BRITISH STANDARD

BS EN
61316:2000
IEC 61316:1999

Industrial cable reels

The European Standard EN 61316:1999 has the status of a British Standard

ICS 29.060.01; 29.120.99; 55.060

National foreword

This British Standard is the official English language version of EN 61316:1999. It is identical with IEC 61316:1999.

The UK participation in its preparation was entrusted to Technical Committee PEL/23/4, Protected type plugs and sockets, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

From 1 January 1997, all IEC publications have the number 60000 added to the old number. For instance, IEC 27-1 has been renumbered as IEC 60027-1. For a period of time during the change over from one numbering system to the other, publications may contain identifiers from both systems.

Cross-references

Attention is drawn to the fact that CEN and CENELEC Standards normally include an annex which lists normative references to international publications with their corresponding European publications. The British Standards which implement these international or European publications may be found in the BSI Standards Catalogue under the section entitled “International Standards Correspondence Index”, or by using the “Find” facility of the BSI Standards Electronic Catalogue.

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Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 28, an inside back cover and a back cover.

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EUROPEAN STANDARD

NORME EUROPÉENNE

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English version

Industrial cable reels
(IEC 61316:1999)

Enrouleurs de câbles industriels
(CEI 61316:1999)

Leitungsroller für industrielle Anwendung
(IEC 61316:1999)

This European Standard was approved by CENELEC on 1999-10-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

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Foreword

The text of document 23H/93/FDIS, future edition 2 of IEC 61316, prepared by SC 23H, Industrial plugs and socket outlets, of IEC TC 23, Electrical accessories, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61316 on 1999-10-01.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2000-07-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2002-10-01

This standard is to be used in conjunction with EN 60309-1:1999.

Annexes designated "normative" are part of the body of the standard.
In this standard, annex ZA is normative.
Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61316:1999 was approved by CENELEC as a European Standard without any modification.

CONTENTS

INDUSTRIAL CABLE REELS

1 Scope

This International Standard applies to cable reels provided with a non-detachable flexible cable with a rated operating voltage not exceeding 690 V a.c./d.c. and 500 Hz with a rated current not exceeding 63 A, primarily intended for industrial use, either indoors or outdoors, for use with accessories complying with IEC 60309-1 or IEC 60309-2.

This standard applies to:

– portable cable reels equipped with one plug or appliance-inlet and at least one socket-outlet, each complying with IEC 60309-1 or IEC 60309-2;

– fixed cable reels equipped with at least one socket-outlet complying with IEC 60309-1 or IEC 60309-2;

– cable reels suitable for use at ambient temperature normally within the range of –25 °C to +40 °C.

The use of this equipment on construction sites and for agricultural, commercial and domestic appliances are not precluded.

This standard also applies to cable reels intended to be used in extra-low voltage installations.

In locations where special conditions prevail, for example, on board ships, vehicles and the like, or where explosions are liable to occur, additional requirements may be necessary.

NOTE – Additional requirements for cable reels for currents higher than 63 A are under consideration.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60050(195):1998, *International Electrotechnical Vocabulary (IEV) – Part 195: Earthing and protection against electric shock*

IEC 60068-2-75:1997, *Environmental testing – Part 2-75: Tests – Test Eh: Hammer tests*

IEC 60245 (all parts), *Rubber insulated cables – Rated voltages up to and including 450/750 V*

IEC 60245-4:1994, *Rubber insulated cables – Rated voltages up to and including 450/750 V – Part 4: Cords and flexible cables*

IEC 60309-1:1999, *Plugs, socket-outlets and couplers for industrial purposes – Part 1: General requirements*

IEC 60309-2:1999, *Plugs, socket-outlets and couplers for industrial purposes – Part 2: Dimensional interchangeability requirements for pin and contact-tube accessories*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*

3 Definitions

For the purpose of this International Standard, the following definitions apply.

NOTE – Where the terms “voltage” and “current” are used, they imply the d.c. or a.c. r.m.s. values.

3.1
rated operating 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 cable may be wound on to a reel

NOTE – Plugs and socket-outlets and appliance inlet or connectors supplied with cable reels are considered as part of the reel.

3.3.1
portable cable reel
cable reel which can be moved easily 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
rewireable cable reel
cable reel so constructed that the flexible cable can be replaced with the aid of a general-purpose tool

3.6
non-rewireable cable reel
cable reel so constructed that it forms a complete unit with the flexible cable, the plug and the socket-outlets fixed by the manufacturer of the cable reel in such a manner that, after dismantling, the cable reel is rendered unfit for any further purpose

3.7
accessible part
part which can be touched by means of the standard test finger

3.8
detachable part
part which can be removed without the aid of a general-purpose tool

3.9
creepage distance
shortest path along the surface of an insulating material between two conductive parts

3.10
clearance
shortest distance in air between two conductive parts

3.11
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

3.12
current cut-out
current-sensing control device intended to switch off automatically under abnormal operating conditions and which has no provision for adjustment by the user

3.13
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

3.14
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 or for fixed cable reel as a separate unit within sight of the cable reel

3.15
basic insulation
insulation of hazardous live parts providing basic protection against electric shock
[IEV 195-06-06 modified]

3.16
supplementary insulation
independent insulation provided in addition to the basic insulation, in order to ensure protection against electric shock in the event of a failure of the basic insulation
[IEV 195-06-07, modified]

3.17
double insulation
insulation comprising basic insulation and supplementary insulation in order to provide protection against electric shock if basic insulation fails
[IEV 195-06-08, modified]

3.18
reinforced insulation
single insulation system which provides protection against electric shock equivalent to double insulation
[IEV 195-06-09, modified]

3.19
termination
insulated or non-insulated connecting devices serving for non-reusable connection of the conductors of the supply cable

3.20
terminal
conductive part of one pole, composed of one or more clamping unit(s) and insulation if necessary

3.21
clamping unit(s)
part(s)of the terminal necessary for mechanical clamping and electrical connection of the conductor(s), including the parts which are necessary to ensure the correct contact pressure

3.22
connecting device
device for the electrical connection of one (or more) conductor(s), either fixed to a base or forming an integral part of the equipment

4 General

4.1 General requirements

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

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

4.2.4 General notes on tests

This subclause of IEC 60309-1 is applicable, except as follows:

4.2.4 *Replacement:*

Unless otherwise stated, one sample is submitted to all the tests, and the requirements are satisfied if all the tests are met.

4.2.5 *Replacement:*

If the sample 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 in the required sequence. Tests which follow shall be made on another sample, which shall comply with the requirements of this standard.

5 Standard ratings

This clause of IEC 60309-1 is applicable except as follows:

5.2 *Replacement:*

The rated current shall not be higher than the maximum rated current of the inlet or of the connector.

Preferred rated currents are given in the following table:

Table 1 – Preferred rated currents

Series I	Series II
A	A
16	20
32	30
63	60

Compliance with the requirements of clause 5 are checked by inspection of the marking.

6 Classification

Cable reels are classified in several ways, as shown below.

6.1 According to the type of construction

– portable cable reels
– fixed cable reels

6.2 According to the method of winding the flexible cable

– hand-operated cable reels
– spring-operated cable reels
– motor-driven cable reels

6.3 According to the degree of protection in IEC 60529

– the minimum degree of protection shall be IP24D.

6.4 According to their protection against excessive temperatures

– cable reels incorporating thermal-cut-out
– cable reels incorporating current-cut-out
– cable reels incorporating both thermal- and current-cut-outs

6.5 According to the method of connecting the cable

– rewireable cable reels
– non-rewireable cable reels

6.6 According to the material of the drum

– cable reels with drum made of insulating material
– cable reels with drum made of other material

7 Marking

7.1 Cable reels shall be marked with:

– rated operating voltage(s) or range(s) in volts;

– symbol for nature of supply;

– either the name, trade mark or identification mark of the manufacturer or of the responsible vendor;

– type reference, which may be a catalogue number;

– symbol for degree of protection;

NOTE – The degrees of protection are based on IEC 60529.

– maximum load which may be connected to the cable reel in fully reeled and fully unreeled condition:

EXAMPLE 1 1 000 W 400 V cable fully reeled

EXAMPLE 2 3 500 W 400 V cable fully unreeled.

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

A ..... Amperes

V ..... Volts

Hz ..... Hertz

W ..... Watts

~ ..... Alternating current

⎓ ..... Direct current

IPXX(D)* ..... Degree of protection

 ..... Fully reeled cable reel

 ..... Fully extended cable reel

 ..... Earth

*(D) This supplementary letter shall not be marked if the first characteristic numeral is a 4 or greater.

For the marking of rated current(s) and rated operating voltage(s) or range(s), figures may be used alone. The figure for d.c. rated operating voltage, if any, shall then be placed before the figure for the a.c. rated operating voltage and separated from it by a line or a dash.

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

7.4 If marking plates or labels are used, they shall be reliably secured. After all the tests of this standard, marking shall be easily legible and labels shall show no curling or loosening at the corners or edges.

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

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 cotton cloth soaked in water and again for 15 s with a piece of cotton cloth soaked in petroleum spirit.

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

NOTE 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, a kauributanol value of approximately 29, an initial boiling point of approximately 65 °C, a dry point of approximately 69 °C and a density of approximately 0,68 g/cm^3.

8 Dimensions

This clause of IEC 60309-1 is applicable except as follows:

8.1 *Addition:*

The surface on which the cable is wound shall be at least eight times the maximum diameter of the cable as given in IEC 60245-4, as appropriate.

For cable reels using flat cable, the surface on which the cable is wound shall have a diameter of at least 10 times the average of the upper and lower dimensions of the cable.

8.2 This subclause of IEC 60309-1 is not applicable.

8.3 This subclause of IEC 60309-1 is not applicable.

9 Protection against electric shock

This clause of IEC 60309-1 is applicable except as follows:

9.1 *Replacement:*

Cable reels shall be designed so that live parts are not accessible when the cable reel 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 tests of 9.1.1 and 9.1.2.

These tests shall be made immediately after the cable reel has passed a current having a value corresponding to the maximum load, when fully reeled, for 1 h at an ambient temperature of 20 °C ± 5 °C.

9.1.1 *The standard test finger shown in figure 2 of IEC 60309-1 is applied with a force of 10 N ± 1 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 compliance with the requirement, the test is repeated but at an ambient temperature of 35 °C ± 2 °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 part shall be accessible.

9.1.2 *The test is made with a straight rigid steel wire of 1±0,015 mm, applied with a force of* $(1^{+0,1}_{0})$ *N. The end of the wire shall be free from burrs and be at right angles to its length.*

NOTE – This test does not apply to the accessories fitted to the cable reel.

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.

9.4 *Addition:*

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 24 and 25.

10 Provision for earthing

10.1 For rewireable cable reels having accessible metal parts insulated from live parts by basic insulation only:

– the earthing terminal shall comply with the requirements of clause 11;
– 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;
– when terminals of live conductors are accessible, any additional dismantling shall not be necessary to reach the earthing terminal. Moreover, the earthing terminal shall not be more than 50 mm distance from the other terminals.

10.2 Corrosion resistance of earth terminal

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 or plated steel complying with clause 25, or other metal no less resistant to corrosion.

10.3 Corrosion resistance of screws and nuts

Screws and nuts of plated steel withstanding the test of clause 25 are considered to be of a metal no less resistant to corrosion than brass.

Compliance with the requirements of 10.1 to 10.3 is checked by inspection.

10.4 Earth connections

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

NOTE 1 – For the purpose of this standard screws and the like for fixing bases or covers are not deemed to be parts which may become live in the event of a fault.

NOTE 2 – If accessible metal parts are screened from live parts by metal parts which are connected to the earthing terminal or termination, or if they are separated from live parts by double insulation or reinforced insulation, they are not, for the purpose of this requirement, regarded as likely to become live in the event of an insulation fault.

Compliance is checked by inspection and by the following test:

A current of 25 A derived from an a.c. source having a no-load voltage not exceeding 12 V is passed between the earthing terminal and each of the accessible metal parts in turn.

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

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

NOTE 3 – Care should be taken that the contact resistance between the measuring probe and the metal part under test does not influence the test results.

10.5 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 is checked by inspection.

10.6 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 connection of the current-carrying conductors and that, in case of excessive stresses, the earthing conductor will not break before the current-carrying conductors break.

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 connections.

The earthing conductor is then connected to its terminal. It shall then be possible to house the loop, which is formed by the protective conductor owing to its surplus length, freely in the wiring space without squeezing or pressing the core when the cover of the cable reel is put on again and fixed correctly.

10.7 The 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 clause 24.

A current derived from an a.c. source, having a no-load voltage not exceeding 12 V, and equal to 1,5 times the rated current of the cable reel 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.

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

10.8 Internal moveable earth connections of cable reels, e.g. slip rings, shall be as follows:

10.8.1 Moveable earth connections between the terminal for the earthing conductor of the incoming cable and the earthing terminal for the outgoing cable, or that of the socket outlet, shall be duplicated. One of these connections shall be a slip ring or an equally effective contact, while the other connection may be a ball-bearing, a plain bearing, or the like, provided it is metallic.

10.8.2 Moveable earth connections between the terminal for the earthing conductor of the incoming 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, provided it is metallic.

Compliance is checked by inspection.

11 Terminals

This clause of IEC 60309-1 is applicable except as follows:

11.1 *Replacement:*

Rewireable cable reels shall be provided with terminals in which connection is made by means of screws, nuts or equally efficient devices.

Non-rewireable cable reels shall not be provided with screwed or snap-on connections.

NOTE 1 – Terminations used should be soldered, welded, crimped or have equally effective permanent connections.

NOTE 2 – It is permissible to use the rewireable terminals of the accessories, such as plugs and couplers as terminations for the flexible cable, if the conductors of the cable are permanently connected to the terminal by soldering or welding.

Connections made by crimping a pre-soldered flexible conductor are not permitted.

Compliance is checked by inspection.

11.6 *Modification:*

Delete, in the first line, the words “to the accessory”.

12 Interlocks

This clause of IEC 60309-1 is not applicable.

13 Resistance to ageing of rubber and thermoplastic material

This clause of IEC 60309-1 is applicable.

14 General construction

14.1 Rewireable 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, or with accessible metal parts,
– internal wiring to remain securely fixed whilst the flexible cable 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.

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

14.3 Non-rewireable 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,
– winding of the flexible cable is done in a smooth space without sharp edges, burrs and the like which might cause damage to the insulation of the flexible cable.

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

14.4 Flexible cables shall be effectively prevented from coming into contact with moving parts which might cause damage to their insulation.

14.5 Bare live conductors shall be reliably secured so that the distance between them, and the distances to accessible metal parts, cannot be reduced below the values given in clause 26.

Compliance is checked by measurement and inspection after the tests of clause 24.

14.6 Cable reels incorporating one or more socket-outlets shall ensure continuity to the earth contacts.

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

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

14.9 A cable reel shall be fitted with a thermal cut-out and/or a current cut-out, which shall be

– trip-free;
– of a non self-resetting type;
– constructed so that when resetting, live parts shall not become accessible;
– constructed so that the setting of temperature or current cannot be altered by the user;
– and which shall disconnect
  a) at least one pole in two-pole cable reels, which shall be the phase pole on polarized cable reels; or
  b) all poles, except the neutral pole on other cable reels.

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

NOTE – In Denmark fuses are not allowed.

14.10 Cable entry shall be reliably fixed and be so shaped as to prevent damage from the material in which they are mounted. Cable entry shall not be made of natural elastomeric material e.g. rubber.

14.11 Cable reels incorporating a residual current device with $I_{\Delta n} \leq 30$ mA shall be so constructed that no more than 2 m of cable remains on the supply side of the residual current device.

Compliance for subclauses 14.6 to 14.11 is checked by inspection and by manual test and furthermore, for 14.10, by the test of clause 13.

14.12 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 it shall be checked that it does not self-reset when kept at a low temperature of (–25 ± 2) °C for approximately 18 h.

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

Plug and appliance inlets shall be in accordance with IEC 60309-1 or IEC 60309-2. At least one of the socket-outlets or connectors shall be in accordance with IEC 60309-1 or IEC 60309-2. Other socket-outlets shall either be in accordance with another harmonized system or in accordance with the system of socket-outlets in the country where the cable reel is intended to be used.

Socket-outlets shall be of a type which prevents the insertion of plugs used with class 0 equipment.

NOTE – The plugs for equipment of class 0 can be used only as far as national wiring rules permit.

Portable cable reels shall be equipped with one plug or appliance inlet and at least one socket outlet. Fixed cable reels shall be equipped with at least one socket outlet.

The rated current of socket-outlets or connectors shall not be higher than the rated current of the cable reel. Socket-outlets or connectors with a rated current lower than the rated current of the cable reel shall be protected by a suitable protecting device.

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

Components shall suit operating conditions specified for the cable reel.

Compliance is checked by inspection.

15 Construction of socket-outlets

This clause of IEC 60309-1 is not applicable.

16 Construction of plugs and connectors

This clause of IEC 60309-1 is not applicable.

17 Construction of appliance inlets

This clause of IEC 60309-1 is not applicable.

18 Degrees of protection

This clause of IEC 60309-1 is applicable except as follows:

18.1 *Replacement of the first two paragraphs by the following:*

Cable reels shall have the degrees of protection marked on the products.

Socket-outlets of domestic type are tested without the plug inserted and with the lid, if any, closed.

Compliance is checked by the appropriate tests mentioned in 18.1 and 18.2.

18.2 *Replacement:*

Cable reels shall be tested in accordance with 18.1 and IEC 60529 in fully unreeled condition for portable cable reels in the most unfavourable position. Fixed cable reels shall be tested as above, but mounted as specified by the manufacturer's instructions.

Immediately after the tests, the samples shall withstand the dielectric strength test specified in 19.3, and inspection shall show that water has not entered the samples to such an extent that could impair its further use.

18.3 This subclause of IEC 60309-1 is not applicable.

18.4 This subclause of IEC 60309-1 is not applicable.

18.5 *Replacement*

All cable reels shall be proofed against humid conditions which may occur in normal use.

Compliance is checked by the humidity treatment described in this subclause, followed immediately by the measurement of the insulation resistance and by the dielectric strength test, specified in clause 19.

Cable entries, if any, are left open. If knock-outs are provided, one of them is opened.

Covers which can be removed or opened without the aid of a tool are removed or opened and subjected to the humidity treatment along with the main part. Spring lids are open during this treatment.

The humidity treatment is carried out in a humidity cabinet containing air with a relative humidity maintained between 91 % and 95 %. The temperature of the air, at all places where samples can be located, is maintained within 1 °C of any convenient value between 20 °C and 30 °C.

The sample is kept in the cabinet for seven days (168 h) for IPX4 and IPX5 cable reels.

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

A relative humidity between 91 % and 95 % 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.

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

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

19 Insulation resistance and dielectric strength

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

Compliance is checked by the tests specified in 19.2 and 19.3 which are made immediately after the test of 18.5 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.

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

For non-rewireable and rewireable cable reels the insulation resistance shall not be less than 5 MΩ 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.

NOTE – 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.

19.3 A voltage of substantially sine-wave form, having a frequency of 50 Hz/60 Hz and the value shown in table 2, is applied for 1 min between the parts indicated in 19.2.

Table 2 – Test voltage for dielectric strength test

Insulation voltage[1] of the cable reels V	**Test voltage** V
Up to and including 50	500
Over 50 up to and including 415	2 000[2]
Over 415 up to and including 500	2 500
Over 500 up to and including 690	3 000

[1] The insulation voltage is at least equal to the highest rated operating voltage.
[2] This value is increased to 2 500 V for metal enclosures lined with insulating material.

Initially, no more than half the prescribed voltage is applied, then it is raised rapidly to the full value.

No flash-over or breakdown shall occur during the test.

Glow discharges without a drop in voltage are neglected.

20 Breaking capacity

This clause of IEC 60309-1 does not apply to cable reels. Accessories used shall comply with their relevant product standards.

21 Normal operation

21.1 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 following test.

21.2 *In cable reels incorporating contacts intended to make connection between fixed and moving parts (e.g. slip rings), each phase conductor, neutral conductor and earthing conductor, if any, is loaded with the rated current related to the minimum cross-section indicated in 23.1.1 and derived from an 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 21.3 and to the electric strength test of 21.4. The increase of resistance shall not be more than 50 % 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 revising when more experience has been gained.

21.3 *The flexible cable is unreeled and fully reeled on to the cable reel as in normal use at a rate of approximately 0,5 m/s, in the direction most likely to occur in normal use. The test is carried out as described below.*

21.3.1 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.

21.3.2 For hand-operated cable reels incorporating movable contacts, the test shall be carried out at the rated current of the fully reeled cable reel:

– 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 cable remain on the reel;
– during the recoiling, the flexible cable is held under tension applying a force of 10 N/mm² of the total cross-sectional area of the conductors of the cable up to a maximum of 100 N;
– the number of cycles of operation for a 16 A cable reel is 10 000 (ten thousand) and for 32 A and 63 A cable reels the number of cycles shall be 4 000 (four thousand).

NOTE – One cycle contains one unreeling followed by one reeling.

21.3.3 For spring and motor-operated 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 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 for 16 A cable reels is 10 000 (ten thousand);
– for 32 A and 63 A cable reels the number of cycles shall be 4 000 (four thousand);
– the cable of a reel incorporating an automatic return mechanism shall be fully unreeled and allowed to return unhindered 100 times using the automatic system incorporated.

After this test, 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 cable.

21.4 Immediately after the tests of 21.3, the cable reels shall withstand an electric strength test, as described in 19.3 but with the test voltage reduced by 500 V for cable reels having an insulation voltage exceeding 50 V. The test is made without a preceding humidity treatment.

No flash-over or breakdown shall occur during the test. In addition, there shall be no breakage of electrical connections or conductors.

22 Temperature rise

22.1 Temperature rise in normal use

22.1.1 Cable reels shall not attain excessive temperatures in normal use, such that they cause a danger to persons or surroundings.

22.1.2 *Compliance is checked by determining the temperature rise of the various parts stated in table 3.*

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 thickness of 20 mm. Cable reels for fixed mounting 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.

Temperature rises are determined by means of fine wire thermocouples, chosen and positioned so 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.

So far as it is possible, the cable reel is positioned so that parts likely to attain highest temperatures touch the disks.

In determining the temperature rises of handles, knobs, grips and the like, consideration is given to all parts which are gripped in normal use and, if 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, a contact between live parts and accessible metal parts, or a reduction of creepage distances or clearances below the values specified in clause 26.

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

The test current corresponds to $\cos \varphi = 1$.

Table 3 – Permissible temperature rise

Parts	Temperature rise K
Rubber insulation of internal and external wiring and flexible cable	35
Polyvinyl chloride insulation of internal wiring	45
Cord-sheath used as supplementary insulation	35
Silicone rubber insulation of internal wiring and flexible cables	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:	
– molding 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
Lampholder E14, B15, B22:	
– metal or ceramic type	130
– insulated type, other than ceramic	90
with T-marking	T-25

[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 described in 27.3 of IEC 60309-1 shall be made.

During the test the thermal- or current-sensing devices shall not operate.

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

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.

22.2 Temperature rise under overload conditions

22.2.1 Cable reels shall be so constructed that there is no risk of fire or electric shock as a result of abnormal electrical load.

Compliance is checked by the tests of 22.2.2 and 22.2.3.

22.2.2 *Cable reels are tested under the conditions described in 22.1.2 and are loaded with the highest possible current at which the thermal cut-out or current-sensing device will not operate, until steady conditions are established, or for 4 h, whichever is the shortest period.*

NOTE – Steady conditions are reached when the temperature does not vary by more than 1 K/h.

The temperature rise of the parts of the cable reels, shown in table 3 shall not exceed by more than 25 K the relevant values in that table.

After the test, the following conditions shall be fulfilled.

a) 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 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 figure 2 of IEC 60309-1 and by the dielectric strength test specified in 19.3, the test voltage being reduced by 500 V.

The humidity treatment is not repeated before the dielectric strength test is carried out.

b) The thermal or current cut-out shall not be deformed or damaged, and the present value shall not be changed.

Compliance is checked by inspection and by a comparison release test on a cable reel that has not been subjected to the test of 22.1.2.

c) The earth connection shall not be impaired.

Compliance is checked by the test specified in 10.4.

22.2.3 *The cable reel is tested fully reeled under the condition described in 22.1.2, the test load being that corresponding to 1,5 times the rated current of the socket-outlets in which the plug of the cable reel may be inserted or 1,5 times the rated current of the protective device in the case of fixed cable reels.*

The load is applied until steady conditions are reached or thermal or current cut-out has operated. After the test:

a) the cable reel shall show no deformation affecting the protection against electric shock.

Compliance is checked by inspection and by a test with the standard test finger shown in figure 2 of IEC 60309-1. It shall not be possible to touch live parts;

b) the earth connection shall not be impaired.

Compliance is checked by the test specified in 10.4.

23 Flexible cables and their connection

23.1 Cable reels shall be provided with a flexible cable complying with IEC 60245-4 of one of the types specified in table 4, the nominal cross-sectional area being not less than the value shown.

NOTE – Flexible cables having nominal cross-sections other than those specified in table 4 may be used if the load is known.

23.1.1 Minimum cable sizes shall be based on the lowest current rating of the plug or the protection device, incorporated in the cable reel, as shown in table 4.

Table 4 – Minimum cable sizes

Preferred rated current A		Type of cable	Nominal cross-section area
Series I	**Series II**	**IEC 60245**	mm^2
16	20	53[1] 57[1] 66	2,5[2]
32	30	53 66	6
63	60	66	16

[1] Not applicable to cable reels having a rated operating voltage exceeding 415 V.

[2] For cable reels having a rated operating voltage not exceeding 50 V, the value is increased to 4 mm^2.

For insulated cable only, the core connected to the earthing terminal shall be identified by the colour combination green/yellow. The nominal cross-sectional area of the earthing conductor and of the neutral conductor, if any, shall be at least equal to that of the phase conductors.

The pilot conductor, if any, shall have a nominal cross-sectional area of at least 2,5 mm^2.

Compliance is checked by inspection and by the test of 23.3.

23.1.2 Flexible cables shall have the same number of conductors as there are poles in the cable reel and in the socket-outlets except for voltage not exceeding 50 V; fitted 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.

23.1.3 The maximum length of flexible cable shall be as shown in table 5.

Table 5 – Maximum length of cable

Nominal cross-sectional area mm^2	Maximum length of cable m
Up to and including 6	80
Over 6 up to and including 16	100

Compliance with the requirements of 23.1 is checked by inspection, by measurement and by checking that the flexible cables are in accordance with IEC 60245-4.

23.2 Cable reels shall be provided with a cable 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 and be so designed that the cable cannot touch clamping screws, if any, of the cable anchorage, if these screws are accessible or electrically connected to accessible metal parts.

Glands shall not be used as cable anchorage. Makeshift methods, such as tying the cable into a knot or tying the ends with string, shall not be used.

Compliance with this requirement is checked by inspection.

23.3 It shall be made clear how relief from strain and 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.

Cable anchorage shall be suitable for the different types of flexible cables declared by the manufacturer, 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 of rewireable cable reels 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 23.4.

23.4 The cable anchorage of cable reels are subjected to a pull test followed by a torque test.

For rewireable 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 clause 25.

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

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

The flexible cable is then subjected 100 times to pulling, using the values specified below. The pulls are applied in the most unfavourable direction in the immediate vicinity of the cable anchorage. The pull values applied are as follows:

a) *80 N for cable reels with flexible cable having a nominal cross-sectional area up to 4 mm^2;*

b) *100 N for cable reels with flexible cable having a nominal cross-sectional area from 6 mm^2 to 10 mm^2;*

c) *120 N for cable reels with flexible cable greater than or equal to 16 mm^2.*

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:

– *0,35 Nm for cable reels with flexible cable less than 16 mm^2 cross-sectional area;*

– *0,425 Nm for cable reels with flexible cable having a nominal cross-sectional area greater than or equal to 16 mm^2.*

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, the ends of the conductors shall not have moved noticeably in the terminals or at the terminations.

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

Compliance is checked by inspection and by the following test. The cable is subjected 25 times to a pull of 100 N. The pulls are applied in the most unfavourable direction without jerks, each time for 1 s.

After the test, the cable shall not be damaged.

Compliance is checked by inspection.

24 Mechanical strength

24.1 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 tests of 24.2, 24.3 24.4 and 24.5.

24.2 *Cable reels are mounted at an angle of 15° from the perpendicular. For this test, the cable reel shall not overturn. These tests are carried out with the cable reel in a fully reeled condition.*

24.3 *Portable cable reels are subjected to blows by means of the spring-hammer according to IEC 60068-2-75.*

The cable reels are kept in a refrigerator at a temperature of –25 °C for at least 16 h, the cable reels being subjected to the test within one minute after their removal from the refrigerator.

24.4 *Portable cable reels are allowed to fall 10 times from a carrying handle height of 0,75 m on to a concrete floor. During the test, the total length of the flexible cable shall be wound on to 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.

24.5 *Portable cable reels are overturned 10 times in their normal position on to a concrete floor in the most unfavourable direction. During the test, the total length of the flexible cable shall be wound on to the reel.*

24.6 After the tests of 24.2 to 24.5, 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 connectors shall not have worked loose or been damaged;
– covers or enclosures shall show no cracks visible to normal or corrected vision without additional magnification;
– 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. Cracks not visible with normal or corrected vision without additional magnification and surface cracks in fibre-reinforced mouldings and the like, are ignored.

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

Compliance is checked by the following test:

Screwed glands are fitted with a cylindrical metal rod having a diameter, in millimetres, equal to the nearest whole number below the internal diameter of the packing, in millimetres. The glands are then tightened by means of a suitable spanner, the force shown in table 6 being applied to the spanner for 1 min, at a point 25 cm from the axis of the gland.

Table 6 – Glands tightening force

Diameter of test rod mm	**Force** N	
	Metal glands	**Glands of moulded material**
Up to and including 20	30	20
Over 20 up to and including 30	40	30
Over 30	50 [1)]	40 [1)]
[1)] These values are provisional.		

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

25 Screws, current-carrying parts and connections

This clause of IEC 60309-1 is applicable except as follows:

25.7 *Addition:*

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

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

Compliance is checked by a test which is currently under consideration.

The requirements of this subclause do not apply to screws, nuts, washers, clamping plates and similar parts of terminals.

26 Creepage distances, clearances and distances through sealing compound

This clause of IEC 60309-1 is applicable.

27 Resistance to heat, fire and tracking

This clause of IEC 60309-1 is applicable.

28 Corrosion and resistance to rusting

This clause of IEC 60309-1 is applicable.

29 Conditional short-circuit current withstand test

This clause of IEC 60309-1 is not applicable.

30 Electromagnetic compatibility

30.1 Immunity

Cable reels, as defined within the scope of this standard, are not, in normal use, affected by electromagnetic disturbances. Electronic components incorporated in cable reels, if any, shall comply with the relevant EMC requirements.

NOTE – Glow lamps, e.g. neon indicators and the like, are not considered to be electronic components in this context.

30.2 Emission

Cable reels as defined within the scope of this standard, do not, in normal use, generate electromagnetic disturbances. Electronic components incorporated in cable reels, if any, shall comply with the relevant EMC requirements.

NOTE – Glow lamps, e.g. neon indicators and the like, are not considered to be electronic components in this context.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

NOTE: When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60050-195	1998	International Electrotechnical Vocabulary (IEV) Chapter 195: Earthing and protection against electric shock	-	-
IEC 60068-2-75	1997	Environmental testing Part 2: Tests - Test Eh: Hammer tests	EN 60068-2-75	1997
IEC 60245 (mod)	series	Rubber insulated cables of rated voltages up to and including 450/750 V	HD 22	series
IEC 60245-4 (mod)	1994	Part 4: Cords and flexible cables	HD 22.4 S3	1995
IEC 60309-1	1999	Plugs, socket-outlets and couplers for industrial purposes Part 1: General requirements	EN 60309-1	1999
IEC 60309-2	1999	Part 2: Dimensional interchangeability requirements for pin and contact-tube accessories	EN 60309-2	1999
IEC 60529	1989	Degrees of protection provided by enclosures (IP Code)	EN 60529 + corr. May	1991 1993

BS EN 61316:2000
IEC 61316:1999

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