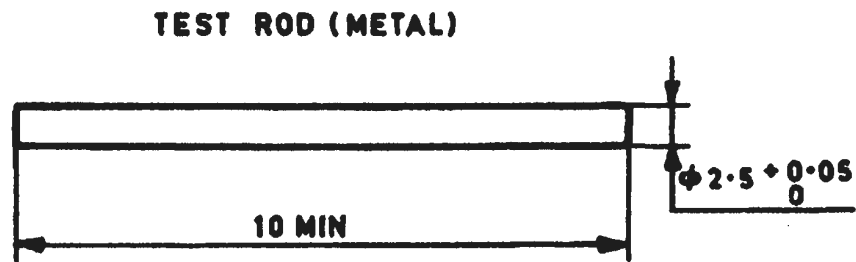
All dimensions in millimetres.

Cases (a) and (b): do not comply.

Cases (c), (d), (e) and (f) comply (compliance shall however be checked also with the requirements of 20.8 using the gauge shown in Fig. 23).

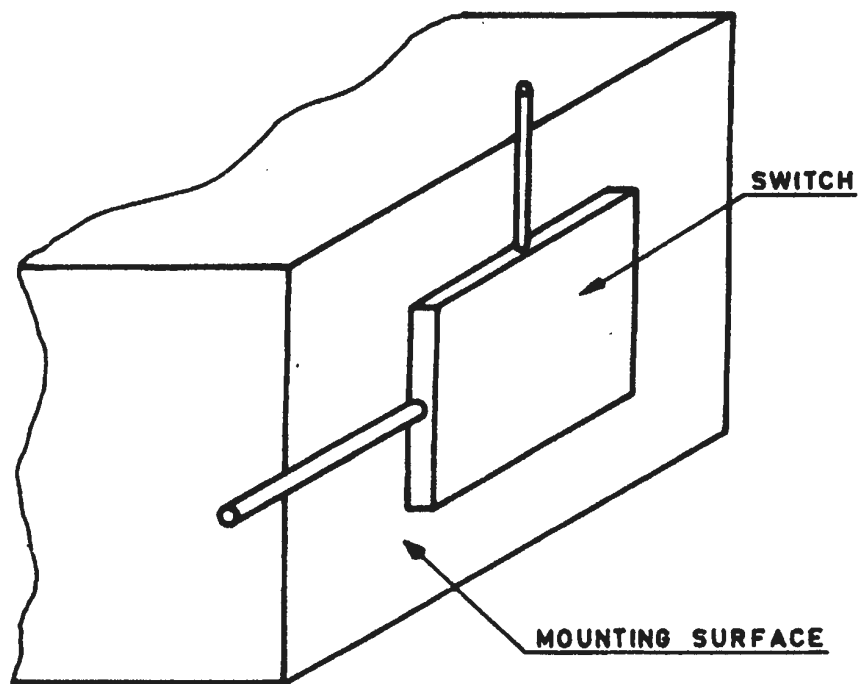
FIG. 22 EXAMPLES OF APPLICATIONS OF THE GAUGE OF FIG. 20 IN ACCORDANCE WITH THE REQUIREMENTS OF 20.7

IS 3854 : 1997



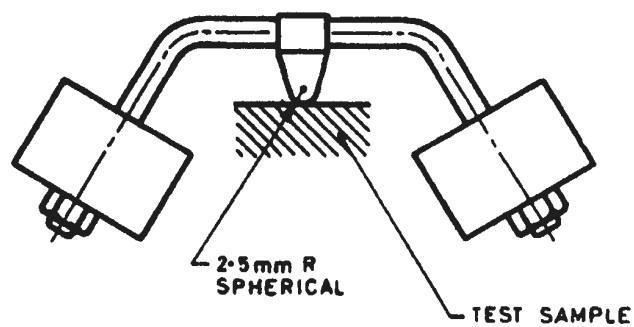
All dimensions in millimetres.

FIG. 23 GAUGE FOR VERIFICATION OF GROOVES, HOLES AND REVERSE TAPERS



All dimensions in millimetres.

FIG. 24 SKETCH SHOWING THE DIRECTION OF APPLICATION OF THE GAUGE OF FIG. 23



All dimensions in millimetres.

FIG. 25 BALL-PRESSURE APPARATUS

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This Indian Standard has been developed from Doc : No. ETD 14 (3677).

Amendments Issued Since Publication

Amendment No.	Date of Issue	Text Affected

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