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मानक

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“जानने का अधिकार, जीने का अधिकार”

Mazdoor Kisan Shakti Sangathan

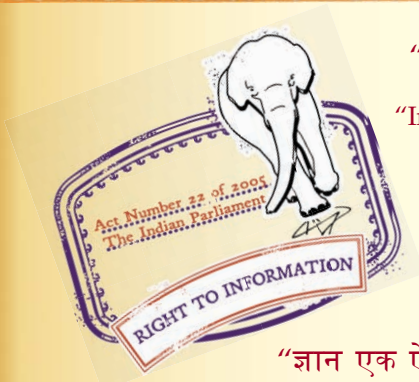
“The Right to Information, The Right to Live”

“पुराने को छोड़ नये के तरफ”

Jawaharlal Nehru

“Step Out From the Old to the New”

IS 15368 (2003): Cable Reels for Household and Similar Purposes [ETD 14: Electrical Wiring Accessories]



“ज्ञान से एक नये भारत का निर्माण”

Satyanarayan Gangaram Pitroda

“Invent a New India Using Knowledge”



“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”

Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

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भारतीय मानक
घरेलू और ऐसे ही प्रयोजनों के लिए केबल रील

Indian Standard
CABLE REELS FOR HOUSEHOLD
AND SIMILAR PURPOSES

ICS 29.060; 29.120.99

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

FOREWORD

This Indian Standard 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 has been published primarily to ensure safety to the user against electric shock, safety against the effects of excessive temperature and fire, and to ensure reliable operation.

Cable reels, which are also commercially known as flex boxes, are the devices comprising a flexible cable attached to a reel, so constructed that the flexible cable may be wound into the reel. The cable reels are incorporated with plugs and socket-outlets including safety feature.

Cable reels are neither a cord extension set nor a cord set. While cord extension set is an assembly consisting of a flexible cable fitted with a non-rewirable portable socket-outlet, the cable reel is an assembly of a flexible cable fitted with a non-rewirable plug and a non-rewirable connection, intended for connection to an electrical appliance and equipment to the electrical supply. Therefore, cable reel is no case an item similar to either cord extension set or cord sets.

This standard is based on corresponding IEC 61242 (1995) 'Electrical accessories — Cable reels for household and similar purposes', issued by International Electrotechnical Commission (IEC) except for the following modifications:

- a) Ambient test conditions, which has been specified as 27°C in place of 20°C.
- b) Schedule of tests including sampling plan for acceptance test have been included.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result 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.

Indian Standard

CABLE REELS FOR HOUSEHOLD AND SIMILAR PURPOSES

1 SCOPE

This standard applies to cable reels for a.c. only, provided with a non-detachable flexible cable with a rated voltage above 50 V and not exceeding 250 V for single-phase cable reels and above 50 V and not exceeding 415 V for all other cable reels and a rated current not exceeding 16A. They are intended for household, commercial and light industrial and similar purposes, either indoors or outdoors, with particular reference to safety in normal use.

Cable reeling devices incorporated in appliances are under consideration.

Cable reels complying with this standard are suitable for use at ambient temperatures not normally exceeding 35°C, but occasionally reaching 45°C. In locations where special conditions prevail, special construction may be required.

NOTE — This standard does not apply to cable reels with a detachable flexible cable.

2 REFERENCES

The following Indian Standards are necessary adjuncts to this standard:

<i>IS No.</i>	<i>Title</i>
694 : 1990	Polyvinyl chloride insulated (PVC) cables of rated voltage 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>)
1293 : 1988	Plugs and socket-outlets of rated voltage up to and including 250 V and rated current up to and including 16 Amperes (<i>second revision</i>)
1359 : 1992	Electroplated coatings of tin (<i>third revision</i>)
1573 : 1986	Electroplated coatings of zinc on iron and steel (<i>second revision</i>)
1885 (Part 17) : 1979	Electrotechnical vocabulary: Part 17 Switchgear and controlgear (<i>first revision</i>)
2824 : 1975	Method for determining the comparative tracking index of solid insulating materials under moist conditions (<i>first revision</i>)
9868 (Part 1) : 1988	Elastomer rubber insulated cables: Part 1 For working voltages up to and

IS No.

Title

11000	including 1 100 V (<i>first revision</i>)
(Part 2/Sec 1) : 1984	Fire hazard testing : Part 2 Test methods, Section 1 Glow-wire test and guidance
12063 : 1987	Classification of degrees of protection provided by enclosures of electrical equipment

3 TERMINOLOGY

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

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

3.1 Rated Voltage

Voltage assigned to the cable reel by the manufacturer.

3.2 Rated Current

Current assigned to the cable reel by the manufacturer.

3.3 Cable Reel

Device comprising a flexible cable attached to a reel, so constructed that the flexible cable may be wound onto the reel.

NOTE — Plugs and socket-outlets supplied with cable reels are considered as part of the reel.

3.3.1 Portable Cable Reel

Cable reel which can be easily moved from one place to another.

3.3.2 Fixed Cable Reel

Cable reel intended for mounting on a fixed support.

3.4 Non-detachable Flexible Cable

Flexible cable which is fixed to a cable reel.

3.5 Rewirable Cable Reel

Cable reel so constructed that the flexible cable can be replaced with the aid of a general purpose tool.

3.6 Non-rewirable Cable Reel

Cable reel so constructed that it forms a complete unit with the flexible cable, and the plug and the socket-outlets are fixed by the manufacturer of the cable reel in such a manner that, after dismantling, the cable reel is rendered unfit for any further use.

3.7 Current Cut-Out

Current sensing device intended to switch off automatically under abnormal operating conditions and which has no provision for adjustment by the user.

3.8 Trip-Free Mechanism

Mechanism designed so that disconnection can neither be prevented nor inhibited by a reset mechanism, and so that the contacts can neither be prevented from opening nor be maintained closed against a continuation of the excess temperature or current.

3.9 Non-self-Resetting Thermal or Current Cut-Out

Thermal or current cut-out which can only be reset by a manual action directly acting on the device which is used exclusively for this purpose and which is mounted in the cable reel.

3.10 Basic Insulation

Insulation of hazardous live parts providing basic protection against electric shock.

3.11 Supplementary Insulation

Independent insulation applied in addition to the basic insulation in order to provide protection against electric shock in event of a failure of the basic insulation.

3.12 Double Insulation

Insulation comprising basic insulation and supplementary insulation in order to provide protection against electric shock if basic insulation fails.

3.13 Reinforced Insulation

Single insulation system which provides protection against electric shock equivalent to double insulation.

3.14 Clamping Unit

Part(s) of the terminal necessary for the mechanical clamping and the electrical connection of the conductor(s), including the parts which are necessary to ensure the correct contact pressure.

3.15 Terminal

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

3.16 Connecting Device

Device for the electrical connection of one (or more) conductor(s), comprising one (or more) terminal(s), either fixed to a base or forming an integral part of the equipment.

3.17 Termination

Insulated or non-insulated connecting device serving

for non-reusable connection of the supply conductors.

3.18 Accessible Part

Part which can be touched by means of the standard test finger.

3.19 Detachable Part

Part which can be removed without the aid of a general-purpose tool.

3.20 Creepage Distance

Shortage path along the surface of an insulating material between two conductive parts.

3.21 Clearance

Distance between two conductive parts along a string stretched the shortest way between these conductive parts.

3.22 Thermal Cut-Out

Temperature sensing control device intended to switch-off automatically under abnormal operating conditions and which has no provision for adjustment by the user.

3.23 Polarized Plug

A plug constructed so that when inserted in a socket outlet installed in a polarized wiring installation; the correct relationship between the neutral and the live pole or poles is maintained.

4 GENERAL REQUIREMENTS

Cable reels shall be so designed and constructed that in normal use their performance is reliable and without danger to the user and surroundings.

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

5 GENERAL CONDITIONS OF TEST

5.1 Tests according to this standard are type tests.

5.2 Unless otherwise specified the tests are made on three samples as delivered.

The components of the cable reels are tested, unless otherwise specified, in accordance with the requirements of the relevant standard, as applicable.

5.3 Unless otherwise specified, the tests are carried out in the order of the clauses, at an ambient temperature between 15°C and 35°C. In case of doubt, the tests are made at an ambient temperature of $27^{\circ} \pm 2^{\circ}\text{C}$.

5.4 Unless otherwise stated, three samples are submitted to all the tests and the requirements are satisfied if all the tests are met.

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

5.5 Schedule of acceptance and routine test are given in 27.2 and 27.3.

6 CLASSIFICATION

Cable reels are classified according to:

6.1 The method of use:

- portable
- fixed

6.2 The method of winding the flexible cable:

- hand-operated
- automatic, that is, spring-operated or motor-operated

6.3 The method of connecting the flexible cable:

- rewirable
- non-rewirable

6.4 The degree of protection against electric shock:

- having normal protection (for example, complying with 8.1.1)
- having increased protection (for example, complying with 8.1.2)

6.5 The degree of protection against harmful ingress of water:

- not protected against harmful ingress of water
- protected against splashing water, that is, with degree of protection IPX4
- protected against water jets, that is, with degree of protection IPX5

6.6 The protection against excessive temperatures:

- incorporating thermal cut-outs and/or current cut-outs
- not incorporating thermal cut-outs or current cut-outs

7 MARKING

7.1 Cable reels shall be marked with:

- rated voltage in volts
- symbol for the nature of supply
- either the name, trade-mark or identification

mark of the manufacturer or of the vendor responsible

- type reference, which may be a catalogue number; symbol for degree of protection against ingress of water if higher than IP20
- Country of manufacture

NOTE — The degree of protection is based on IS 12063.

- maximum load which may be connected to the socket-outlets, to be stated in watts supplemented with the voltage in volts, for fully-reeled and fully-extended conditions

Example: “1 500 W – 230 V flexible cable fully-reeled, 3 000 W – 230 V flexible cable fully-extended”

Cable reels not protected against excessive temperature shall, in addition to the marking of the maximum allowable loads, be marked with:

“Warning — Exceeding the maximum allowable loads may involve fire risk.”

Cable reels fitted with a thermal and/or current cut-outs shall be marked with an instruction clearly stating how to reset the device.

NOTE — Cable reels may additionally be marked with rated current in amperes.

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

— amperes	A
— volts	V
— watts	W
— alternating current	~
— neutral	N
— earth	
— fully-reeled cable reel	
— fully-extended cable reel	
— protected against splashing water	IPX4
— protected against water jets	IPX5

NOTES

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

2 The letter X shall be replaced by the relevant number which is minimum 2 for this standard.

7.3 Rewirable cable reels shall be marked with:

- terminals intended exclusively for the neutral conductor shall be indicated by the letter N
- earthing terminals shall be indicated by the earth symbol
- marking indicating the cross-sectional area, the type and the length of the flexible cable shall be placed where it is clearly visible

These markings shall be so placed that they are easily legible whilst replacing the flexible cable and they shall not be placed on screws, removable washers or on other parts which might easily be removed when connecting conductors.

7.4 The information required in 7.1 shall be clearly visible when the cable reel is in normal use and shall be given by symbols if symbols are defined in 7.2 or otherwise in the official language.

In addition, the symbol for degree of protection against ingress of water and the maximum load shall be placed so that they are clearly discernible, which may be achieved by use of enlarged letters, contrasting colours, underlining, placing on separate lines, etc.

7.5 If marking plates or labels are used they shall be reliably secured. After all the tests of this standard, markings shall be readily discernible, labels shall show no curling or loosening at the corners or edges.

Compliance with the requirements of 7.1 to 7.5 is checked by inspection and by the test of 7.6.

7.6 Marking shall be durable and easily legible with normal or corrected vision, without additional magnification.

Compliance is checked by inspection and by the following tests:

The test is made by rubbing the marking by hand for 15 s with a piece of cotton cloth soaked with water and again for 15 s with a piece of cotton cloth soaked with 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 is of a type consisting of a solvent hexane with an aromatic content of maximum 0.1 volume percentage, a kauributanol value of 29, an initial boiling point of approximately 65°C, a dry point of approximately 69°C and a density of approximately 0.68 g/cm³.

7.6.1 BIS Certification Marking

The cable reels may also be marked with the Standard Mark.

7.6.2 The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. The details of conditions under which the license for use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

8 PROTECTION AGAINST ELECTRIC SHOCK

8.1 Cable reels shall be so designed that live parts are not accessible when the cable reels is in normal use and when parts which can be removed without the aid of a tool, have been removed.

Compliance is checked by inspection and if necessary, by the test of 8.1.1. For cable reels with increased protection against electric shock the test of 8.1.2 is also applied.

These tests shall be made immediately after the cable reel has passed a current having the value corresponding to the maximum load, when fully-reeled, for 1 h at an ambient temperature of $27^{\circ} \pm 5^{\circ}\text{C}$.

8.1.1 The standard test finger shown in Fig. 1 is applied with a force of $10 \text{ N} \pm 1 \text{ N}$ in every possible position; an electrical indicator with a voltage not less than 40 V and not more than 50 V is used to show contact with the relevant part.

For cable reels, where the use of elastomeric or thermoplastic material is likely to influence the compliance with the requirement, the test is repeated but at an ambient temperature of $40^{\circ} \pm 2^{\circ}\text{C}$, the cable reels being at this temperature.

During this additional test, the parts of elastomeric or thermoplastic material of the cable reel are subjected for 1 min to a force of 75 N, applied through the tip of a straight unjointed 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 the insulating material could impair the safety of the cable reel.

During this test, the cable reel shall not deform to such an extent that those dimensions which ensure safety are unduly altered and no live parts shall be accessible.

8.1.2 The test is made with a straight rigid steel wire as specified in Fig. 2 applied with a force of $1 \text{ N} + 0.1/0 \text{ N}$. The end of the wire shall be free from burrs and be at right angles to its length.

The protection is satisfactory if the wire cannot enter the enclosure, or if it enters, it does not touch live parts inside the enclosure.

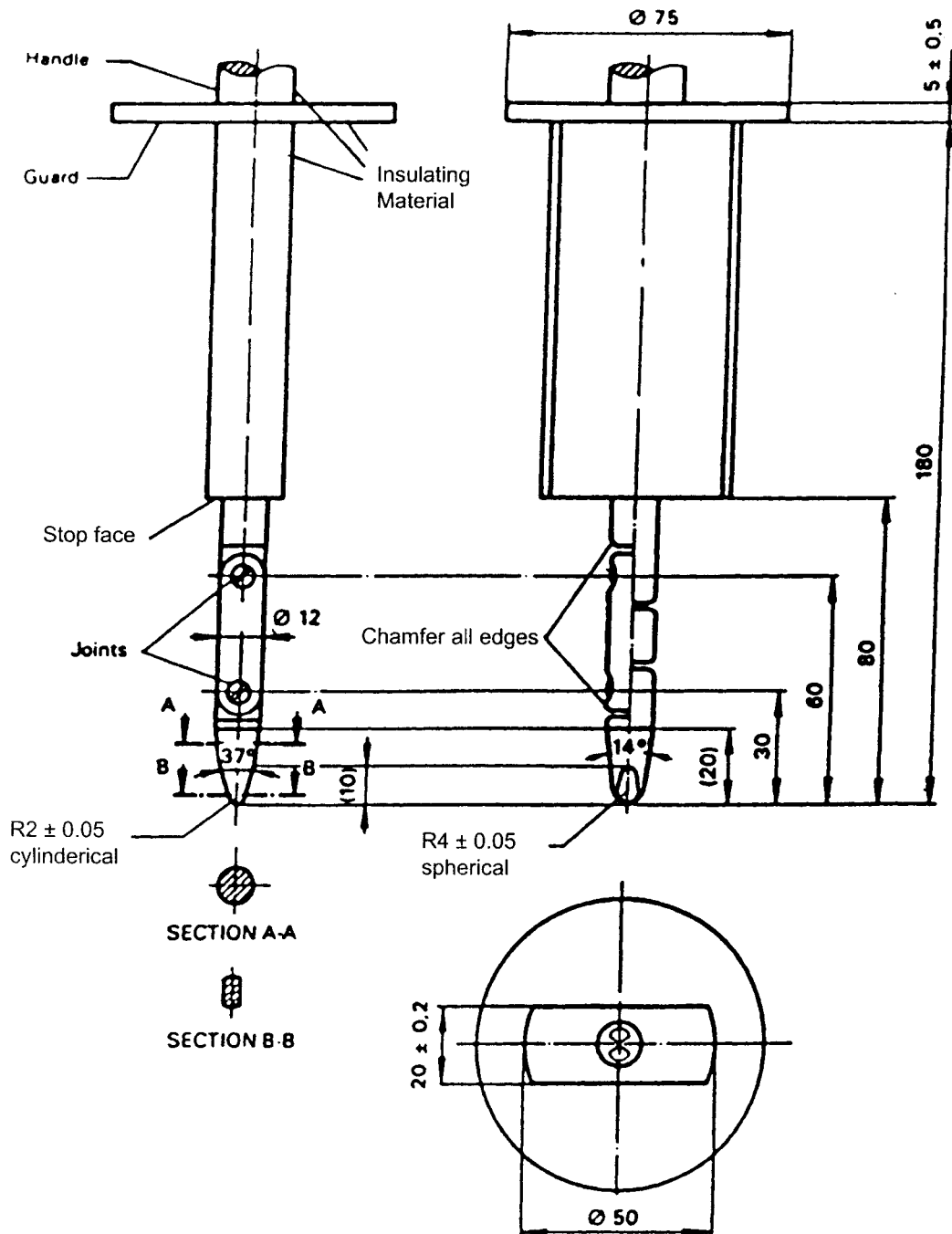
The test wire is provided with an electrical indicator, with a voltage not less than 40 V and not more than 50 V, to show contact with relevant part.

8.2 Parts providing protection against electric shock shall have adequate mechanical strength and shall be reliably secured by means of screws or in a similar reliable manner so that they will not work loose in normal use.

Compliance is checked by inspection and by the tests of clauses 21 and 23.

9 PROVISION FOR EARTHING

9.1 For rewirable cable reels having accessible metal parts insulated from live parts by basic insulation only:



Linear dimensions are in millimeters

Tolerance on dimensions without specific tolerance:

On angles: 0
-10°

On linear dimensions:

Up to 25 mm: 0
-0.05

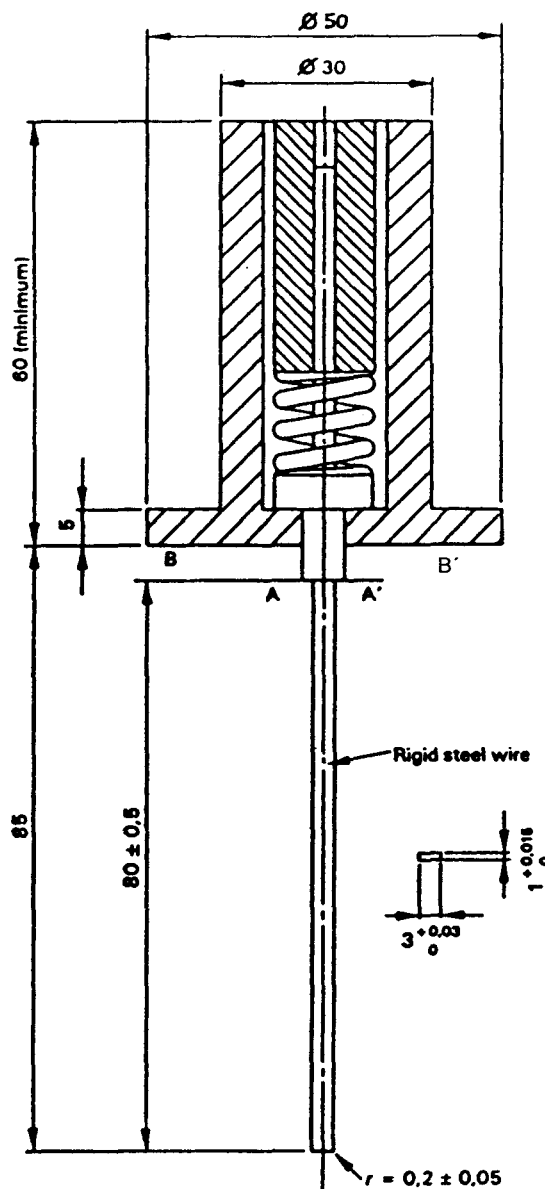
Over 25 mm: ± 0.2

Material of finger: for example heat-treated steel

Both joints of this finger may be bent through an angle of $90 + \begin{smallmatrix} 10^\circ \\ 0 \end{smallmatrix}$ 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 shall ensure 90° bending angle with tolerance of $+ \begin{smallmatrix} 10^\circ \\ 0 \end{smallmatrix}$

FIG. 1 STANDARD TEST FINGER



To calibrate the gauge, a push force of 1N is applied on the steel rigid wire in the direction of its axis: the characteristics of the gauge internal spring shall be such that the surface $A-A'$ is brought practically to the same level as the surface $B-B'$ when this force is applied.

All dimensions in millimetres.

FIG. 2 GAUGE FOR CHECKING NON-ACCESSIBILITY OF LIVE PARTS FOR CABLE REELS WITH INCREASED PROTECTION

- the earthing terminal shall comply with the requirements of 10
- the earthing terminal shall be located in proximity to the terminals for current carrying conductors
- internal connections between the earthing terminal and accessible metal parts shall be independent of the connection of the flexible cable in order to prevent loosening of internal connections during the replacement of flexible cable

9.2 All parts of the earthing terminal shall be such that there is no risk of corrosion resulting from contact between these parts and the copper of the earthing conductor, or any other metal that is in contact with these parts. The body of the earthing terminal 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, plated steel complying with 26, or other metal not less resistant to corrosion.

9.3 If the body of the earthing terminal is a part of a

frame or enclosure of aluminium or aluminium alloy, precautions shall be taken to avoid the risk of corrosion resulting from contact between copper and aluminium or its alloys.

Screws and nuts of plated steel withstanding the test of **26** are considered to be of a metal no less resistant to corrosion than brass.

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

For the purpose of this requirement, small screws and the like for fixing bases or covers are not deemed to be parts which may become live in the event of an insulation fault.

9.5 The earth connection shall be effectively ensured under all conditions which may occur in normal use, including loosening of fixing screws for covers, careless mounting of the cover or the like.

Compliance with the requirements of **9.1** to **9.5** is checked by inspection.

9.6 Earthing terminals intended for the connection of flexible external conductors shall be designed with ample space for slack of the earthing conductor in such a way that, if the strain relief should fail, the connection of the earthing conductor is subjected to strain after the connections of the current-carrying conductors and that, in case of excessive stress, the earthing conductor will break after the current-carrying conductors.

Compliance is checked by the following test:

The flexible cable is connected to the cable reels in such a way that the current-carrying conductors are led from the strain relief to the corresponding terminals along the shortest possible path.

After they are correctly connected, the core of the earthing conductor is led to its terminal and cut off at a distance 8 mm longer than necessary for its correct connection.

The earthing conductor is then connected to its terminal. It shall then be possible to house the loop, which is formed by the earthing conductor owing to its surplus length, when the cover of the cable reel is remounted and fixed correctly.

9.7 Internal earthing circuit in cable reels, including any joints contacts and the like, shall be of low electrical resistance.

Compliance is checked by the following measurement which is made after the test specified in **21**.

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 of the cable or 25 A, whichever is the

greater, is passed through the earthing circuit. The voltage drop is measured and the resistance calculated from the current and the resistance calculated from the current and this voltage drops.

The resistance shall not exceed 0.05 Ω .

9.8 In cable reels having accessible parts insulated from live parts by basic insulation only, the connection between the earthing terminal for the incoming flexible cable and accessible metal parts of the cable reel shall be of low electrical resistance.

Compliance is checked by the following measurement which is made after the test specified in **21**.

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 of the flexible cable or 25 A, whichever is the greater, is passed through the earthing circuit. The voltage drop is measured and the resistance calculated from the current and this voltage drop.

The resistance shall not exceed 0.1 Ω .

9.9 Internal movable earth contacts, for example, slip rings, of cable reels shall be as follows.

9.9.1 Movable earth contacts between the terminal for the earthing conductor of the incoming flexible cable and the earthing terminal for the outgoing flexible cable or that of the socket-outlet shall be duplicated.

One of these shall be a slip ring or an equally effective contact, while the other may be a ball bearing, a plain bearing or the like, as long as it is of metal.

9.9.2 Movable earth contacts between the terminal for the earthing conductor of the incoming flexible cable and accessible metal parts of the cable reel shall be duplicated each of which may be a ball bearing, a plain bearing or the like, if of metal.

10 TERMINALS

10.1 Non-rewirable cable reels shall be provided with terminations which shall be soldered, welded, crimped or equally effective non-reusable connections.

Connections made by crimping a pre-soldered flexible conductor are not permitted, unless the soldered area is outside the crimping area.

Compliance is checked by inspection.

10.2 Rewirable cable reels shall be provided with screw-type terminals for external copper conductors.

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

Internal connections shall be independent of the

connection of the external flexible cable.

NOTE — An internal connection is considered independent if the conductor of any internal wiring maintains its correct position in the terminal when replacing the external flexible cable.

Compliance is checked by inspection.

10.3 Terminals with screw clamping for external copper conductors

10.3.1 Cable reels shall be provided with terminals which shall allow the proper connection of copper conductors having nominal cross-sectional areas as shown in Table 1.

Compliance is checked by inspection, and by the insertion of the largest conductor after the insulation has been removed and the ends of the rigid stranded and of the flexible conductors have been reshaped.

The stripped end of the conductor shall be able to enter completely within the clamping unit aperture without use of undue force.

10.3.2 Screw-type terminals shall allow the conductor to be connected without special preparation.

Compliance is checked by inspection.

NOTE — The term 'special preparation' covers soldering of the wires of the conductor, use of 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.

10.3.3 Screw-type terminals shall have adequate mechanical strength. Screws and nuts for clamping the conductors shall have an ISO metric thread or a thread comparable in pitch and mechanical strength.

Compliance is checked by inspection.

10.3.4 Screw-type terminals shall be resistant to corrosion. Terminals, the body of which is made of metal as specified in 23.5, are considered as complying with this requirement.

Terminals of ferrous material are subjected to the test of 26.

NOTE — Tests on terminals made of other material, are under consideration.

10.3.5 Screw-type terminals shall be so fixed that when the clamping means is tightened or loosened, the terminal does not work loose, the internal conductors are not subject to stress and that creepage distances and clearances are not reduced below the values specified in 24.

Compliance is checked by inspection after the test of 23.1.

NOTES

1 Terminals may be prevented from working loose by fixing with two screws, by fixing with one screw in a recess such that there is no appreciable play, or by other suitable means.

2 Covering with sealing compound without other means of locking is not considered to be sufficient.

However self-hardening resins may be used to lock terminals which are not subject to torsion in normal use.

10.3.6 Screw-type terminals shall be so designed that they clamp the conductor without undue damage to it.

Compliance is checked by the following test.

The clamping unit is fitted with the appropriate number of conductors, as shown in Table 1, first with conductors of the smallest cross-sectional areas and then with conductors of the largest cross-sectional areas.

The clamping screws or nuts are tightened with the torque according to Table 2.

Column I of Table 2 applies to headless screws 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.

Table 1 Nominal Cross-Sectional Area of Conductors
(Clauses 10.3.1 and 10.3.6)

Rated Current	Rigid (Solid or Stranded) Copper Conductors		Flexible Copper Conductors	
	Nominal Cross-Sectional Area	Diameter of Largest Conductor	Nominal Cross-Sectional Area	Diameter of Largest Conductor
A	mm ²	mm	mm ²	mm
Portable cable reels up to and including 16A	—	—	From 0.75 up to and including 1.5	1.8
Fixed cable reels up to and including 10A	From 1 up to and including 2.5	2.2	From 0.75 up to and including 1.5	1.8
Fixed cable reels above 10A, up to and including 16A	From 1.5 up to and including 2 × 2.5	2.2	From 1 up to and including 1.5	1.8

Table 2 Torque for Testing Screws and Nuts
(Clause 10.3.6)

Nominal Diameter of Thread mm	Torque, Nm	
	I	II
Up to and including 2.8	0.2	0.4
Over 2.8 up to and including 3.0	0.25	0.5
Over 3.0 up to and including 3.2	0.3	0.6
Over 3.2 up to and including 3.6	0.4	0.8
Over 3.6 up to and including 4.1	0.7	1.2
Over 4.1 up to and including 4.7	0.8	1.8
Over 4.7 up to and including 5.3	0.8	2.0

Column II applies to screws which are tightened by means of a screwdriver and to screws and nuts which are tightened by means other than a screwdriver.

Each conductor is subjected to the following test, arranged as shown in Fig. 3.

The end of one conductor is passed through an appropriate sized bushing in a platen positioned at a height (*H*) below the equipment as given in Table 3. The bushing is positioned in a horizontal platen such

that its centre line describes a circle of 75 mm diameter, concentric with the centre of the clamping unit in the horizontal plane; the platen is then rotated at a rate of (10 ± 2) rev/min.

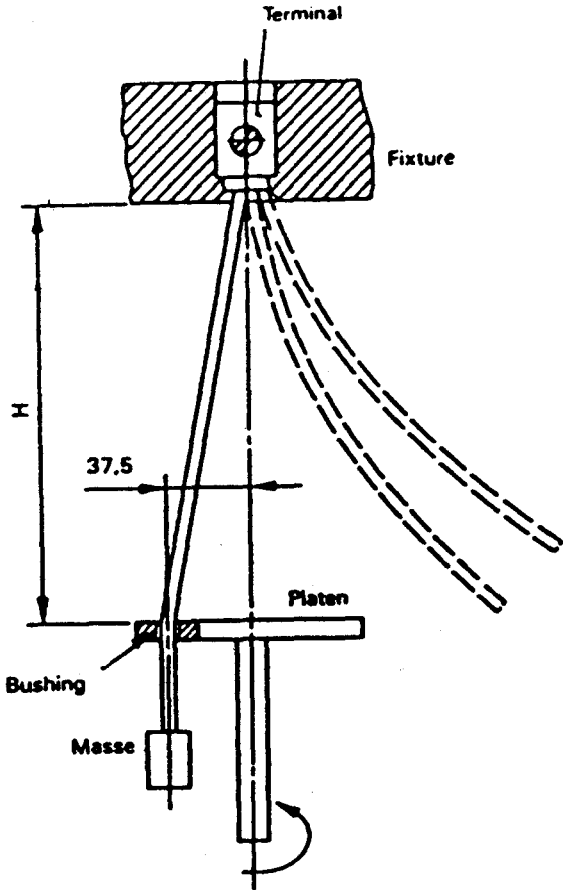
The distance between the mouth of the clamping unit and the upper surface of the bushing shall be within ± 15 mm of the height in Table 3. The bushing may be lubricated to prevent binding, twisting or rotation of the insulated conductor.

A mass as specified in Table 3 is suspended from the end of the conductor. The duration of the test is 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 terminal shall not be subjected to additional torsion and pull forces.

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



All dimensions in millimetres.

FIG. 3 ARRANGEMENTS FOR CHECKING DAMAGE TO CONDUCTORS

Table 3 Diameter of Bushing Hole, Heights and Masses for Conductor for the Arrangement for Checking Damage to Conductors (see Fig. 3)
(Clause 10.3.6)

Conductor Cross-Sectional Area mm ²	Diameter of Bushing Hole ¹⁾ mm	Height ²⁾ H mm	Mass for Conductor kg
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	260	0.7

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

²⁾ Tolerance for height $H \pm 15$ mm.

10.3.7 Screw-type terminals 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 the appropriate number of conductors, as shown in Table 1, first with conductors of the smallest cross-sectional areas, and then with conductors of the largest cross-sectional areas.

The clamping screws or nuts are tightened with the torque equal to two-thirds of the torque shown in the appropriate column of Table 2.

Each conductor is then subjected to a pull as specified in Table 4 applied without jerks, for 1 min in the direction of the axis of the conductor space.

Table 4 Pull Forces

Cross-sectional area, mm ²	0.75	1.0	1.5	2.5
Pull force, N	30	35	40	50

NOTE --- For the tests of 10.3.6 and 10.3.7:

- the clamping units may be tested separately from the cable reel.
- separate clamping units may be provided by the manufacturer.

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

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

10.3.8 Screw-type terminals shall be so designed or placed that neither a rigid solid conductor nor a wire of a stranded or flexible conductor can slip out while the clamping screws or nuts are tightened.

Compliance is checked by the following test:

The terminals are fitted with the appropriate conductors

having the largest cross-sectional area specified in Table 1.

Terminals intended for the looping-in of two or three conductors as checked, when fitted with the permissible number of conductors. Terminals are fitted with conductors in accordance with IS 694 and IS 9968 (Part 1).

Before insertion into the clamping means of the terminal, wires of rigid solid or stranded conductors are straightened. In addition, rigid stranded conductors may be twisted to restore them approximately to their original shape and flexible conductors are twisted in one direction so that there is uniform twist of one complete turn in a length of approximately 2 cm.

The conductor is inserted into the clamping unit until it just protrudes from the far side of the clamping unit if possible, 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 2.

For flexible conductors the test is repeated with a new conductor which is twisted as before, but in the opposite direction.

After the test, no wire of the conductor shall have escaped outside the clamping unit.

10.3.9 Clamping screws or nuts of earthing terminals 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 a manual test.

11 FLEXIBLE CABLES AND THEIR CONNECTION

11.1 Cable reels shall be provided with a flexible cable complying with IS 694 or IS 9968 (Part 1) and not lighter than ordinary tough rubber sheathed flexible cable or light PVC sheathed flexible cable.

11.1.1 Minimum cable sizes shall be based on the lowest rating of the plug or any protection device, incorporated in the cable reel; in particular:

- up to and including 6A: not less than 0.75 mm²
- 10A: not less than 1.0 mm²
- 16A: not less than 1.5 mm²
- other cables shall be interpolated.

11.1.2 Flexible cables shall have the same number of conductors as there are poles in the plug and in the socket-outlets, earthing contacts, if any, being considered as one pole, irrespective of their number.

The conductor connected to the earthing contact shall be identified by the colour combination green/yellow.

11.1.3 Maximum length of flexible cable shall be as shown in Table 5.

Table 5 Maximum Length of Flexible Cable

Cross-sectional area of flexible cable, mm ²	0.75	1	1.5	2.5
Length, m	30	40	60	100

11.1.4 The end of a stranded conductor shall not be consolidated by soft soldering at places where the conductor is subject to contact pressure, unless the clamping means is designed so as to obviate the risk of a bad contact due to cold flow of the solder.

Compliance with the requirements of **11.1** is checked by inspection, by measurement and by checking that the flexible cables are in accordance with IS 694 or IS 9968 (Part 1), as applicable.

11.2 Cable reels shall be provided with an anchorage so that the conductors are relieved from strain, including twisting, where they are connected to the terminals, and that their covering is protected from abrasion.

The cable anchorage shall be of insulating material, or be provided with an insulating lining fixed to the metal parts of the cord anchorage and be so designed that the flexible cable cannot touch clamping screws, if any, of the cord anchorage, if these screws are accessible or electrically connected to accessible metal parts.

Glands shall not be used as cable anchorages.

Make shift methods, such as tying the flexible cable into a knot or tying the ends with string, shall not be used.

Compliance with this requirement is checked by inspection.

11.3 For rewirable cable reels:

- it shall be clear how the relief from strain and the prevention from twisting is intended to be effected
- the cable anchorage, or parts of it, shall be integral with or fixed to one of the parts of the cable reel
- the cable anchorage shall be suitable for the different types of flexible cables which may be connected, and insulating linings, if any, shall be securely fixed to the metal parts. Metal parts of the cable anchorage shall be insulated from the earthing circuit
- the cable anchorage shall be so designed and

located that replacement of the flexible cable is easily possible

- clamping screws, if any, which have to be operated when replacing the flexible cable, shall not serve to fix any other component

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

11.4 The cable anchorage of cable reels is subjected to a pull test followed by a torque test.

Non-rewirable cable reels are tested with the flexible cable as delivered, but with the conductors of flexible cable cut adjacent to the terminations.

For rewirable cable reels, the conductors are introduced into the terminals, the terminal screw being tightened just sufficiently to prevent the conductors from easily changing their position. The cable anchorage is used in the normal way, any clamping screws being tightened with a torque equal to two-thirds of that specified in **10.3.6**.

After reassembly of the cable reel, the parts shall fit snugly. It shall not be possible to push the flexible cable into the cable reel to any appreciable extent.

The flexible cable is then subjected 100 times to a pull of the value specified below. The pulls are applied in the most unfavourable direction in the immediate vicinity of the cable anchorage:

- 60N for cable reels with flexible cable having a nominal cross-sectional area not exceeding 1.0 mm²
- 80N for cable reels with flexible cable having a cross-sectional area greater than 1.0 mm²

The pulls are applied without jerks, each time for 1 s.

Immediately afterwards, the flexible cable is subjected for 1 min to a torque of 0.25 Nm.

During the test, the flexible cable shall not be damaged.

After the test, the flexible cable shall not have been displaced by more than 2 mm and the ends of the conductors shall not have moved noticeably in the terminals, or at the terminations.

11.5 Cable reels shall be so designed that the flexible cable is protected against damage caused by the opening for the passage of the flexible cable.

Compliance is checked by inspection and by the following test.

The flexible cable is subjected 25 times to a pull of 60N. The pulls are applied in the most unfavourable direction without jerks, each time for 1 s.

After the test, the flexible cable shall not be damaged.

11.6 The rated current of the plug, if any, shall not be less than the rated current of the cable reel.

Compliance is checked by inspection.

12 CONSTRUCTION

12.1 Cable reels shall be so constructed that the surface on which the flexible cable is wound shall have a diameter of at least eight times the maximum diameter of the circular flexible cable or at least eight times the average of the maximum lower and upper dimensions of a flat flexible cable as given in IS 694 or IS 9968 (Part 1), as appropriate.

Compliance is checked by measurement.

12.2 Accessible metal parts of cable reels insulated from live parts by basic insulation only shall be reliably connected to an earthing terminal or earthing contact (see 9.4).

Accessible metal parts of other cable reels shall be separated from live parts by double or reinforced insulation. Such cable reels may be provided with means for maintaining the continuity of protective circuits provided such means are within the cable reel and are insulated from accessible surfaces by double or reinforced insulation.

Compliance is checked by inspection and by the test specified in 17 and 24.

12.3 Rewirable cable reels shall be so constructed as to permit:

- the conductors to be easily introduced into the terminals
- the correct positioning of the conductors without their insulation coming into contact with bare metal parts of a polarity different from that of the conductor
- winding of the flexible cable in a smooth space without sharp edges, burrs and the like which might cause damage to the insulation of the flexible cable
- internal wiring to remain securely fixed whilst the flexible cable for fixed wiring is connected
- an adequate arrangement of the terminals so as to allow the flexible cable to be easily introduced and connected without the risk of damaging the insulation of the flexible cable

Compliance is checked by inspection and by disconnecting and reconnecting using the flexible cables as delivered with the cable reel.

12.4 Inlet openings in metal through which flexible cables pass shall be provided with bushing of insulating material.

12.5 Non-rewirable cable reels shall be such that:

- the flexible cable cannot be separated from the cable reel without making it permanently useless
- the cable reel cannot be opened by hand or by using a general purpose tool, for example, a screwdriver

NOTE — A cable reel is considered to be permanently useless when, for re-assembling the cable reel, parts or materials other than the original are to be used.

12.6 Flexible cables shall be effectively prevented from coming into contact with moving parts which might cause damage to the flexible cable.

12.7 Bare live conductors shall be so fixed that the distance between them, and the distances to accessible metal parts shall be secured in a reliable manner so that they cannot decrease under the required values given in 24.

Compliance is checked after the tests of 21.

12.8 Cable reels shall be so constructed that there is no risk of contact between live parts and accessible metal parts due to loosened internal wiring, screws or the like.

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

12.10 Cable reels shall be so constructed that there are no free openings in their covers for live parts other than the entry openings of the socket-outlets for the pins of plugs.

12.11 Thermal cut-outs and current cut-outs:

- shall be trip-free
- shall be of the non-self-resetting type
- shall be so constructed that they can be reset without opening covers for terminals
- shall be so constructed that the setting of temperature or of current cannot be altered by the user
- shall disconnect:
 - a) at least 1 pole in two-pole cable reels, which shall be the phase pole on polarized cable reels
 - b) all poles, except the neutral pole, in other cable reels

Fuses are only allowed when it is not possible for the user to change them with fuses of a higher rating than originally fitted. The protective conductor, if any, shall not be interrupted.

12.12 Cut-outs shall not self-reset at low temperature.

Compliance is checked by the following test:

The cut-out shall be caused to operate and shall be checked that it does not self-reset when kept at low temperature of $-10^{\circ} \pm 2^{\circ}\text{C}$ for approximately 8 h.

12.13 Switches, if fitted, shall disconnect all poles, except if fitted in cable reels using polarized plug and socket-outlets where the neutral need not be switched off.

The protective conductor, if any, shall not be interrupted.

12.14 Inlet bushings shall be reliably fixed and be so shaped as to prevent damage from the material in which they are mounted. Inlet bushings shall not be made of natural or synthetic elastomeric material, for example, rubber.

12.15 Cable reels with incorporated residual current-operated circuit-breakers shall be so constructed that no more than 2 m of cable remain on the supply side of the residual current-operated circuit-breaker (see Fig. 6 on page 20).

Compliance with the requirements of **12.4** to **12.15** is checked by inspection and by a manual test, and furthermore, for **12.14** by the test of clause **14**.

12.16 Residual current operating circuit-breakers incorporated in cable reels shall have a rated residual current not greater than 30 mA.

Compliance is checked by inspection.

13 COMPONENTS

Components incorporated or integrated in cable reels, such as flexible cables, plugs and socket-outlets, current cut-outs, thermal cut-outs, safety transformers, motors, switches, fuses, residual current operated circuit-breakers, lampholders and connecting devices shall comply with the relevant standards as far as they reasonably apply.

Components shall suit the conditions occurring in the cable reel.

Compliance is checked by inspection.

14 RESISTANCE TO AGEING

Cable reels shall be so constructed and be of a material such that they are sufficiently resistant to ageing.

Compliance is checked by the following accelerated ageing test, followed immediately by the tests specified in **15** and **17**.

Cable reels are fitted with flexible cables for which they are designed, glands, if any, being tightened with a torque equal to two-thirds of that specified in **21**.

The cable reel fully-reeled is placed in its normal position of use in a heating cabinet ventilated by natural circulation in an atmosphere having the composition and pressure of the ambient air. The temperature in the heating cabinet and the duration of the ageing test are $70^{\circ} \pm 2^{\circ}\text{C}$ for seven days (168 h).

After the cable reel has been allowed to return to room temperature at the end of the test, the cable reel is examined without being dismantled and without loosening or tightening any of the screwed connections.

The samples shall show no crack visible with normal or corrected 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 sample is pressed with a force of 5N.

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

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

Furthermore, the sealing compounds shall not flow out.

NOTE — The force of 5N can be obtained in the following way. The sample is placed on one of the parts of a balance and the other pan is loaded with a mass equal to the mass of the sample plus 500 g. Equilibrium is then restored by pressing the sample with the forefinger wrapped in a dry piece of rough cotton cloth.

15 RESISTANCE TO HARMFUL INGRESS OF WATER

The enclosure of cable reels protected against splashing water or water jets shall provide the degree of protection against ingress of water in accordance with the classification of cable reels.

Compliance is checked by the following tests:

- cable reels protected against splashing water are subjected to the test specified for the degree of protection IPX4 according to the requirement of IS 12063
- cable reels protected against water jets are subjected to the test specified for the degree of protection IPX5, according to the requirements of IS 12063

Immediately after testing, the cable reels shall withstand an electric strength test specified in **17.2** and inspection shall show that water has not entered to any appreciable extent and has not reached live parts.

16 RESISTANCE TO HUMIDITY

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

Compliance is checked by the following humidity treatment:

If knock-outs are provided, one of them is opened.

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, at all places where samples can be located, is maintained within 1°C of any convenient value t between 15°C and 35°C.

Before being placed in the humidity cabinet, the sample is brought to a temperature between t and $t \pm 4^\circ\text{C}$.

The samples are kept in the cabinet for:

- two days (48 h) for ordinary cable reels
- seven days (168 h) for splash-proof and jet-proof cable reels protected against splashing water and water jets

NOTES

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

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 sufficiently 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.

Immediately after this treatment the cable reels shall comply with the insulation resistance and the electric strength test specified in 17.1 and 17.2. They shall show no damage within the meaning of this standard.

17 INSULATION RESISTANCE AND ELECTRIC STRENGTH

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

Compliance is checked by the tests specified in 17.1 and 17.2 which are made immediately after the test of 16 in the humidity cabinet or in the room in which the samples were brought to the prescribed temperature, after reassembly of those parts which may have been removed. Cable reels shall be unreeled prior to carrying out the tests.

17.1 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 insulation resistance shall not be less than 5 M Ω and shall be measured consecutively:

- a) between all poles connected together and the body;
- b) between each pole in turn and all others, these being connected to the body;

- c) between any metal enclosure and metal foil in contact with the inner surface of its insulating lining, if any.

This test is only made if an insulating lining is necessary to provide insulation;

- d) between any accessible metal part of the anchorage, including clamping screws, and the earthing terminal or earthing contact, if any, of portable cable reels; and
- e) between any accessible metal part of the anchorage of portable cable reels and a metal rod of the maximum diameter of the flexible cable inserted in its place.

The term 'body' includes all accessible metal parts, handles, knobs, grips and the like and their shafts, if these shafts become live in the event of an insulating fault, and metal foil in contact with all accessible surfaces of insulating material; it does not include metal parts which are not accessible.

Measurements (c), (d) and (e) are not made on non-rewirable cable reels.

Whilst the metal foil is wrapped round the outer surface or placed in contact with the inner surface of parts of insulating material it is pressed against holes or grooves without any appreciable force by means of a straight unjointed test finger having the same dimensions as the standard test finger shown in Fig. 1.

17.2 The insulation of the cable reel is subjected for 1 min to a voltage of substantially sine-wave form, having a frequency of 50 Hz. Initially not more than half the prescribed voltage is applied, then it is raised rapidly to the full value. The points of application are those indicated in 17.1.

The test voltage shall be as follows:

- 1 250 V for cable reels having a rated voltage up to and including 130 V
- 2 000 V for cable reels having a rated voltage exceeding 130 V

In case of accessible metal parts which are not earthed the voltage between these parts and live parts shall be 4 000 V.

No flashover or breakdown shall occur during the test.

NOTES

1 A revision of the 4 000 V value is under consideration.

2 Glow discharges without drop in voltage are neglected.

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

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

4 The r.m.s. value of the test voltage applied is measured within ± 3 percent.

18 NORMAL OPERATION

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

Compliance is checked by the tests of **18.2** to **18.4**.

18.2 In cable reels incorporating contacts intended to make connection between fixed and moving parts (for example, slip rings) each phase conductor, neutral conductor and earthing conductor, if any, is loaded with the current related to the minimum cross-section of **11.1** derived from the a.c. source with a no-load voltage not exceeding 12 V

The voltage drop is measured adjacent to the contact making members.

This measurement shall be made immediately after the cable reel, under rated load, has reached its steady thermal condition.

In no case shall the resistance exceed 0.05 Ω .

The test is repeated after the cable reel has been subjected to the test for normal operation described in **18.3** and to the electric strength test of **18.4**.

The increase of resistance shall be not more than 50 percent with a maximum of 0.075 Ω for the phase conductor(s) and the neutral conductor, and a maximum of 0.05 Ω for earthing conductor.

NOTE — This test may need revision when more experience has been gained.

18.3 The flexible cable is unreeled and recoiled on to the cable reel as in normal use at a maximum rate of 0.5 m/s in the direction most likely to occur in normal use.

The test is carried out as described in **18.3.1** to **18.3.3**.

18.3.1 For hand-operated cable reels not incorporating movable contacts (slip rings or the like):

- the total length of the flexible cable is unreeled
- the number of cycles of operation is 100

18.3.2 For hand-operated cable reels incorporating movable contacts:

- the flexible cable is unreeled in such a way that the rotating part of the reel makes approximately two revolutions, and such that at least two turns of the flexible cable remain on the reel
- during the recoiling, the flexible cable is held under tension applying a force of 10 N/mm² the total cross-sectional area of the conductors of the flexible cable
- the number of cycles of operation is 10 000.

18.3.3 For automatic cable reels:

- the flexible cable is unreeled in such a way that the rotating part of the reel makes approximately two revolutions, and such that at least two turns of flexible cable remain on the reel
- during the recoiling, the flexible cable is held under tension applying a force which is adapted to the reeling force of the cable reel
- the number of cycles of operation is 10 000
- the cable of a reel incorporating an automatic return mechanism shall be fully-unreeled and allowed to return unhindered 100 times incorporated using the automatic system

After the tests of **18.3.1**, **18.3.2** and **18.3.3**, the cable reel shall show no damage impairing safety and its further use.

In particular, the cable reel shall show:

- no loosening of electrical connections
- no loosening of mechanical parts or connections
- no damage to the sheath or insulation of the flexible cable

18.4 Immediately after the tests of **18.3**, the cable reels shall withstand an electric strength test, as described in **17.2**, but with the test voltage reduced by 500 V. The test is made without a preceding humidity treatment.

No flashover or breakdown shall occur during the test.

In addition there shall be no breakage of electrical connections or conductors.

19 TEMPERATURE RISE IN NORMAL USE

19.1 Cable reels shall not attain excessive temperatures in normal use (*see* Table 6), such that they cause any danger to persons or surroundings.

19.2 Compliance is checked by determining the temperature rise of the various parts under the following conditions:

Portable cable reels are placed in their normal position of use in a test corner as near to the walls as possible. The test corner consists of a floor and two walls at right angles, all of a dull black-painted plywood having a nominal thickness of 20 mm.

Fixed cable reels are mounted on the wall or the ceiling in a test corner as near to the ceiling and wall as possible. The test corner consists of a ceiling and two walls at right angles, all of dull black-painted plywood having a thickness of 20 mm.

Such temperature rises are determined by means of

fine-wire thermocouples so chosen and positioned that they have the minimum effect on the temperature of the part under test.

Thermocouples used for determining the temperature rise of the surface of walls, ceiling and floor are embedded in the surface or attached to the back of small blackened disks of copper or brass, 15 mm in diameter and 1 mm thick, which are flush with the surface.

As far as possible, the cable reel is positioned so that parts likely to attain the highest temperature touch the disks.

In determining the temperature rise of handles, knobs, grips and the like, consideration is given to all parts which are gripped in normal use and of insulating material, to parts in contact with hot metal.

The temperature rise of electrical insulation is determined at places where failure could cause a short-circuit, contact between live parts and accessible metal parts, or reduction of creepage distances or clearances below the values specified in 24.

The test is made both with cable reels fully reeled and unreeled. Cable reels are loaded with the rated power corresponding respectively to the marking for the unreeled and reeled condition; they are operated until steady conditions are established.

The test current corresponds to $\cos \varphi = 1 - \frac{0}{0.05}$.

20 TEMPERATURE RISE UNDER OVERLOAD CONDITION

Cable reels shall be so constructed that there is no risk of fire or electric shock as a result of abnormal electrical load. Cable reels incorporating a thermal and/or current cut-outs are subjected to the test of 20.1, other types are submitted to the test of 20.2.

20.1 Cable reels are tested under the conditions described in 19, and are loaded with the highest possible current at which the thermal or current cut-out will not operate, until steady conditions are established, or 4 h, whichever is the shorter period.

NOTE — Steady conditions are reached when the temperature does not vary more than 1 K/h (1°C/h).

The temperature rise of the parts of the cable reels, shown in Table 6 shall not exceed by more than 25 K (°C) of the relevant values in Table 6.

After the test, the following conditions shall be fulfilled:

- the cable reel shall show no deformation affecting the protection against electric shock
- there shall be no short-circuit or damage to the insulation of the cable reel or to the flexible cable, and the further use of the cable reel shall not be impaired

Compliance is checked by inspection, by a test with the standard test finger shown in Fig. 1, applied immediately after the temperature rise test and by the electric strength test specified in 17.2, the test voltage being reduced by 500 V.

The humidity treatment is not repeated before the electric strength test.

The thermal and/or current cut-out shall not be deformed or damaged, and the preset value shall not be changed.

Compliance is checked by inspection and by a comparison release test on a thermal or current cut-out fitted in a cable reel that has not been subjected to the test of 20.1.

The earth connection shall not be impaired.

Compliance is checked by the test specified in 9.7.

20.2 For this test, three additional samples shall be used. The cable reel is tested fully-reeled, under the conditions described in 19, the test load being that corresponding to 1.5 times the maximum rated current of the socket-outlets in which the plug of the cable reel may be inserted, at the rated voltage or 1.5 times the rated current of the protective device in case of fixed cable reels.

The test circuit shall be protected by a short-circuit protective device. The short-circuit current at the point where the cable reel is installed being 3 000 A $\pm$ 5 percent.

The load is applied until steady state conditions are reached or the short-circuit protective device has operated.

After the test, the following conditions shall be fulfilled:

- The cable reel shall show no deformation affecting the protection against electric shock.

Compliance is checked with the cable reel kept fully-reeled, by inspection and by a test with the standard test finger of Fig. 1. It shall not be possible to touch live parts.

After the cable reel has cooled down to approximately room temperature, the following pull is applied without jerks, as in normal unreeling operation, five times, each time for 10 s:

- 60 N maximum for cable reels with flexible cable having a nominal cross-sectional area not exceeding 1.0 mm²
- 80 N maximum for cable reels with flexible cable greater than 1.0 mm²

The cable reel is submitted again to the test with the standard test finger of Fig. 1, during which it shall not

Table 6 Maximum Normal Temperature Rise
(Clauses 19.1 and 20.1)

Parts	Temperature Rise K (°C)
Rubber insulation of internal and external wiring and flexible cable	35
Polyvinyl chloride insulation of internal and external wiring and flexible cable	45
Cord-sheath used as supplementary insulation .	35
Silicone rubber insulation of internal wiring and flexible cords	145
Rubber used for gaskets or other parts the deterioration of which could affect safety:	
— when used as supplementary insulation or as reinforced insulation	40
— in other cases	50
Material used as insulation other than for wires:	
— moulding of	
• phenol-formaldehyde with cellulose fillers	85
• phenol-formaldehyde with mineral fillers	100
• melamine-formaldehyde	75
• urea-formaldehyde	65
— polyester with glass-fibre reinforcement	110
— silicone rubber	145
— polytetrafluoroethylene	265
— pure mica and tightly sintered ceramic material when such products are used as supplementary or reinforced insulation	400
— thermoplastic material	¹⁾
Supports, walls, ceiling and floor of the test corner	60
Sliding contacts	65
Handles and similar parts which, in normal use, are touched by hand:	
— of metal	40
— of insulating material	50
Terminals, including earthing terminals for external conductors	60
Lampholder E27:	
— metal or ceramic type	160
— insulated type, other than ceramic	120
Lampholders E 14, B 15, B 22:	
— metal or ceramic type	130
— insulated type, other than ceramic	90
— with T-marking	T-25

NOTE — Experience has shown that the hottest point of flexible cable insulation is likely to occur between the second and third layers, in the central area of the cable reel when carefully reeled.

¹⁾ Due to the great number of thermoplastic insulating materials, it is not possible to specify permissible temperature rises for such materials. Provisionally, the ball pressure test of 22.3 shall be made.

During the test, the thermal and/or current cut-outs shall not operate.

After the test, the cable reel shall show no deformation or damage within the meaning of this standard.

During the test the temperature rises necessary to perform the test of 22.3 are to be determined.

be possible to touch live parts or metal parts, not connected to earth, which might have come in contact with live parts. If the cable is partially or fully-extended, the extended part of the cable is then submitted to a dielectric test applying voltage values as specified in 17.2, but reduced by 500 V.

The extended part of the cable is immersed in water at a temperature of $27^{\circ} \pm 5^{\circ}\text{C}$ for 1 h leaving a maximum of 200 mm of extended cable above the water at each end.

The voltage is then applied between all conductors connected together and the water, the test voltage being applied for 5 min.

- The continuity of the connection to earth of the accessible metal parts, if any, mentioned under 9.4 shall not be impaired if the continuity of the live conductor(s) is maintained.

Compliance is checked by inspection and by a

continuity test using an electrical indicator according to 8.1.1.

— The cable reel shall not have caught fire.

21 MECHANICAL STRENGTH

21.1 Cable reels shall have adequate mechanical strength and be so constructed as to withstand such rough handling as may be expected in normal use.

Compliance is checked by the following:

- Portable cable reels having a total mass up to and including 2.5 kg, by the tests of 21.2 and 21.3;
- Portable cable reels having a total mass over 2.5 kg but not exceeding 30 kg, by the tests of 21.2 and 21.4;
- Portable cable reels having a total mass over 30 kg, by the tests of 21.2 and 21.5;
- Cable reel for fixed mounting, by the test of 21.2;
- Cable reels provided with screwed glands, by the additional test of 21.7.

21.2 Blows are applied to the cable reel by means of the spring-operated impact-test apparatus shown in Fig. 4, the impact energy being 1 J.

The apparatus consists of three main parts: the body, the striking element and the spring loaded release cone. The body comprises the housing, the striking element guide, the release mechanism and all parts rigidly fixed thereto. The mass of this assembly is $1\,250 \pm 10$ g. The striking element comprises the hammer head, the hammer shaft and the cocking knob. The mass of this assembly is 250 ± 10 g.

The hammer head has a hemispherical face of radius 10 mm and is made of polyamide having a Rockwell hardness of HR 100.

The cone has a mass of 60 g, and the cone spring exerts a force of approximately 5 N when the release jaws are on the point of releasing the striking element. The release mechanism springs are adjusted so that they exert a force just sufficient to keep the release jaws in the engaged position.

The tripping force required to release the striking element should not exceed 10 N. The configuration of the hammer shaft, the hammer head and the means for the adjustment of the hammer spring is such that the hammer spring has released all its stored energy approximately 1 mm before the tip of the hammer head passes the plane of impact.

For the last millimetre of its travel prior to impact, the striking element shall be free from friction, a freely moving mass having only kinetic energy and no stored energy. Moreover, after passing the phase of impact, the striking element shall be free to travel without interference over a further distance of at least 8 mm.

The apparatus is cocked by pulling the cocking knob until the release jaws engage with the groove in the hammer shaft.

The blows are applied by pushing the release cone against the sample in a direction perpendicular to the surface of the point to be tested.

The pressure is slowly increased so that the cone moves back until it is in contact with the release bars, which then moves to operate the release mechanism and allows the hammer to strike.

The cable reel is rigidly supported and three blows are applied to every point of the enclosure that is likely to be weak, including socket-outlets, signal lamps and the like, if these are integral with the reel construction. The blows are applied to those parts which in normal use are exposed to blows, not being protected by mounting in a recess.

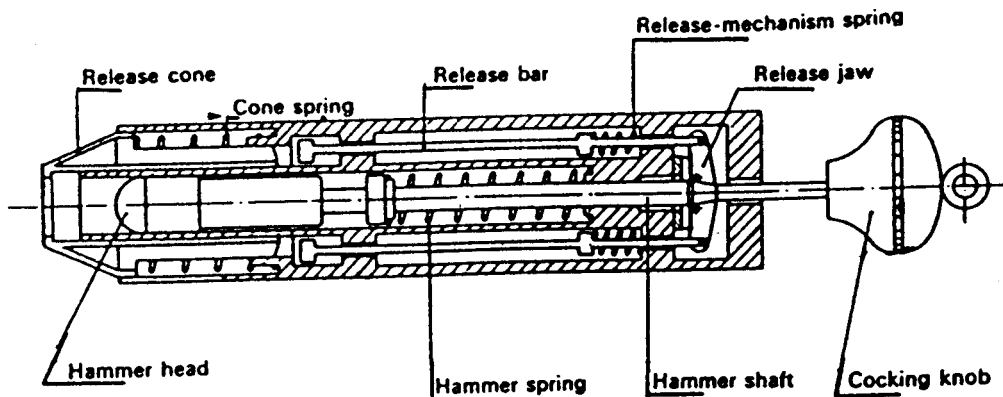


FIG. 4 IMPACT TEST APPARATUS

Portable cable reels non-protected against harmful ingress of water are subjected to the impact test of this sub-clause at a temperature of -5°C .

Portable cable reels protected against splashing water or water jets are subjected to the impact test of this sub-clause at a temperature of $-15^{\circ} \pm 2^{\circ}\text{C}$.

The cable reels are kept in a refrigerator until the prescribed temperature has been reached, the cable reels being subjected to the test within 1 min after their removal from the refrigerator.

21.3 Cable reels are allowed to fall 10 times in the most onerous way from a height of 0.75 m onto a concrete floor. During the test, the total length of the flexible cable shall be wound onto the reel.

21.4 Cable reels are allowed to fall 10 times from a carrying handle height of 0.75 m onto a concrete floor. During the test, the total length of the flexible cable shall be wound onto the reel.

NOTE — The term ‘carrying handle height’ denotes the vertical distance from the floor up to the handle of the cable reel which is normally used for carrying the cable reel over a short distance.

21.5 Cable reels are overturned 10 times in their normal position against a concrete floor in the most unfavourable direction but not more than three times in the same direction.

During the test, the total length of the flexible cable shall be wound onto the reel.

21.6 After the tests of **21.2** to **21.5**, the protection against electric shock shall not be affected, and the cable reel shall show no damage which may affect safety or impair the further use of the cable reel. In particular:

- socket-outlets and electrical connections shall not have worked loose or been damaged;
- covers or enclosures shall show no cracks visible to the naked eye;
- the effectiveness of insulating barriers or other parts of insulating material shall not have been damaged.

Damage to the finish, small dents which do not affect creepage distances or clearances, and small chips which do not adversely affect the protection against electric shock or moisture are neglected.

NOTE — Cracks not visible with normal or corrected vision, without additional magnification, and surface cracks in fibre reinforced mouldings and the like are ignored.

21.7 Screwed glands shall withstand the mechanical stresses occurring in normal use.

Compliance is checked by the following test:

The screwed gland is fitted with a cylindrical metal

rod having a diameter, in millimetres, equal to the nearest whole number below the internal diameter of the packing.

The gland is then tightened by means of a suitable spanner, the torque shown in Table 7 being applied for 1 min.

Table 7 Test Torque for Glands

Diameter of Test Rod mm	Torque Nm	
	Metal Glands	Glands of Moulded Material
Up to and including 14	6.25	3.75
Above 11 up to and including 20	7.50	5.00
Above 20	10.00	7.50

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

22 RESISTANCE TO HEAT

22.1 Cable reels shall be sufficiently resistant to heat.

Compliance is checked by the tests specified in **22.2** and **22.3**, which are carried out with cable reels having the cable fully unreeled.

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

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

After the test, the samples are then allowed to cool down to approximately room temperature.

The standard test finger as shown in Fig. 1 is then applied with a force not exceeding 5N: there shall be no access to live parts.

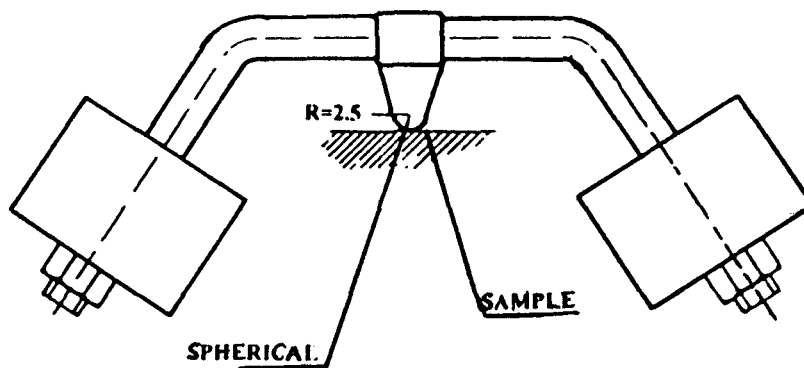
After the test, the marking shall still be legible.

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

22.3 External parts of insulating material, parts of insulating material necessary to retain live parts and parts of the earthing circuit, if any, in position, are subjected to a ball-pressure test by means of the apparatus shown in Fig. 5.

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 this surface by a force of 20 N.

The ball pressure test apparatus is raised to the prescribed test temperature before the specimen is placed in a heating cabinet.



All dimensions in millimetres.

FIG. 5 BALL PRESSURE APPARATUS

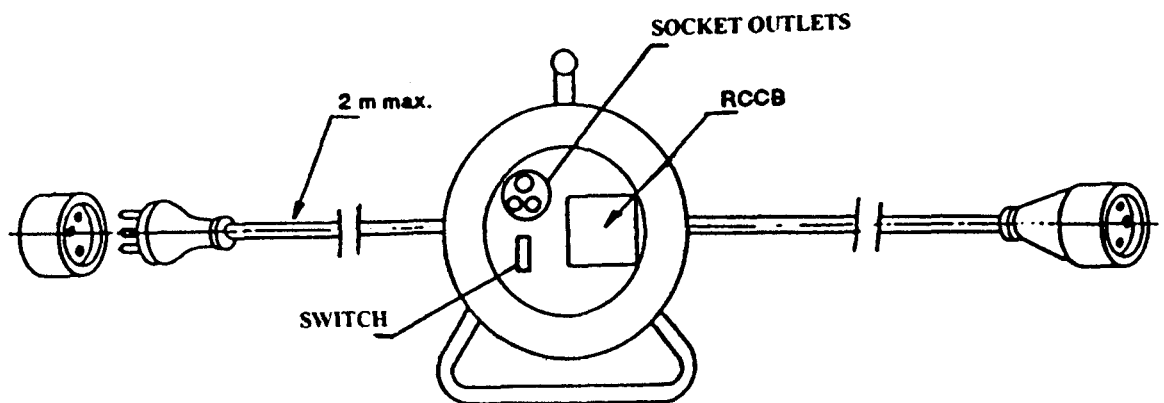


FIG. 6 EXAMPLES OF CABLE REELS WITH INCORPORATED RESIDUAL CURRENT CIRCUIT BREAKERS

The test is made in the heating cabinet at a temperature which is $40^{\circ} \pm 2^{\circ}\text{C}$ in excess of the temperature rise of the relevant parts determined during the test at clause 19, or at a temperature of $70^{\circ} \pm 2^{\circ}\text{C}$, whichever is the higher. For parts of insulating material necessary to retain live parts and parts of the earthing circuit, if any, in position, the temperature shall be $125^{\circ} \pm 2^{\circ}\text{C}$.

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.

23 SCREWS, CURRENT-CARRYING PARTS AND CONNECTIONS

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

Screws which transmit electrical contact pressure shall screw into metal.

Compliance is checked by inspection and, for screws and nuts transmitting contact pressure or which are operated while the cable reel is being mounted and connected, by following test.

The screws or nuts are tightened and loosened:

- 10 times for screws in engagement with a thread of insulating material
- five times for nuts and other screws

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

When testing terminal screws and nuts, a copper conductor having the largest cross-sectional area specified in 10.3.1 or a conductor having a cross-sectional area equal to that of the flexible cable

delivered with the cable reel is placed in the terminal.

The test is made by means of a suitable test screwdriver, applying a torque as shown in Table 2.

The conductor is moved each time the screw or nut is loosened. During the test, terminals shall not work loose and no damage impairing the further use of the screwed connections shall occur, such as breakage of screws or damage to threads, washers, pressure plates or the head slots (rendering the use of the appropriate screwdriver impossible).

NOTES

- 1 Screws or nuts which are operated while the cable reel is being mounted and connected include terminal screws or nuts, assembly screws, screws for fixing covers and the like.
- 2 The shape of the blade of the test screwdriver should match the head of the screw.
- 3 The screws and nuts are not tightened in jerks.
- 4 Damage to covers is neglected.
- 5 It is recommended that screws which are likely to be tightened by the user be captive.

23.2 For screws in engagement with a thread of insulating material and which are operated while the cable reel is being mounted and connected, correct introduction into the screw hole or nut shall be ensured.

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

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

23.3 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 of the insulating material.

Compliance is checked by inspection.

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

23.4 Screws, nuts, 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 a 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.

23.5 Current-carrying parts, including those of

terminals (also earthing terminals), shall be of a metal having, under the conditions occurring in the cable reel, 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 rolled sheet (in cold condition) and at least 50 percent copper for other parts
- 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:
 - 5 µm for cable reels not protected against harmful ingress of water
 - 12 µm for cable reels protected against splashing water
 - 25 µm service condition No. 3, for cable reels protected against waterjets
- steel provided with an electroplated coating of nickel and chromium according to IS 1068, the coating having a thickness of at least:
 - 20 µm for cable reels not protected against harmful ingress of water
 - 30 µm for cable reels protected against splashing water
 - 40 µm for cable reels protected against water jets
- steel provided with an electroplated coating of tin, according to IS 1359, the coating having a thickness of at least:
 - 12 µm for cable reels not protected against harmful ingress of water
 - 20 µm for cable reels protected against splashing water
 - 30 µm for cable reels protected against water jets

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

Compliance is checked by inspection.

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

23.7 Thread-forming screws of thread-cutting 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.

23.8 Thread cutting screws shall not be used where the user may need to remove them for connection or replacement of flexible cable.

23.9 Screws which are operated when mounting or connecting the cable reel shall not be of metal which is soft or liable to creep, such as zinc or aluminium.

23.10 Screws which are removed when replacing the flexible cable or other parts, shall not be of insulating material, if their replacement by metal screws could impair the insulation between live parts and earthed parts or accessible metal parts.

Compliance with the requirements of **23.7** to **23.10** is checked by inspection.

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

Compliance with the requirement is checked by inspection and, if in doubt, by chemical analysts.

24 CREEPAGE DISTANCES, CLEARANCES AND DISTANCES THROUGH SEALING COMPOUND

Creepage distances and clearances shall be not less than the values shown in Table 8.

Compliance is checked by measurement.

Measurements are made on the cable reels as delivered, lined with the appropriate flexible cables; fixed cable reels are wired with the largest cross-sectional area of fixed wiring cable specified in **10.3.1**.

Distances through slots or openings in external parts of insulating material are measured to a 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 test finger in Fig. 1, but is not pressed into openings.

NOTES

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

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

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

25.1 Resistance to Abnormal Heat and 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 cable reel, shall not be unduly affected by abnormal heat or fire.

Compliance is checked by means of the following glow-wire tests:

The glow-wire 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

Table 8 Minimum Creepage Distances and Clearances
(Clause 24)

Sl No.	Description	Rated Voltage of the Cable Reel			
		Up to and Including 250 V		Over 250 V Up to and Including 415 V	
		Creepage distance	Clearances	Creepage distance	Clearances
1)	Between live parts of different polarity	3	3	4	3
2)	Between live parts and:				
	a) the earthing contact or accessible earthed metal parts	3	3	4	3
	b) accessible metal parts separated from live parts by reinforced insulation or double insulation	6	6	8	6
	c) other metal parts separated from live parts by functional insulation	3	3	4	3
3)	Between accessible metal parts and other metal parts which are separated from accessible metal parts by supplementary insulation	3	3	4	3

NOTE — This table does not apply to components which have to meet their own standards (see clause 13).

earthing circuit of fixed cable reels in position, by the test made at a temperature of 850°C

- for parts of insulating material necessary to retain current-carrying parts and parts of the earthing circuit of portable cable reels in position, by the test made at a temperature of 750°C
- for 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, by the test made at a temperature of 650°C

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

Small parts, such as washers, are not subjected to the test of this sub-clause.

The test is not made on parts of ceramic material.

NOTE — 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 condition, has a limited time to burn without spreading fire by flame or burning parts or droplets falling down from the tested part onto the pinewood board covered with a tissue paper.

If possible, the sample should be a complete cable reel.

If the test cannot be made on a complete cable reel, a suitable part may be cut from it for the purpose of the test.

The test is made on one sample.

In case of doubt, the test shall be repeated on two further samples.

The test is made applying the glow-wire once.

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

The tip of the glow-wire shall be applied to the specified surface of the sample taking into account the conditions of the intended use under which a heated or glowing element may come into contact with the sample.

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

- there is no visible flame and no sustained glowing, or if;
- flames and glowing at the sample extinguish within 30 s after the removal of the glow-wire.

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

25.2 Resistance to Tracking

Insulating parts of cable reels other than ordinary, supporting or in contact with live parts and earthing circuits, shall be resistant to tracking.

For material other than ceramic, compliance is checked by the proof tracking test specified in IS 2824, using the test solution A and a test voltage of 175 V.

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

The test is made at three places on the sample, or on three samples.

26 RESISTANCE TO RUSTING

Ferrous parts, shall be adequately protected against rusting.

Compliance is checked by the following test.

All grease is removed from the parts to be tested by immersion in trichloroethane or an equivalent degreasing agent for 10 min. The parts are then immersed for 10 min in a 10 percent solution of ammonium chloride in water at a temperature of $27^\circ \pm 5^\circ\text{C}$.

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

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

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

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 only subjected to the test if there is doubt about the effectiveness of the grease film, and the test is then made without previous removal of the grease.

NOTE — When using the liquids specified for the test, adequate precautions should be taken to prevent inhalation of the vapour.

27 SCHEDULE OF TESTS

27.1 Type Test

The following shall be carried out as type tests on selected sample (*see 5*) of cable reels being drawn preferably at random from a regular lot of production:

- a) Marking (*see 7*);
- b) Protection against electric shock (*see 8*);
- c) Provision for earthing (*see 9*);
- d) Terminals and terminations (*see 10*);
- e) Flexible cables and their connection (*see 11*);

- f) Construction (*see 12*);
- g) Components (*see 13*);
- h) Resistance to ageing (*see 14*);
- j) Resistance to harmful ingress of water (*see 15*);
- k) Resistance to humidity (*see 16*);
- m) Insulation resistance and electric strength (*see 17*);
- n) Normal operation (*see 18*);
- p) Temperature rise in normal use (*see 19*);
- q) Temperature rise under overload condition (*see 20*);
- r) Mechanical strength (*see 21*);
- s) Resistance to heat (*see 22*);
- t) Screws, current-carrying parts and connections (*see 23*);
- u) Creepage distances, clearances and distances through sealing compound (*see 24*);
- v) Resistance of insulating material to abnormal heat, to fire and to tracking (*see 25*); and
- w) Resistance to rusting (*see 26*).

27.2 Criteria for Acceptance

The specimen subjected to the type tests shall pass the test for providing conformity with the requirements of this standard. The criteria of acceptance are given in 5.4.

27.3 Acceptance Tests

The following shall constitute the acceptance tests:

- a) Protection against electric shock (*see 8*);
- b) Provision for earthing (*see 9*);
- c) Resistance to humidity (*see 16*);
- d) Insulation resistance and electric strength (*see 17*);
- e) Normal operation (*see 18*); and
- f) Temperature rise in normal use (*see 19*); and
- g) Mechanical strength (*see 21*).

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

27.4 Routine Tests

Guidance for routine tests are under consideration.

ANNEX A

(Clause 27.3.1)

SAMPLING PROCEDURE

A-1 LOT

In any consignment, all samples of cable reels 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.

A-1.1 Selection of Samples

From each lot, a certain number of cable reels as specified in Table 9 shall be selected at random and subjected to tests specified in 27.2.

A-2 CRITERION FOR CONFORMITY

A-2.1 In Table 9, N1 is the size of the first sample. If the number of failures found in this sample is less than or equal to C1 the lot shall be considered to be

conforming to this standard and accepted. If the number of failures is greater than or equal to C2, the lot shall be rejected. If the number of failures is between C1 and C2, further sample of N2 pieces shall be taken and subjected to all tests.

A-2.1.1 If the number of failures in the two samples combined is less than C2 the lot shall be accepted, otherwise rejected.

Table 9 Sampling Plan
(Clauses A-1.1 and A-2.1)

Lot Size	N1	N2	(N1 + N2)	C1	C2
Up to 50	5	5	0	2	2
51 to 100	8	8	0	2	2
101 to 300	13	13	0	2	2
301 to 500	20	20	0	2	3
501 and above	32	32	0	3	4

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