BRITISH STANDARD

BS EN
61995-1:2008

Devices for the connection of luminaires for household and similar purposes —

Part 1: General requirements

ICS 29.120.20; 29.140.40

BSI
British Standards

National foreword

This British Standard is the UK implementation of EN 61995-1:2008. It was derived by CENELEC from IEC 61995-1:2005.

The CENELEC common modifications have been implemented at the appropriate places in the text and are indicated by tags (e.g. [C> <C]).

The UK participation in its preparation was entrusted to Technical Committee PEL/23, Electrical accessories.

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

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 July 2008

ISBN 978 0 580 54128 5

Amendments/corrigenda issued since publication

Date	Comments

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 61995-1

May 2008

ICS 29.120.20; 29.140.40

English version

Devices for the connection of luminaires for household and similar purposes - Part 1: General requirements

(IEC 61995-1:2005, modified)

Dispositifs de connexion pour luminaires pour usage domestique et analogue - Partie 1: Exigences générales (CEI 61995-1:2005, modifiée)

Betriebsmittel für den Anschluss von Leuchten für Haushalt und ähnliche Zwecke - Teil 1: Allgemeine Anforderungen (IEC 61995-1:2005, modifiziert)

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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

Ref. No. EN 61995-1:2008 E

Foreword

The text of the International Standard IEC 61995-1:2005, prepared by SC 23B, Plugs, socket-outlets and switches, of IEC TC 23, Electrical accessories, together with common modifications prepared by the Technical Committee CENELEC TC 23BX, D.C. plugs and socket outlets and switches for household and similar fixed electrical installations, was submitted to the Unique Acceptance Procedure and was approved by CENELEC as EN 61995-1 on 2008-04-01.

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)	2009-04-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2013-04-01

Annexes ZA and ZB have been added by CENELEC.

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Endorsement notice

The text of the International Standard IEC 61995-1:2005 was approved by CENELEC as a European Standard with agreed common modifications.

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CONTENTS

1 Scope 5
2 Normative references 5
3 Terms and definitions 6
4 General requirements 8
5 General notes on tests 8
6 Ratings 9
7 Classification 9
8 Marking 10
9 Checking of dimensions 12
10 Protection against electric shock 13
11 Provision for earthing 15
12 Terminals and terminations 15
13 Construction of DCL outlets 27
14 Construction of DCL Plugs 31
15 Resistance to ageing and to humidity 33
16 Insulation resistance and electric strength 34
17 Operation of earthing contacts 36
18 Making and breaking capacity 36
19 Temperature rise 37
20 Force necessary to insert and withdraw the plug 39
21 Flexible cables and their connection 39
22 Mechanical strength 42
23 Resistance to heat 52
24 Screws, current-carrying parts and connections 54
25 Creepage distances, clearances and distances through sealing compound 56
26 Resistance of insulating material to abnormal heat, to fire and to tracking 58
27 Resistance to rusting 60
28 EMC Requirements 60

Annex ZA (normative) Special national conditions 62
Annex ZB (normative) Normative references to international publications with their corresponding European publications 63

Bibliography 61

Figure 1 – Arrangement for checking damage to conductors 17
Figure 2 – Information for deflection test 26
Figure 3 – Circuit diagram for temperature rise test 58
Figure 4 – Apparatus for testing the flexible cable retention 40
Figure 5 – Sequence of blows for parts A, B, C and D 44
Figure 6 – Arrangement for test on covers or cover-plates 46

Figure 7 – Gauge (thickness: about 2 mm) for the verification of the outline of covers or cover-plates....48
Figure 8 – Examples of application of the gauge of Figure 7 on covers fixed without screws on a mounting surface or supporting surface....49
Figure 9 – Examples of application of the gauge of Figure 7 in accordance with the requirements of 22.6....50
Figure 10 – Gauge for verification of grooves, holes and reverse tapers....51
Figure 11 – Sketch showing the direction of application of the gauge of Figure 10....51
Figure 12– Ball pressure test apparatus....53

Table 1 – Connection of copper conductors....16
Table 2– Values for checking damage to conductors....18
Table 3 – Values for pull forces....19
Table 4 – Core composition of conductors....19
Table 5 – Screw torque values....20
Table 6 – Test current for checking screwless terminals....23
Table 7 – Conductors for deflection test....27
Table 8 – Force for deflection test....27
Table 9– Forces to be applied to covers, cover-plates whose fixing is not dependent on screws....29
Table 10 – Test sequence for temperature rise test....39
Table 11 – Cable dimensions for the flexible cable retention test....41
Table 12 – Schedule of mechanical strength test....42
Table 13 – Height of fall for impact test....43
Table 14 – Creepage distances and clearances....58

DEVICES FOR THE CONNECTION OF LUMINAIRES FOR HOUSEHOLD AND SIMILAR PURPOSES –

Part 1: General requirements

1 Scope

〖C〗 This standard applies to devices for the connection of luminaires (DCL) intended for household and similar purposes, for the electrical connection of fixed luminaires of class I or class II to final circuits rated at not more than 16 A without providing a mechanical support for the luminaire. DCLs are intended for use according to their IP rating per EN 60529.

Outlets have an earthing contact and a rated current of 6 A, plugs are rated at 6 A.

The rated voltage is 250 V at 50 Hz. 〈C〗

NOTE 1 This standard does not cover integrated DCL-plugs (under consideration).

This standard can also be applied to types other than those with standardised interface.

〖C〗 NOTE 2 Void. 〈C〗

DCL plugs and DCL outlets complying with this standard are suitable for use under the following conditions:

– an ambient temperature not normally exceeding 25 °C, but occasionally reaching 35 °C;

NOTE 3 The effect of the heat generated by the luminaire may affect the ambient temperature local to the DCL.

– a temperature not exceeding 70 °C at the terminals of the DCL outlet including the effect of heat generated by the luminaire and the passage of current.

NOTE 4 The requirements and tests of this standard may also be used as a guide when testing DCL's which have different interface configurations or ratings.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60068-2-32:1975, *Environmental testing – Part 2: Tests – Test Ed: Free fall*

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

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

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

IEC 60417-DB:[1)], *Graphical symbols for use on equipment*

IEC 60529, *Degrees of protection provided by enclosures*

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

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

3 Terms and definitions

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

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

Throughout this standard the word "earthing" is used for "protective earthing".

3.1
device for connecting a luminaire
DCL
system comprising a DCL outlet and a DCL plug providing a fixed luminaire with electrical connection to and disconnection from a fixed installation

NOTE The designations DCL, DCL outlet or DCL plug, are used when it is necessary to specify particular requirements and test specifications.

3.2
DCL outlet
device for connecting a luminaire having socket-contacts designed to engage with the pins of a DCL plug and having terminals for the connection of cable

3.3
DCL plug
device for connecting a luminaire having pins designed to engage with the contacts of a DCL outlet, also incorporating means for the electrical connection and mechanical retention of flexible cable

3.4
rewirable DCL plug
DCL plug so constructed that the flexible cable can be replaced

3.5
non-rewirable DCL plug
DCL plug so constructed that it forms a complete unit with the flexible cable after connection and assembly by the manufacturer of the plug (see also 14.1)

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1) "DB" refers to the IEC on-line database.

3.6
moulded-on DCL plug
non-rewirable DCL plug, the manufacture of which is completed by insulating material moulded around pre-assembled component parts and the terminations of the flexible cable

3.7
rated voltage
voltage assigned to the DCL plug or DCL outlet by the manufacturer

3.8
rated current
current assigned to the DCL plug or DCL outlet by the manufacturer

3.9
mounting box
box in or on a wall or ceiling, etc., for flush or surface application, intended to house a DCL outlet

3.10
terminal
insulated or non-insulated connecting device intended for reusable electrical connection of the external conductors

3.11
termination
insulated or non-insulated connecting device intended for non-reusable electrical connection of the external conductors

3.12
clamping unit
part or parts of a terminal necessary for the mechanical clamping and the electrical connection of the conductor(s)

3.13
screw-type terminal
terminal for the connection and subsequent disconnection of a conductor or the interconnection of two or more conductors capable of being dismantled, the connection being made, directly or indirectly, by means of screws or nuts of any kind

3.14
pillar terminal
terminal with screw clamping in which the conductor is inserted into a hole or cavity, where it is clamped under the shank of the screw or screws. The clamping pressure may be applied directly by the shank of the screw or through an intermediate member to which pressure is applied by the shank of the screw

NOTE Examples of pillar terminals are shown in IEC 60999-1.

3.15
screw terminal
terminal with screw clamping in which the conductor is clamped under the head of the screw. The clamping pressure may be applied directly by the head of the screw or through an intermediate part, such as a washer, clamping plate or anti-spread device

NOTE Examples of screw terminals are shown in IEC 60999-1.

3.16
stud terminal
terminal with screw clamping in which the conductor is clamped under a nut. The clamping pressure may be applied directly by a suitably shaped nut or through an intermediate part, such as a washer, clamping plate or anti-spread device

NOTE Examples of stud terminals are shown in IEC 60999-1.

3.17
mantle terminal
terminal with screw clamping in which the conductor is clamped against the base of a slot in a threaded stud by means of a nut. The conductor is clamped against the base of the slot by a suitably shaped washer under the nut, by a central peg if the nut is a cap nut, or by equally effective means for transmitting the pressure from the nut to the conductor within the slot

NOTE Examples of mantle terminals are shown in IEC 60999-1.

3.18
screwless terminal
connecting device for the connection and subsequent disconnection of a rigid (solid or stranded) or flexible conductor or the interconnection of two or more conductors capable of being dismantled, the connection being made, directly or indirectly, by means of springs, parts of angled, eccentric or conical form, etc., without special preparation of the conductor concerned, other than removal of insulation

3.19
loop terminal
supply terminal intended for the interconnection of live conductors

〖C〗 **3.Z1**
DCL temporary lampholder
independent lampholder designed in order to be temporarily connected to a DCL outlet, in compliance with the corresponding standards.

Moreover this lampholder is provided with a DCL rewirable plug (2P + E) to be used for the connection of a luminaire later 〖C〗

4 General requirements

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

Compliance is checked by carrying out all the relevant tests specified.

5 General notes on tests

5.1 *Tests according to this standard are type tests.*

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

Non-rewirable DCL plugs are tested with the type and size of flexible cable as delivered.

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 (20 ± 5) °C.*

Plugs and outlets are tested separately, unless otherwise specified.

The neutral is treated as a pole.

5.4 *Unless otherwise specified, three specimens are subjected to all the relevant tests.*

For the purpose of the test of 12.3.11 three new specimens are required.

For the purpose of the test of Clause 20 one additional specimen is required.

5.5 *The specimens are submitted to all the relevant tests and the requirements are satisfied if all these tests are met.*

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

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

6 Ratings

DCL plugs and DCL outlets shall have a rated voltage of 125 V a.c. or 250 V a.c. and a rated current of 6 A.

Compliance is checked by inspection of the marking and by the tests described in this standard.

7 Classification

7.1 DCLs are classified according to their interface design:

a) complying with the relevant part 2 of this standard;
b) other types (not complying with any relevant part 2 of this standard).

7.2 DCL outlets shall have an earthing contact and are classified:

7.2.1 according to the method of application:

– fixed type;
– floating type;

7.2.2 according to the type of terminals:

– DCL outlets with screw-type terminals;
– DCL outlets with screwless terminals for rigid conductors only;
– DCL outlets with screwless terminals for rigid and flexible conductors;

7.2.3 according to the provision of a loop terminal:

– DCL outlets with a loop terminal;
– DCL outlets without a loop terminal;

NOTE The loop terminal may be needed for the continuity of the live conductor.

7.2.4 according to the method of mounting as a consequence of design:

– design A – DCL outlets where the cover or cover-plate or parts of them can be removed without displacement of the conductors;
– design B – DCL outlets where the cover or cover-plate or parts of them cannot be removed without displacement of the conductors.

NOTE If a DCL outlet has a base (main part) which cannot be separated from the cover or cover-plate and requires a supplementary plate which can be removed for redecorating the wall or ceiling without displacement of the conductors, it is considered to be of design A, provided the supplementary plate meets the requirements specified for covers and cover-plates.

7.3 DCL plugs are classified:

7.3.1 according to the method of connecting the cable:

– rewirable DCL plugs;
– non-rewirable DCL plugs;

7.3.1.1 rewirable DCL plugs are classified according to the type of terminal:

– DCL plug with screw-type terminals,
– DCL plug with screwless terminals for rigid and flexible conductors.

〖C〗 Note Void. 〖C〗

7.3.2 according to the class of luminaire to which they are intended to be connected:

– DCL plugs for fixed luminaires of Class I;
– DCL plugs for fixed luminaires of Class II;

NOTE For the description of the classes of equipment, see IEC 61140 (Protection against Electric Shock – Common aspects for installation and equipment).

7.4 according to the degree of protection per IEC 60529;

7.5 according to the provision of signal contacts:

7.5.1 with provision;

7.5.2 without provision.

8 Marking

8.1 DCL outlets shall be marked with the following information:

– rated current;
– rated voltage;
– symbol for alternating current;
– name or trademark of the manufacturer or responsible vendor;
– terminal identification (see 8.5);
– symbol indicating that the outlet is only to be used with luminaires.

In addition DCL outlets with screwless terminals shall be marked with:

– an appropriate marking indicating the length of insulation to be removed before the insertion of the conductor in the screwless terminal;

– an indication of the suitability to accept rigid conductors only (“r“) for those DCL outlets having this restriction. (see also 12.3.1).

NOTE 1 The additional markings may be put on the DCL outlet, on the packaging unit and/or given in an instruction sheet which accompanies the DCL outlet.

NOTE 2 The manufacturer should explain the marking “r” in the instruction sheet (r - use rigid conductors only).

The symbol indicating “luminaires only” shall be visible after installation but not necessarily after insertion of the DCL plug.

8.2 DCL plugs shall be marked with the following information:

– rated current;

– rated voltage;

– symbol for alternating current;

– name or trademark of the manufacturer or responsible vendor;

– terminal identification (see 8.5);

– symbol indicating the plug is only for use with luminaires.

The symbol indicating “luminaires only” shall be visible after fitting the flexible cable but not necessarily after insertion into the DCL outlet.

In addition DCL plugs with screwless terminals shall be marked with:

– an appropriate marking indicating the length of insulation to be removed before the insertion of the conductor in the screwless terminal

NOTE The additional markings may be put on the DCL plug, on the packaging unit and/or given in an instruction sheet which accompanies the DCL plug.

8.3 DCL outlets and DCL plugs shall be provided with information warning the user that these products are intended only for the connection of fixed luminaires.

Where it is necessary for safe operation that the user be aware of any particular characteristics of the DCL plug or DCL outlet, the necessary information shall be given.

The instructions and information referred to in this subclause shall be given by marking the DCL plug or DCL outlet itself, or where this is not practicable, in a notice which accompanies it.

8.4 Where symbols are used they shall be as follows:

– amperes A

– volts V

– nature of supply (symbol IEC 60417- 5032) ~

– line L

– neutral N

– protective earth (symbol IEC60417- 5019) 

– symbol for use with luminaires only (symbol IEC60417-5974) 

For the marking of rated current and rated voltage, figures may be used alone. These figures shall be placed on one line separated by an oblique line. Alternatively the figure for rated current shall be placed above the figure for rated voltage, separated by a horizontal line. The marking for the nature of supply if any shall be next to the marking for voltage and current.

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

NOTE 2 Details of construction of symbols are given in IEC 60470.

NOTE 3 The marking for current, voltage and nature of supply may be, for example, as follows:

6 A 250 V~ or 6/250~ or $\frac{6}{250}$ **~**

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

Earthing terminals shall be indicated by the symbol for protective earth.

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

NOTE "Easily removable parts" are those parts which can be removed during the normal installation of the DCL outlet or the assembly of the DCL plug.

Terminations of non-rewirable DCL plugs need not be marked.

8.6 Markings shall be durable and easily legible.

Compliance is checked by inspection and by the following test:

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

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

NOTE It is recommended that the petroleum spirit used consist 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 specific density of approximately 0,68 g/cm³.

9 Checking of dimensions

9.1 DCL types classified according to 7.1 a) shall comply with the standard sheets of the relevant part 2.

Compliance is checked by measurement and/or by means of gauges.

9.2 〚C〉 DCL types classified according to 7.1 b) as other types shall comply with the relevant specification and shall not

– be interchangeable with any socket-outlet systems of IEC 60083 and EN 60309-2,

– create a hazardous situation with DCL types complying with the standard sheets of Part 2 or any existing DCL or any socket-outlet systems of IEC 60083 and EN 60309-2. 〈C〛

Compliance is checked by measurement and/or by means of gauges.

10 Protection against electric shock

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

Live parts of DCL plugs shall not be accessible when the DCL plug is in partial or complete engagement with a DCL outlet.

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

The specimen is mounted as for normal use and fitted with conductors of the smallest cross-sectional areas and the test is then repeated using conductors of the largest cross-sectional areas, as specified in Table 1.

For DCL outlets, the test finger specified in IEC 61032 test probe B is applied in every possible position.

For DCL plugs, the test finger is applied in every possible position when the plug is in partial or complete engagement with a DCL outlet.

An electrical indicator with a voltage of (45 ± 5) V, is used to show contact with the relevant part.

For DCL systems where the use of elastomeric or thermoplastic material is likely to influence the requirement, the test is repeated but at an ambient temperature of (35 ± 2) °C, the DCLs being at this temperature.

During this additional test the DCLs 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 accessory, and it is applied to thin walled knock-outs with a force of 10 N.

During this test, the DCL, with its associated mounting means, shall not deform to such an extent that those dimensions shown in the relevant standard sheets which ensure safety are unduly altered and no live part shall be accessible.

10.2 Parts which are accessible when the DCL is wired and mounted as for normal use, with exception of small screws and the like, isolated from live parts, for fixing bases and covers or cover plates of DCL outlets, shall be made of insulating material; however the covers or cover-plates of fixed DCL outlets may be made of metal if the requirements given in 10.2.1 or 10.2.2 are fulfilled.

10.2.1 The covers or cover-plates of metal shall be protected by supplementary insulation made by insulating linings or insulating barriers fixed to covers or cover-plates or to the body of the DCL, in such a way that the insulating linings or insulating barriers:

– either cannot be removed without being permanently damaged,
– or are so designed that:
  – they cannot be replaced in an incorrect position;
  – if they are omitted, the DCLs are rendered inoperable or manifestly incomplete;

– there is no risk of accidental contact between live parts and metal covers or cover-plates, for example through their fixing screws, even if a conductor should come away from its terminal;
– precautions are taken in order to prevent creepage distances or clearances becoming less than the values specified in Clause 25.

Compliance is checked by inspection.

The above linings or barriers shall comply with the tests of Clauses 16 and 25.

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

10.2.2 The metal covers or cover-plates shall be securely connected, through a low resistance connection, to the earth during fixing of the cover or the cover-plate itself.

NOTE 1 Fixing screws of metal covers, cover-plates or other means are allowed.

The creepage distances and the clearances between the live pins of a DCL plug when fully inserted and the earthed metal cover of a DCL outlet shall comply with items 2 and 7 of Table 14 respectively.

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

〖C〉 NOTE 2 Void. 〈C〗

10.3 It shall not be possible to make connection between a pin of a DCL plug and a live contact of a DCL outlet while any other pin is accessible.

Compliance is checked by manual test using a DCL outlet with corresponding DCL plug and test finger specified in IEC 61032 test probe B in a manner most likely to make contact with live parts. In applying the test a supply of (45 ± 5) V, in series with a suitable indicating lamp, shall be connected between the test finger and the relevant conducting parts of the DCL plug and/or DCL outlet.

For DCLs with enclosures or bodies of thermoplastic material, the test is made at an ambient temperature of (35 ± 2) °C, both the DCL and the gauge being at this temperature.

For DCL outlets provided with metal covers or cover plates, a clearance, between a pin and a socket-contact, of at least 2 mm is required, when another pin, or pins, is (are) in contact with the metal covers or cover-plates.

10.4 External parts of DCL plugs, with the exception of assembly screws and the like, current-carrying and earthing pins, earthing straps and metal rings around pins, shall be of insulating material. Covers of DCL plugs may be of metal provided they comply with the requirements of 10.2.1 or 10.2.2.

Compliance is checked by inspection.

NOTE Lacquer, enamel or sprayed insulating coating is not deemed to be insulating material for the purpose of 10.1 to 10.4.

11 Provision for earthing

11.1 DCLs with earthing contact shall be so constructed that, when inserting the DCL plug, the earth connection is made before the current-carrying contacts of the DCL plug become live.

When withdrawing the DCL plug, the current-carrying pins shall not remain live after the earth connection is broken.

Compliance is checked by inspection and by measurement.

11.2 Earthing terminals of rewirable DCLs shall allow the proper connection of copper conductors in accordance with Clause 12.

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

NOTE 1 This requirement does not apply to the metal cover or cover-plates complying with 10.2.1.

NOTE 2 For the purpose of this requirement, small screws and the like, isolated from live parts, for fixing bases, covers or cover-plates, are not considered as accessible parts which may become live in the event of an insulation fault.

Compliance with the requirements of 11.2 to 11.3 is checked by inspection and by the tests of Clause 12.

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

〚C〛 For DCL with resilient earthing contact where the contact pressure is not dependant on insulating material, the connection between the earthing contact of the DCL outlet and that of the DCL plug shall be of low resistance.

Compliance is checked by the following test after the tests of Clauses 18 and 19:

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 is passed between the earthing terminal and each of the accessible metal parts in turn and for DCLs with earthing contacts between the DCL outlet earthing terminal and DCL plug earthing terminal. 〚C〛

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

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

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

12 Terminals and terminations

All the tests on terminals, with the exception of the test of 12.3.9, shall be made after the test of 15.1.

12.1 General

DCL outlets and rewirable DCL plugs shall be provided with screw-type terminals or with screwless terminals which allow the proper connection of copper conductors.

If pre-soldered flexible conductors are used, care shall be taken that in screw-type terminals the pre-soldered area shall be outside the squeezed area when connected as for normal use.

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

Non-rewirable DCL plugs shall be provided with soldered, welded, crimped or equally effective permanent connections for copper conductors as shown in Table 1; screwed or snap-on connections shall not be used.

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 and the following tests.

Table 1 – Connection of copper conductors

〈C〉

Accessory		Terminal	Rigid (solid & stranded) conductors) [a]	Flexible conductors
DCL outlet	Floating	Line, neutral and earth terminals	From 1 × 1,0 mm^2 up to 2 × 2,5 mm^2 inclusive	From 1 × 1,0 mm^2 up to 2 × 2,5 mm^2 inclusive
	Fixed	Line, neutral and earth terminals	From 1 × 1,0 mm^2 up to 2 × 2,5 mm^2 inclusive	From 1 × 1,0 mm^2 up to 2 × 2,5 mm^2 inclusive
		Loop terminal (when fitted)	From 2 × 1,0 mm^2 up to 2 × 2,5 mm^2 inclusive	From 2 × 1,0 mm^2 up to 2 × 2,5 mm^2 inclusive
DCL plug		Live, neutral and earth terminals (when fitted)	From 1 × 0,5 mm^2 up to 1 × 1,5 mm^2 inclusive	From 1 × 0,5 mm^2 up to 1 × 1,5 mm^2 inclusive
NOTE In the following countries only loop terminals able to connect 3 × 2,5 mm^2 conductors are allowed: UK.				
[a] The use of flexible conductors of the same cross sectional area is permitted.				

〈C〉

12.2 Terminals with screw clamping for external copper conductors

12.2.1 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 re-shaping of the conductor before its introduction into the terminal or the twisting of a flexible conductor to consolidate the end.

12.2.2 Screw-type terminals shall have adequate mechanical strength.

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

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

Compliance is checked by inspection and by the tests of 12.2.5 and 12.2.7.

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

12.2.3 Screw-type terminals shall be resistant to corrosion.

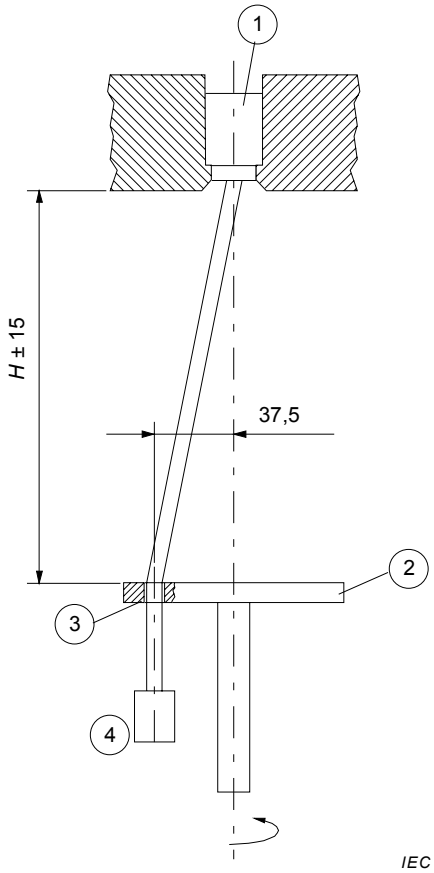
Terminals, the body of which is made of copper or of a copper alloy as specified in 24.5 are considered as complying with this requirement.

12.2.4 Screw-type terminals shall be so designed that they clamp the conductor(s) without unduly damaging it(them).

Compliance is checked by the following test:

The terminals are fitted with new conductors of the type and of the minimum and maximum cross-sectional areas according to Table 1 and tested in the equipment shown in Figure 1:

– *firstly with conductors of the minimum cross-sectional area;*
– *secondly with conductors of the maximum cross-sectional area.*



Dimensions in millimetres

(1) Terminal
(2) Platen
(3) Bushing[a]
(4) Mass

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

Figure 1 – Arrangement for checking damage to conductors

The length of the test conductor shall be 75 mm longer than the height (H) specified in Table 2.

The test conductor is then connected to the clamping unit, the clamping screws or nuts are tightened with the torque according to Table 5.

Each of the conductors is subjected to the following test:

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

The distance between the mouth of the clamping unit and the upper surface of the bushing shall be within ±15 mm of the height in Table 2. The bushing may be lubricated to prevent binding, twisting or rotation of the insulated conductor.

A mass as specified in Table 2 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.

Table 2– Values for checking damage to conductors

Conductor cross-sectional area mm²	Diameter of bushing hole [a] mm	Height mm	Mass for conductor kg
0,5	6,5	260	0,3
0,75	6,5	260	0,4
1,0	6,5	260	0,4
1,5	6,5	260	0,4
2,5	9,5	280	0,7

[a] 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.

12.2.5 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 new conductors of the type and of the minimum and maximum cross-sectional area according to Table 1.

Screws are tightened with a torque equal to two-thirds of the torque shown in the appropriate column of Table 5.

If the screw has a hexagonal head with a slot, the torque applied is equal to that shown in column II of Table 5 or higher, as stated by the manufacturer.

Each conductor is then subjected to a pull of the value shown in the following Table 3, the pull being applied without jerks, for 1 min in the direction of the axis of the conductor.

During the test, the conductor shall not slip out of the clamping unit.

Table 3 – Values for pull forces

Cross sectional area [mm²]	0,5	0,75	1,0	1,5	2,5
Pull force [N]	30	30	35	40	50

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

Compliance is checked by the following test.

The terminals are fitted with new conductors of the type and cross sectional area according to Table 1 and whose core composition complies with Table 4.

The terminals of DCL outlets are checked both with rigid solid conductors and with rigid stranded conductors.

The terminals of DCL plugs are checked with flexible conductors.

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

Table 4 – Core composition of conductors

Cross-sectional area mm²	**Number of wires and nominal diameter of wires in mm**		
	Flexible conductor	**Rigid solid conductor**	**Rigid stranded conductor**
0,5	16 × 0,21	–	–
0,75	24 × 0,21	–	–
1,0	32 × 0,21	1 × 1,13	7 × 0,42
1,5	30 × 0,26	1 × 1,38	7 × 0,52
2,5	50 × 0,26	1 × 1,78	7 × 0,67

Before insertion into the clamping unit, wires of stranded rigid conductors and flexible conductors may be reshaped. The use of tools is permitted.

It shall be possible to fit the conductor into the clamping unit without use of undue force.

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 screws, or nuts, are then tightened with a torque as specified in Table 5.

After the test no wire of the conductor shall have escaped outside the clamping unit thus reducing creepage distances and clearances required by this standard.

12.2.7 Screw-type terminals shall be so fixed or located within the DCL that when the clamping screws or nuts are tightened or loosened, the terminals shall not work loose from their fixings within the DCL.

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

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

A solid rigid copper conductor of 2,5 mm^2 cross-sectional area for DCL outlets and 1,0 mm^2 for DCL plugs is placed in the terminal.

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

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

Table 5 – Screw torque values

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
Oover 3,6 up to and including 4,5	0,7	1,2

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

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

During the test the terminals shall not work loose and there shall be no damage, such as breakage of screws or damage to the head slots (rendering the use of the appropriate screwdriver impossible), threads, washers or stirrups that will impair the further use of the terminals.

12.2.8 Screws or nuts of earthing terminals identified as such 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 inspection.

NOTE 1 In general terminals shown in Figures 2 to 5 of IEC 60999-1 meet this requirement, provided they comply with the test of this standard.

NOTE 2 It may be necessary to incorporate a resilient part (e.g. a pressure plate), if the end product is intended to be subjected to vibration or temperature cycling.

12.2.9 Earthing clamping units 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 clamping unit shall be of brass or other metal no less resistant to corrosion, unless it is a part of the metal frame or enclosure; in this latter case the screw or nut shall be of brass or other metal no less resistant to corrosion.

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

Precautions shall be taken to ensure that the surface of the metal frame or enclosure is clean when the conductor is clamped against it.

Compliance is checked by inspection.

NOTE 1 Screws or nuts of plated steel withstanding the corrosion test are considered to be of a metal no less resistant to corrosion than brass.

NOTE 2 A test for checking the resistance to corrosion is under consideration.

12.2.10 For pillar terminals, the distance between the major diameter of the clamping screw and the end of the conductor when fully inserted, shall be at least 1,5 mm.

Compliance is checked by measurement, after a conductor of maximum size as shown in Table 1 has been fully inserted and fully clamped.

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

12.3 Screwless terminals for external copper conductors

12.3.1 Screwless type terminals, unless otherwise specified by the manufacturer, shall accept rigid and flexible conductors as indicated in Table 1, in which case no marking is necessary.

If a screwless type terminal according to the manufacturer's specification can accept only rigid (solid and stranded) conductors, this shall be either clearly marked on the end product, for connecting purposes, by the letter "r", or indicated on the smallest package unit or in technical information and/or catalogues (see 8.1).

Compliance is checked by inspection and by the insertion of the largest conductor as specified in Table 1 after the insulation has been removed, and the end of the conductor has been reshaped.

The stripped end of the conductor shall be able to enter completely within the terminal, without use of undue force.

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

Compliance is checked by inspection.

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

12.3.3 Parts of screwless terminals mainly intended for carrying current shall be of materials as specified in 24.5.

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

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

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

The conductor shall be clamped between metal surfaces.

Compliance is checked by inspection and by the test of 12.3.6.

NOTE Conductors are considered to be unduly damaged if they show appreciable deep or sharp indentations.

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

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

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

Compliance is checked by inspection and by the test of 12.3.9.

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

– during the insertion, the operation of the clamping means for one of the conductors is independent of the operation of that of the other conductor(s);
– during the disconnection, the conductors can be disconnected either at the same time or separately;
– each conductor shall be introduced into a separate clamping unit (not necessarily in separate holes).

It shall be possible to clamp securely any number of conductors up to the maximum as specified by the manufacturer.

Compliance is checked by inspection and by tests with the appropriate conductors (number and size).

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

Compliance is checked by inspection and by the tests of 12.3.9.

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

12.3.8 Screwless terminals shall be reliably retained within the DCLs. They shall not be displaced when the conductors are inserted or withdrawn during installation.

Compliance is checked by inspection and by the tests of 12.3.9.

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

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

The test is carried out with solid copper conductors, first with conductors having the largest cross-sectional area, and then with conductors having the smallest cross-sectional area specified in Table 1 being connected to the terminal.

This connection and subsequent disconnection shall be made five times with the largest conductor and five times with the smallest conductor.

New conductors shall be used each time, except for the fifth time, when the conductor used for the fourth insertion is clamped at the same place.

For each insertion, the conductors are either pushed as far as possible into the terminal or shall be inserted so that adequate connection is obvious.

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

After each insertion, the conductor being inserted is rotated 90° along its axis at the level of the clamped section and subsequently disconnected.

After these tests, the terminal shall not be damaged in such a way as to impair its further use.

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

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

a) The test is carried out by loading the screwless terminals for 1 h with an alternating current, as specified in Table 6, and connecting conductors 1 m long having the cross-sectional area as specified in the same table.

The test is carried out on each clamping unit.

Table 6 – Test current for checking screwless terminals

	Test current A	**Nominal cross-sectional area of the conductor** mm^2
DCL outlet	22 [a]	2,5
DCL plug	9	1
[a] This test current takes account of the terminals passing a 16A through current.		

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

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

In no case shall the voltage drop exceed 15 mV.

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

If the back connection of the terminal is not accessible, the specimens may be adequately prepared by the manufacturer; care shall be taken not to affect the behaviour of the terminals.

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

b) Screwless terminals already subjected to the determination of the voltage drop specified in the previous test of Item a) are tested as follows.

During the test, a current equal to the test current value given in Table 6 is passed. The whole test arrangement, including the conductors, shall not be moved until the measurements of the voltage drop have been completed.

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

- *with current flowing for approximately 30 min;*
- *without current flowing for a further 30 min approximately.*

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

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

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

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

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

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

The test apparatus, the principle of which is shown in Figure 2a, shall be so constructed that:

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

NOTE 1 A reference direction need not be specified.

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

The deflecting device shall be so designed that:

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

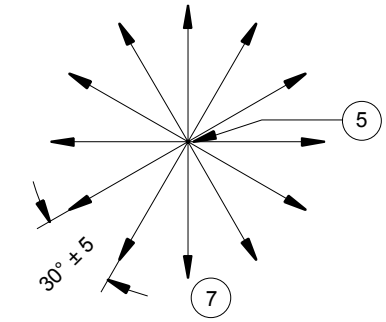
Provisions shall be made so that the voltage drop across the clamping unit under test can be measured when the conductor is connected, as shown for example in Figure 2b.

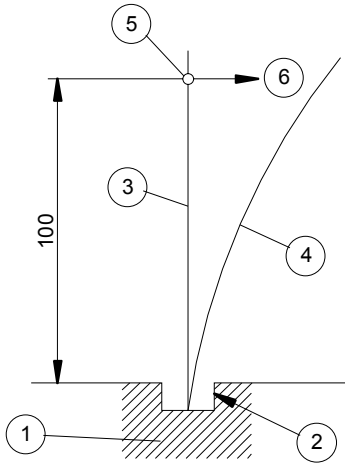
The specimen is mounted on the fixed part of the test apparatus in such a way that the specified conductor inserted into the clamping unit under test can be freely deflected.

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

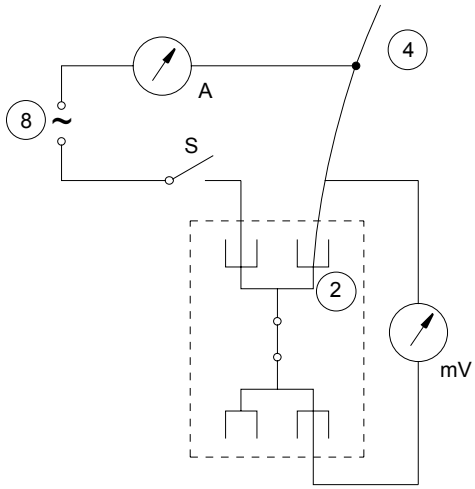
NOTE 2 If necessary, the inserted conductor may be permanently bent around obstacles, so that these do not influence the results of the test.

NOTE 3 In some cases, with the exception of the case of guidance for the conductor, it may be advisable to remove those parts of the specimens which do not allow the deflection of the conductor corresponding to the force to be applied.





IEC 444/05



IEC 445/05

Dimensions in millimetres

Key
A Ammeter
S Switch
mV Millivoltmetre
1 Specimen
2 Clamping unit under test
3 Test conductor
4 Test conductor, deflected
5 Point of application of the force for deflecting the conductor
6 Deflection force (perpendicular to the straight conductor)
7 Directions of application of the forces
8 Supply

Figure 2a – Principle of the test apparatus for deflection on screwless terminals

Figure 2b – Example of test arrangement to measure the voltage drop during deflection test on screwless terminals

Figure 2 – Information for deflection test

A clamping unit is fitted as for normal use with a rigid solid copper conductor having the smallest cross-sectional area specified in Table 7 and is submitted to a first test sequence; the same clamping unit is submitted to a second test sequence using the conductor having the largest cross-sectional area, unless the first test sequence has failed.

The force for deflecting the conductor is specified in Table 8, the distance of 100 mm being measured from the extremity of the terminal, including the guidance, if any, for the conductor, to the point of application of the force to the conductor.

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

Table 7 – Conductors for deflection test

Nominal cross-sectional area of the test conductor mm²	
First test sequence	Second test sequence
1,5	2,5

Table 8 – Force for deflection test

Nominal cross-sectional area of the test conductor mm²	Force for deflecting the test conductor [a] N
1,5	0,5
2,5	1,0
[a] The forces are chosen so that they stress the conductor close to the limit of elasticity	

A test current equal to the rated current of the DCL outlet is passed through the clamping unit under test. A force according to Table 8 is applied to the test conductor inserted in the clamping unit under test in the direction of one of the 12 directions shown in Figure 2a and the voltage drop across this clamping unit is measured. The force is then removed.

The force is then applied successively on each one of the remaining 11 directions shown in Figure 2a following the same test procedure.

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

The other two specimens of DCL outlets of the set are tested following the same test procedure, but moving the 12 directions of the force so that they differ by approximately 10° for each specimen.

If one specimen has failed at one of the directions of application of the test force, the tests are repeated on another set of specimens, all of which shall comply with the repeated tests.

13 Construction of DCL outlets

13.1 Contact assemblies in DCL outlets shall have sufficient resiliency to ensure adequate contact pressure and they shall be so designed that contact pressure is not transmitted through insulating material, unless there is sufficient resiliency in the metallic parts to compensate for any possible shrinkage or yielding of the insulating material.

Compliance is checked by inspection and by the tests of Clauses 18 and 19.

13.2 DCL outlet contact assemblies shall be resistant to corrosion.

Compliance is checked by inspection and according to 24.5.

13.3 Insulating linings, barriers and the like shall have adequate mechanical strength.

Compliance is checked by inspection and by the tests of Clause 22.

13.4 DCL outlets shall be so constructed as to permit:

– easy introduction and connection of the conductors in the terminals,
– correct positioning of the conductors,
– easy fixing to a surface or in a mounting box specified by the manufacturer,
– adequate space within the enclosure (cover or mounting box) so that after installation of the DCL outlet the insulation of the conductors is not necessarily pressed against live parts of different polarity.

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

NOTE 2 For surface type DCL outlets intended to be mounted on a mounting plate a wiring channel may be needed to comply with this requirement.

In addition, DCL outlets classified as design A shall permit easy positioning and removal of the cover or cover-plate, without displacing the conductors.

Compliance is checked by inspection and by an installation test with conductors of 2,5 mm^2 (see 12.2.1 and 12.3.1).

13.5 DCL outlets shall be so designed that full engagement of associated DCL plugs is not prevented by any projection from their engagement face.

Compliance is checked by determining that the gap between the engagement faces of the DCL outlet and a DCL plug does not exceed 1 mm when the DCL plug is inserted into the DCL outlet as far as it will go.

13.6 Covers, cover-plates, or parts of them, which are intended to ensure protection against electric shock, shall be held in place at two or more points by effective fixings. They may be fixed by means of a single fixing, for example, by a screw, provided that they are located by another means (e.g. by a shoulder).

The removal of these covers, cover-plates or parts of them where fixing is not dependent on screws and where the removal is obtained by applying a force in a direction approximately perpendicular to the mounting/supporting surface shall not give access to live parts with the test finger specified in IEC 61032 test probe B.

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

NOTE 2 Live parts and non-earthed metal parts separated from live parts in such a way that creepage distances and clearances have values not less than those specified in Table 14 are not considered as accessible if the requirements of this subclause are met.

Where the fixing of covers or cover-plates of DCL outlets of design A serve to fix the base there shall be means to maintain the base in position, even after removal of the cover or cover-plates.

Compliance is checked according to 13.6.1, 13.6.2 or 13.6.3.

13.6.1 *For covers or cover-plates whose fixings are of the screw-type: by inspection only.*

13.6.2 *For covers or cover-plates where fixing is not dependent on screws and where removal is obtained by applying a force in a direction approximately perpendicular to the mounting/supporting surface (see Table 9):*

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

  by the tests of 22.3;

– *when their removal may give access, with the test finger specified in IEC 61032 Test probe B, to non-earthed metal parts separated from live parts in such a way that creepage distances and clearances have the values specified in Table 14:*

  by the tests of 22.4;

– *when their removal may give access, with the test finger specified in IEC 61032 Test probe B, only to:*

  – *insulating parts, or*

  – *earthed metal parts, or*

  – *metal parts separated from live parts in such a way that creepage distances and clearances have twice the values specified in Table 14:*

  by the tests of 22.5.

Table 9 – Forces to be applied to covers, cover-plates whose fixing is not dependent on screws

Accessibility with the test finger after removal of covers, cover-plates or parts of them	Tests according to subclauses	Force to be applied N			
		DCL outlets complying with 22.6 and 22.7		DCL outlets not complying with 22.6 and 22.7	
		Shall not come off	Shall come off	Shall not come off	Shall come off
To live parts	22.3	40	120	80	120
To non-earthed metal parts separated from live parts by creepage distances and clearances according to Table 14	22.4	10	120	20	120
To insulating parts, earthed metal parts or metal parts separated from live parts by creepage distances ⟨C⟩ and clearances ⟨C⟩ twice those according to Table 14	22.5	10	120	10	120

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

by the same tests of 13.6.2 except that the covers or cover-plates or parts of them need not come off when applying a force not exceeding 120 N in directions perpendicular to the mounting/supporting surface.

13.7 DCL outlets shall be so constructed that, when they are mounted and wired as for normal use, there are no openings in the enclosures giving access to live parts other than the entry openings for the pins of the DCL plug.

Compliance is checked by inspection.

Small gaps between enclosures and conduits or cables or between enclosures and earthing contacts, if any, are neglected.

13.8 Screws or other means for mounting the DCL outlet shall be easily accessible from the front. These means shall not serve any other fixing purpose.

Compliance is checked by inspection.

13.9 The mounting plate of surface-type DCL outlets shall have adequate mechanical strength.

Compliance is checked by inspection after the test of 13.5 and by the test of 22.2.

13.10 DCL outlets shall not be an integral part of lampholders.

Compliance is checked by inspection.

13.11 Metal strips of the earthing circuit shall have no burrs which might damage the insulation of the supply conductors.

Compliance is checked by inspection.

13.12 DCL outlets to be installed in a box shall be so designed that the conductor ends can be prepared after the box is mounted in position, but before the DCL outlet is fitted in the box.

Compliance is checked by inspection.

13.13 Inlet openings for use with circular conduits shall allow the introduction of the conduit or the protective covering of the cable so as to afford complete mechanical protection.

Surface-type DCL outlets shall be so constructed that the conduit or protective covering of the cable can enter at least 1 mm into the enclosure.

For surface-type DCL outlets the inlet opening for conduit entries, or at least two of them if there are more than one, shall be capable of accepting conduit sizes of 16 or 20 or a combination of these sizes.

Compliance is checked by inspection and by measurement.

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

14 Construction of DCL Plugs

14.1 Non-rewirable DCL plugs shall be such that:

– their flexible cable cannot be separated from them without making them permanently useless, and

– they cannot be opened by hand or by using a general purpose tool, for example a screwdriver used as such.

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

Compliance is checked by inspection.

14.2 Pins of DCL plugs shall have adequate mechanical strength.

Compliance is checked by the test of Clause 22.

14.3 Pins of DCL plugs shall be:

– locked against rotation,

– not removable without dismantling the plug, and

– adequately fixed in the body of the DCL plug when the DCL plug is wired and assembled as for normal use.

It shall not be possible to replace the earthing or neutral pins of DCL plugs in an incorrect position.

Compliance is checked by inspection and by manual test.

14.4 Pins shall be resistant to corrosion.

Compliance is checked by inspection and according to 24.5.

14.5 DCL plugs shall be so constructed that, when they are wired as for normal use, there are no openings in the enclosures giving access to live parts.

Compliance is checked by inspection.

Small gaps between enclosures and cables or between enclosures and earthing contacts, if any, are neglected.

14.6 Rewirable DCL plugs shall be so constructed that the conductors can be properly connected and that, when the plug is wired and assembled as for normal use, there is no risk that:

– the cores are pressed against each other,

– a core, the conductor of which is connected to a live terminal, comes into contact with accessible metal parts,

– a core, the conductor of which is connected to the earthing terminal, comes into contact with live parts.

Compliance is checked by inspection and by manual test.

14.7 Rewirable DCL plugs shall be so designed that terminal screws or nuts cannot become loose and fall out of position in such a way that they establish an electrical connection between live parts and the earthing terminal or metal parts connected to the earthing terminal.

Compliance is checked by inspection and by manual test.

14.8 Rewirable DCL plugs with earthing contact shall be designed with ample space for slack of the earthing conductor in such a way that, if any strain relief is rendered inoperative, the connection of the earthing conductor is subjected to strain after the connections of the current-carrying conductors and that, in case of excessive stresses, the earthing conductor will break after the current-carrying conductors.

This requirement is not applicable to removable DCL plugs integral with a luminaire where strain is not likely to be transmitted to terminals during installation, use or maintenance.

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

The flexible cable is connected to the accessory 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 when using the shortest possible path for its correct connection.

The earthing conductor is then connected to the terminal. It must then be possible to house the loop, which is formed by the earthing conductor owing to its surplus length when the accessory is assembled correctly.

In non-rewirable non-moulded-on DCL plugs with earthing contact, the length of the conductors between the terminations and the flexible cable anchorage shall be so adjusted that the current-carrying conductors will be stressed before the earthing conductor, if the flexible cable slips in its anchorage.

Compliance is checked by inspection.

14.9 For rewirable DCL plugs:

– it shall be clear how the relief from strain and the prevention of twisting of the flexible cable is intended to be effected;
– the flexible cable anchorage, or at least part of it, shall be integral with or reliably fixed to one of the component parts of the plug;
– makeshift methods, such as tying the flexible cable in a knot or tying the ends with string, shall not be used;
– the flexible cable anchorage shall be suitable for the different types of flexible cable which may be connected.

Screws, if any, which have to be operated to clamp the flexible cable, shall not serve to fix any other component.

NOTE This does not exclude a cover serving to retain the flexible cable in position in the flexible cable anchorage provided the cable remains in place in the accessory when the cover is removed.

– flexible cable anchorage shall be of insulating material or be provided with an insulating lining fixed to the metal parts;

– metal parts of the flexible cable anchorage, including clamping screws, shall be insulated from the earthing circuit.

Compliance is checked by inspection.

14.10 Insulating parts of the DCL plug which keep the live parts in position shall be reliably fixed together, and it shall not be possible to dismantle the DCL plug without the use of a tool.

Compliance is checked by inspection and by manual test.

For rewirable DCL plugs it shall not be possible to remove covers, cover-plates or parts of them intended to ensure protection against electric shock without the use of a tool.

Compliance is checked as follows:

– *for covers, cover-plates or parts of them whose fixing is of the screw type, compliance is checked by inspection*

– *for covers, cover-plates or parts of them whose fixing is not dependent on screws and whose removal may give access to live parts, compliance is checked by the tests of 22.3.1.*

14.11 Screws intended to allow the access to the interior of the plug shall be captive.

NOTE The use of tight fitting washers of cardboard or the like is deemed to be an adequate method for securing screws which must be captive.

Compliance is checked by inspection.

15 Resistance to ageing and to humidity

15.1 Resistance to ageing

DCL systems shall be resistant to ageing.

Parts intended for decorative purposes only, such as certain lids, are to be removed before the test.

Compliance is checked by the following test:

DCL systems, mounted as for normal use, are subjected to a test in a heating cabinet with an atmosphere having the composition and pressure of the ambient air.

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

The duration of the ageing test is 7 days (168 h).

The use of an electrically heated cabinet is recommended.

After the treatment, the specimens are allowed to attain approximately room temperature. They are examined and shall show no crack visible with normal or corrected vision without additional magnification and the specimens shall be capable of meeting the remaining requirements of this standard.

15.2 Resistance to humidity

DCL systems shall be proof against humidity 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 electric strength test specified in Clause 16.

Inlet openings in the enclosure, if any, are left open if knockouts are provided.

Parts which can be removed without the use of a tool, are removed and subjected to the humidity treatment with the main part.

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, where specimens are placed, is maintained within ± 1 K of any convenient value t between 20 °C and 30 °C.

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

The specimens are kept in the cabinet for 2 days (48 h).

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

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

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

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

16 Insulation resistance and electric strength

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

Compliance is checked by the following tests, which are made immediately after the test of 15.2, in the humidity cabinet or in the room in which the specimens were brought to the prescribed temperature, after re-assembly of those parts which can be removed without the use of a tool which were removed for that test.

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

The insulation resistance shall be not less than 5 MΩ.

16.1.1 *For DCL outlets, the insulation resistance is measured consecutively:*

a) between all poles connected together and the body, the measurement being made with a plug in engagement;

b) between each pole in turn and all others, these being connected to the body, with a plug in engagement;

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

NOTE 1 The term "body" used in items a) and b) includes accessible metal parts, metal frames supporting the base of flush-type DCL outlets, metal foil in contact with the outer surface of accessible external parts of insulating material, fixing screws of bases or covers and cover-plates, external assembly screws and earthing terminals or earthing contacts.

NOTE 2 Test c) is only made if any insulating lining is necessary to provide insulation.

NOTE 3 While 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 test probe 11 of IEC 61032.

16.1.2 *For DCL plugs, the insulation resistance is measured consecutively:*

a) between all poles connected together and the body;

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

c) between any metal part of the flexible cable anchorage, if any, including clamping screws, and the earthing terminal or earthing contact, if any;

d) between any metal part of the flexible cable anchorage and a metal rod of the maximum diameter of the flexible cable inserted in its place (see Table 11).

NOTE 1 The term "body" used in items a) and b) includes all accessible metal parts, external assembly screws, earthing terminals, earthing contacts and metal foil in contact with the outer surface of accessible external parts of insulating material, other than the engagement face.

NOTE 2 Measurements c) and d) are not made on non-rewirable plugs.

NOTE 3 While 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 test probe 11 of IEC 61032.

16.2 *A voltage of substantially sine-wave form, having a frequency of 50 Hz or 60 Hz, is applied for 1 min between the parts indicated in 16.1.*

〚C〉 *The test voltage shall be 2 000 V.* 〈C〛

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

No flashover or breakdown shall occur during the test.

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

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

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

NOTE 4 Glow discharges without drop in voltage are neglected.

17 Operation of earthing contacts

Earthing contacts shall provide adequate contact pressure and shall not deteriorate in normal use.

Compliance is checked by the test of Clauses 18 and 19.

18 Making and breaking capacity

DCL plugs and DCL outlets shall have adequate making and breaking capacity.

Compliance is checked as follows:

Rewirable DCLs are fitted with conductors as specified for the test of Clause 19.

Non-rewirable DCL plugs shall be tested with the conductors provided.

DCL plugs are tested using a DCL outlet of the same configuration complying with this standard. Care is taken that the pins of the test plug are in good condition before the test is started.

DCL outlets are tested using a DCL plug of the same configuration complying with this standard. The length of stroke is appropriate to the design.

The DCL plug is inserted into and withdrawn from the DCL outlet at a rate of 15 strokes per min. The period during which the test current is passed from engagement of the plug until subsequent disengagement is $(1{,}5\ ^{+0{,}5}_{0})$ *s.*

NOTE A stroke is an insertion or a withdrawal of the plug

The following tests are conducted:

An inductive load equal to the rated current ($\cos\varphi = 0{,}6 \pm 0{,}05$*) is connected to the DCL plug. The DCL plug is inserted and withdrawn from the DCL outlet 100 times (200 strokes).*

▌Ⓒ〉 *The tests are carried out at 250 V.* 〈Ⓒ▐

The locking means, if any, is disabled for this test.

During the test no substantial arcing shall occur.

After the test, the specimens shall show no damage impairing their further use and the entry holes for the pins shall not show damage which may impair the safety within the meaning of this standard.

19 Temperature rise

19.1 DCL plugs and DCL outlets shall be so designed and constructed, that when installed and used as in normal use the temperature rise of current-carrying parts is not excessive. The test shall be carried out in the box as specified by the manufacturer.

Compliance is checked as follows using corresponding DCL outlets and DCL plugs.

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

NOTE 1 The test assembly should be allowed to dry for at least 7 days when first made.

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

NOTE 2 The sides of the cavity in the pine-wood block may have a cylindrical shape.

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

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

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

The test assembly shall be placed in a draught free environment for the test with the mounting surface orientated appropriate to the DCL outlet being tested (wall/ceiling).

The terminals of DCL outlets are wired with a cable having a nominal cross sectional area of 2,5 mm^2.

The terminals of rewirable DCL plugs intended for the connection of flexible cable are wired with a 0,75 mm^2 circular two core flexible cable type 60227 IEC 53 complying with IEC 60227-5.

Non-rewirable DCL plugs are tested with the flexible cable supplied.

In rewirable independent and component DCL plugs, terminals intended for the connection of flexible cables are wired with a 0,75 mm^2 circular two core flexible cable type 60227 IEC 53 complying with IEC 60227-5.

Terminal screws, if any, are tightened with a torque equal to two thirds of those given in Table 5.

NOTE 3 To ensure normal cooling of the terminals, conductors connected to socket-outlets and rewirable plugs should have a length of at least 1 m. For non-rewirable plugs the length should be as delivered by the manufacturer but in any case it should not be greater than 1 m.

19.3 *Resistive loads are then connected to the cables referred to in 19.2 to provide test conditions according to Table 10 in a circuit shown in Figure 3. For test 1 in Table 10 the plug is connected to a 6 A resistive load.*

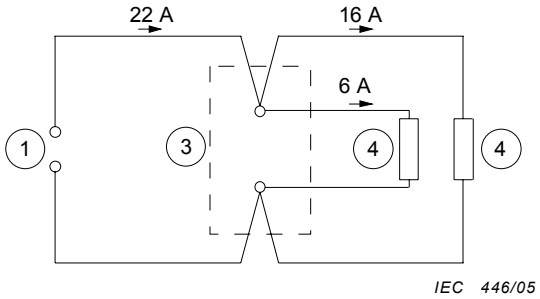


Figure 3a – Circuit diagram for Test 1

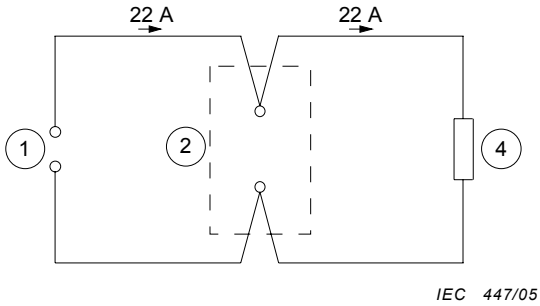


Figure 3b – Circuit diagram for Test 2

(1) Supply
(2) DCL outlet
(3) DCL
(4) Load

Figure 3 – Circuit diagram for temperature rise test

〖C〗 *For accessories designed and constructed so that the contact pressure in the earthing socket-contact assemblies is reliant on the insulating material additional separate tests shall be made passing the current through the earthing contact and the phase or neutral contact whichever is nearer.* 〈C〗

Table 10 – Test sequence for temperature rise test

Loads	Test 1	Test 2
Load through DCL plug	6 A	no load
Transferred load via DCL outlet terminals	16 A	22 A
Total load on the supply terminals of the DCL outlet	22 A	22 A

The load currents as specified in Table 10 are passed for 1 h.

The temperature is determined by means of melting particles, colour changing indicators or thermocouples, so chosen and positioned that they have negligible effect on the temperature being determined.

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

During the test the temperature rise necessary to perform the test of 23.3 shall be determined.

19.4 *Non-rewirable independent DCL plugs shall be tested using a circuit as described in 19.2 and the test of 19.3 but connected to a resistive load corresponding to the flexible cable fitted.*

20 Force necessary to insert and withdraw the plug

The construction of DCLs shall allow the easy insertion and withdrawal of the plug, but prevent the inadvertent disengagement of plug and outlet in normal use.

Compliance is checked by the following test:

A previously untested specimen of the DCL plug and DCL outlet and a specimen having previously completed the tests of Clause 19 are tested.

All pins are wiped free from grease before use.

Each DCL outlet is fixed to a suitable flat surface.

Each DCL plug, in turn, is inserted and withdrawn from each DCL outlet and the force required to perform each movement measured.

〚C〛 *In no single movement shall the force required to insert or withdraw the plug exceed 50 N nor shall it be less than 10 N.* 〚C〛

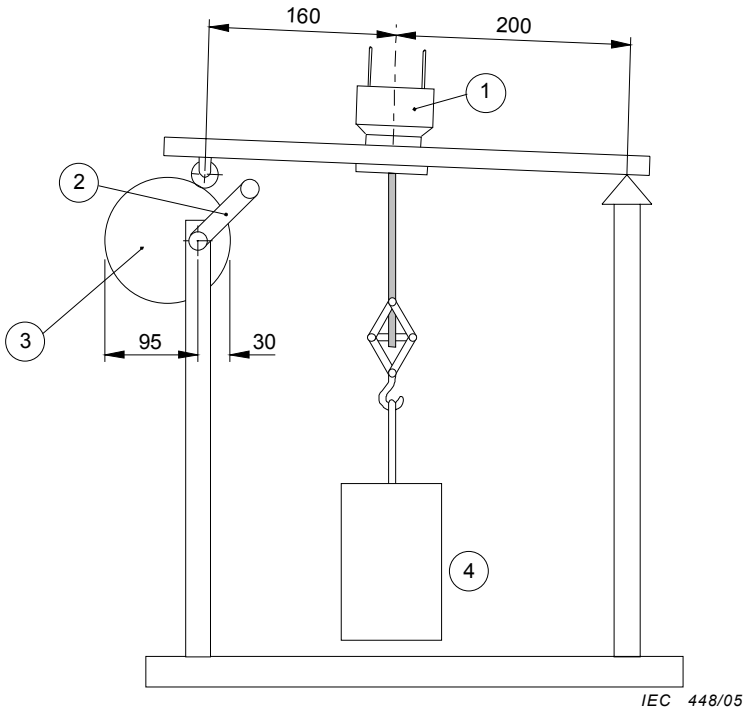
21 Flexible cables and their connection

21.1 DCL plugs shall be provided with a flexible cable anchorage such that the conductors are relieved from strain, including twisting, where they are connected to the terminals or terminations, and that their covering is protected from abrasion.

Compliance is checked by inspection.

21.2 *The effectiveness of the cable anchorage is checked by the following test by means of an apparatus as shown in Figure 4.*

Non-rewirable DCL plugs are tested as delivered; the test is made on new specimens.



Dimensions in millimetres

(1) Specimen
(2) Crank
(3) Eccentric
(4) Load

Figure 4 – Apparatus for testing the flexible cable retention

Rewirable DCL plugs are tested with each of the types of flexible cable specified in Table 11.

Table 11 – Cable dimensions for the flexible cable retention test

Rating of DCL plug	Number of poles	Types of flexible cable [a]	Number of conductors and nominal cross-sectional area N° × mm²	Limits for external dimensions for flexible cables mm		Torque for test of 21.2 Nm
				min.	max.	
6 A, 250 V	2	60227 IEC 52	2 × 0,5	4,6 or 3,0 × 4,9	5,9 or 3,7 × 5,9	0,15
		60227 IEC 52	2 × 0,75	4,9 or 3,2 × 5,2	6,3 or 3,8 × 6,3	0,15
	3	60227 IEC 53	3 × 0,75	6,0	7,6	0,25
		60227 IEC 53	3 × 1,0	6,3	8,0	0,25

[a] Rewirable plugs may be used with a flat two-core cable type 60227 IEC 52 as well as round three-core cable type 60227 IEC 53.

Conductors of the flexible cable of rewirable DCL plugs are introduced into the terminals, the terminal screws being tightened just sufficiently to prevent the position of the conductors from easily changing.

The flexible cable anchorage is used in the normal way, clamping screws, if any, being tightened with a torque equal to two-thirds of that specified in Table 5.

After re-assembly of the specimen, the component parts shall fit snugly and it shall not be possible to push the flexible cable into the specimen to any appreciable extent.

The specimen is placed in the test apparatus so that the axis of the flexible cable is vertical where it enters the specimen.

The flexible cable is then subjected 100 times to a pull of 60 N.

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

Care should be taken to exert the same pull on all parts (core, insulation and sheath) of the flexible cable simultaneously.

Immediately afterwards, the flexible cable is subjected for 1 min to a torque appropriate to the cable as shown in Table 11.

After the tests, the flexible cable shall not have been displaced by more than 2 mm. For rewirable DCL plugs, the end of the conductors shall not have moved noticeably in the terminals; for non-rewirable DCL plugs, there shall be no break in the electrical connections.

For the measurement of the longitudinal displacement, a mark is made on the flexible cable while it is subjected to light tension, at a distance of approximately 20 mm from the end of the specimen or the flexible cable guard, before starting the tests. If, for non-rewirable DCL plugs, there is no definite end to the specimen or the flexible cable guard, an additional mark is made on the body of the specimen.

After the tests, the displacement of the mark on the flexible cable in relation to the specimen or the flexible cable guard is measured while the flexible cable is subjected to the pull.

21.3 Non-rewirable DCL plugs shall be provided with a suitable flexible cable complying with IEC 60227-5. Any conductor connected to an earthing contact shall be identified by the colour combination green/yellow.

NOTE – Tinsel cord is considered unsuitable.

Compliance is checked by inspection.

22 Mechanical strength

DCLs shall have adequate strength to withstand the stresses imposed during installation and use.

Compliance is checked by the appropriate tests of 22.1 to 22.8 as shown in Table 12:

Table 12 – Schedule of mechanical strength test

Test according to subclause	DCL outlets	DCL plugs
22.1	X	
22.2	X	
22.3	X	
22.4	X	
22.5	X	
22.6	X	
22.7	X	
22.8		X

22.1 *The specimens are subjected to blows by means of an impact-test apparatus as described in Annex D of IEC 60068-2-75.*

NOTE The impact test apparatus described in Annex D of IEC 60068-2-75 is the pendulum hammer.

The plywood can be turned 60° in both directions about a vertical axis.

Surface type DCL outlets are mounted on the plywood as for normal use.

Flush-type DCL outlets are mounted in a recess provided in a block of hornbeam or material having similar mechanical characteristics, which is fixed to a sheet of plywood and not in its relevant mounting box.

If wood is used for the block, the direction of the wood fibres shall be perpendicular to the direction of the impact.

Flush DCL outlets shall be fixed by means of screws to lugs recessed in the block.

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

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

The striking element is allowed to fall from a height which is specified in Table 13.

Table 13 – Height of fall for impact test

Height of fall mm	DCL Outlets
100	A
150	B
200	C
250	D

A = Parts on the front surface, including the parts which are recessed.

B = Parts which do not project more than 15 mm from the mounting surface (distance from the wall/ceiling) after mounting as in normal use with the exception of the above parts A.

C = Parts other than those in A which project between 15 mm and 25 mm from the mounting surface (distance from the wall/ ceiling) after mounting as in normal use.

D = Parts other than those in A which project more than 25 mm from the mounting surface (distance from the wall/ceiling) after mounting as in normal use.

The impact energy determined by the part of the specimen which projects most from the mounting surface is applied on all parts of the specimen, with the exception of those in A in Table 13.

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

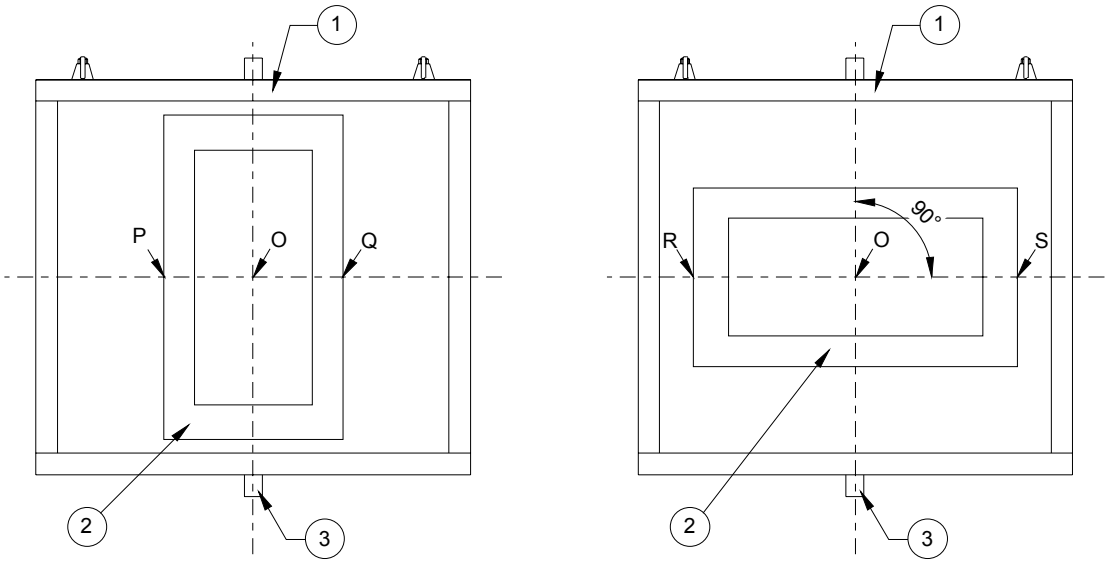
The specimens are subjected to blows, which are evenly distributed. The blows are not applied to knock-outs.

The following blows are applied:

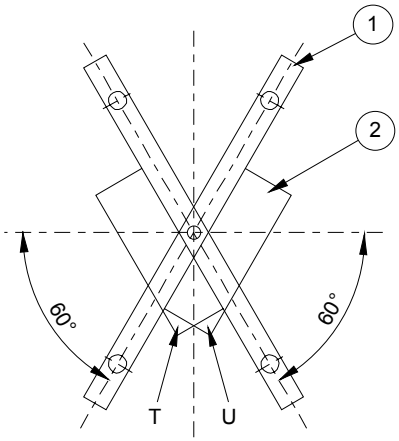
– *for parts specified in A, five blows (see Figure 5a and Figure 5b):*
  - *one blow to the centre,*
  - *one blow on each of the two most unfavourable points between the centre and the edges, after the specimen has been moved horizontally,*
  - *one blow on similar points, after the specimen has been turned 90° about its axis perpendicular to the plywood;*
– *for parts specified in B (as far as applicable), C and D, four blows:*
  - *one blow is applied on one of the sides of the specimen where the blow can be applied, after the plywood sheet has been turned 60° about a vertical axis (see Figure 5c);*

- *one blow on the opposite side of the specimen where blows can be applied, after the plywood sheet has been turned 60° about a vertical axis, in the opposite direction (see Figure 5c).*

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



5a 5b



5c

IEC 449/05

Application of the blows			
Sketch	Total number of blows	Points of application	Parts to be tested
5a)	3	One at the centre One between 0 and P [a] One between 0 and Q [a]	A
5b)	2	One between 0 and R [a] One between 0 and S [a]	A
5c)	2	One on the surface T [a] One on the surface U [a]	B, C and D
[a] The blow is applied to the most unfavourable point.			

1) Sheet of plywood
2) Specimen
3) Pivot

Figure 5 – Sequence of blows for parts A, B, C and D

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

In case of doubt, it is verified that it is possible to remove and to replace external parts, such as boxes, enclosures, covers and cover-plates, without these parts or their insulating lining being broken. If a cover-plate backed by an inner cover is broken, the test is repeated on the inner cover, which shall remain unbroken.

Damage to the finish, small dents which do not reduce creepage distances or clearances below the values specified in 25.1 and small chips which do not adversely affect the protection against electric shock 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.

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

22.2 *Surface-type DCL outlets are first fixed to a cylinder of rigid steel sheet, having a radius equal to 4,5 times the distance between fixing holes, but in any case not less than 200 mm. The axes of the holes are in a plane perpendicular to the axis of the cylinder and parallel to the radius through the centre of the distance between the holes.*

The fixing screws are gradually tightened, the maximum torque applied being 0,5 Nm for screws having a thread diameter up to and including 3 mm and 1,2 Nm for screws having a larger thread diameter.

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

During and after the tests, the DCL outlets shall show no damage impairing their further use.

Fifteen minutes after removal from the test apparatus, the specimens shall show no damage within the meaning of this standard.

22.3 *When testing the forces necessary for cover-plates to come off, the DCL outlets are mounted as for normal use. Flush-type DCL outlets are fixed in appropriate mounting boxes, which are installed as for normal use so that the rims of the boxes are flush with the mounting surface and the covers or cover-plates are fitted. If they are provided with locking means which can be operated without the aid of a tool, these means are unlocked.*

Compliance is then checked according to 22.3.1 and 22.3.2.

22.3.1 Verification of the non-removal of covers or cover-plates

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

– *40 N for covers, cover-plates or parts of them complying with the tests of 22.6 and 22.7;*

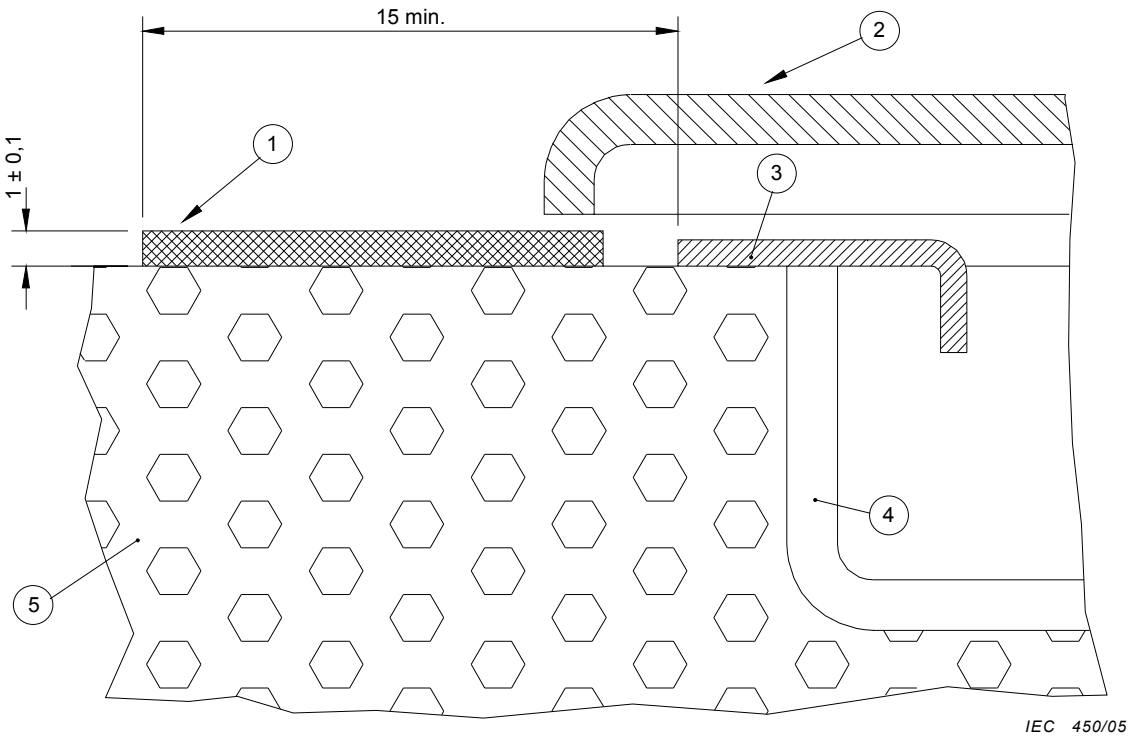
– *80 N for other covers, cover-plates or parts of them.*

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

The test is then repeated on a new specimen, the cover or cover-plate is fitted on the wall after a sheet of hard material, (1 ± 0,1) mm thick, has been fitted around the supporting frame as shown in Figure 6.

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

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



Dimensions in millimetres

(1) Sheet of hard material

(2) Cover-plate

(3) Supporting frame

(4) Mounting box

(5) Wall

Figure 6 – Arrangement for test on covers or cover-plates

22.3.2 Verification of the removal of covers or cover-plates

A force not exceeding 120 N is gradually applied, in directions perpendicular to the mounting/supporting surfaces, to covers, cover-plates or parts of them by means of a hook placed in turn in each of the grooves, holes, spaces or the like, provided for removing them.

The covers or cover-plates shall come off.

The test is made 10 times to each separable part, the fixing of which is not dependent on screws (equally distributing as far as practicable the application points); the removal force is applied each time to the different grooves, holes or the like provided for removing the separable part.

The test is then repeated on new specimens, the cover or cover-plate is fitted on the wall after a sheet of hard material, (1 ± 0,1) mm thick, has been fitted around the supporting frame, as shown in Figure 6.

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

22.4 *The test is made as described in 22.3, but applying, for 22.3.1, the following forces:*

– *10 N for covers or cover-plates complying with the test of 22.6 and 22.7*

– *20 N for other covers or cover-plates.*

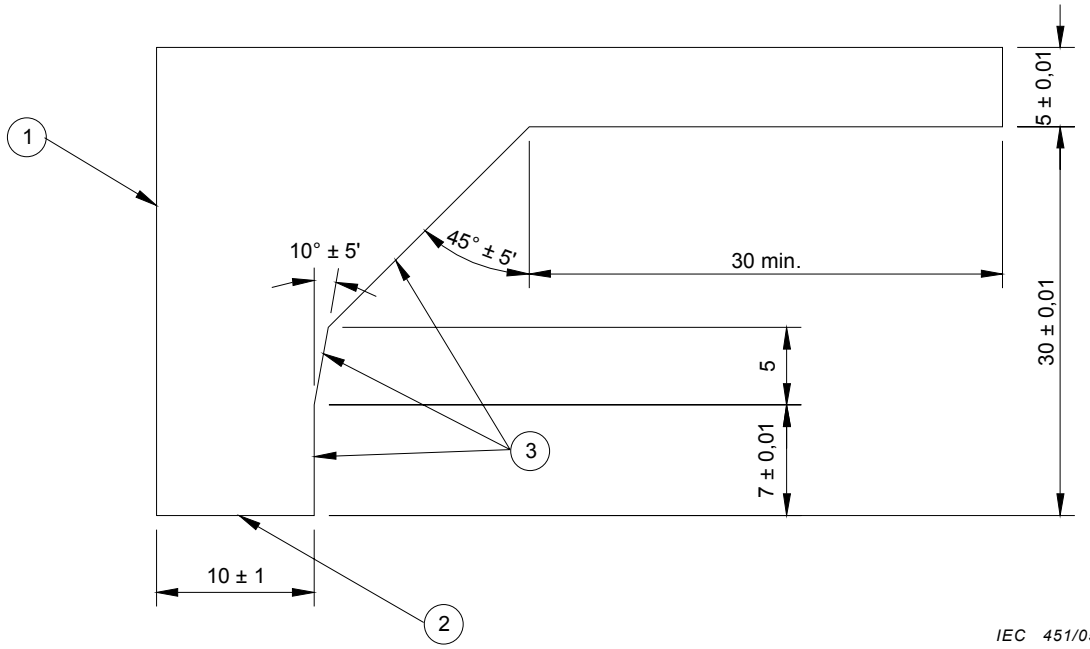
22.5 *The test is made as described in 22.3, but applying, for 22.3.1, the force of 10N for all covers or cover-plates.*

22.6 *The gauge shown in Figure 7 is pushed toward each side of each cover or cover-plate which is fixed without screws on a mounting or supporting surface, as shown in Figure 8.*

The face B resting on the mounting/supporting surface, with the face A perpendicular to it, the gauge is applied at right angles to each side under test.

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

The distances between the face C of the gauge and the outline of the side under test, measured parallel to face B, shall not decrease (with the exception of grooves, holes, reverse tapers or the like, placed at a distance less than 7 mm from a plane including face B and complying with the test of 22.7) when measurements are repeated starting from point X in the direction of the arrow Y (see Figure 9).



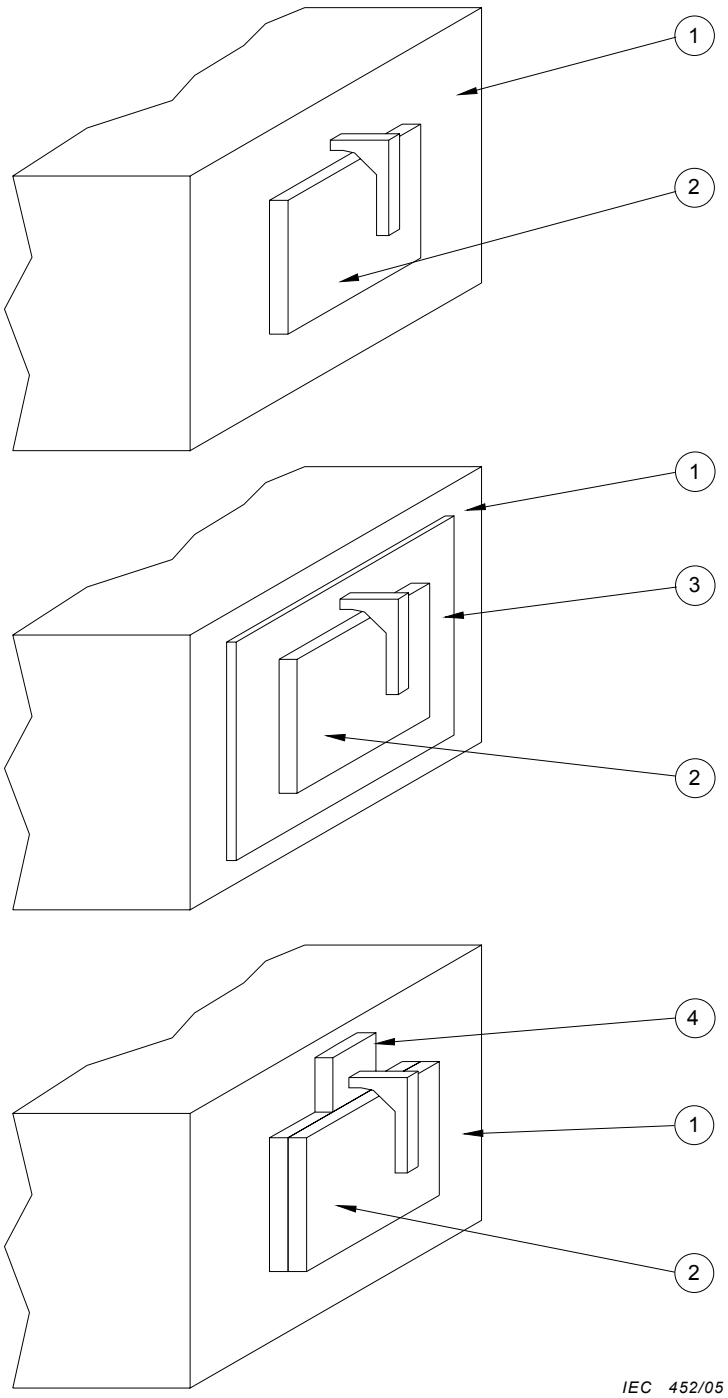
Dimensions in millimetres

(1) Face A

(2) Face B

(3) Face C

Figure 7 – Gauge (thickness: about 2 mm) for the verification of the outline of covers or cover-plates



(1) Mounting support

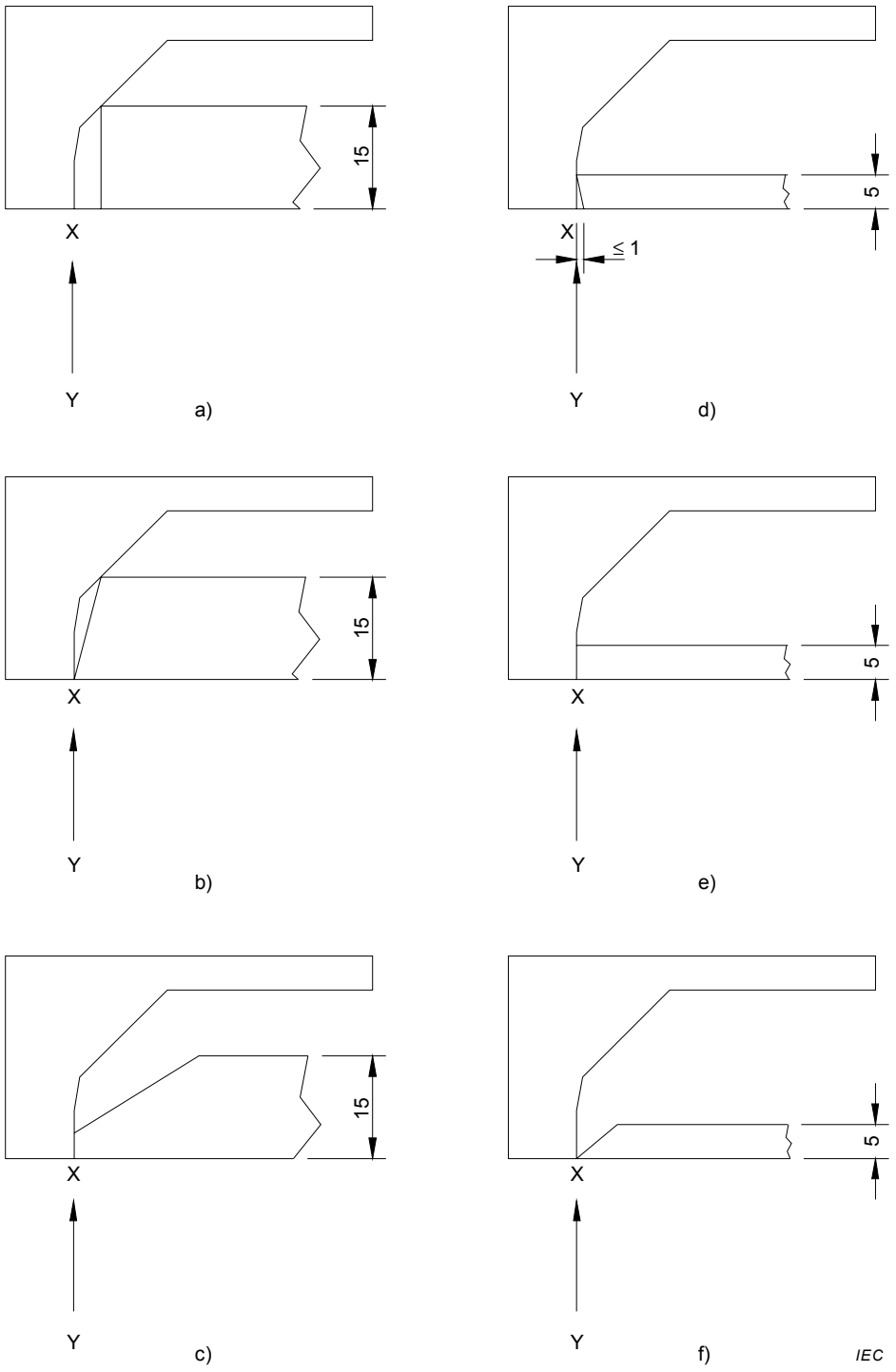
(2) DCL outlet

(3) Surface support

(4) Spacing piece having the same thickness as that of the supporting part

.

Figure 8 – Examples of application of the gauge of Figure 7 on covers fixed without screws on a mounting surface or supporting surface



Dimensions in millimetres

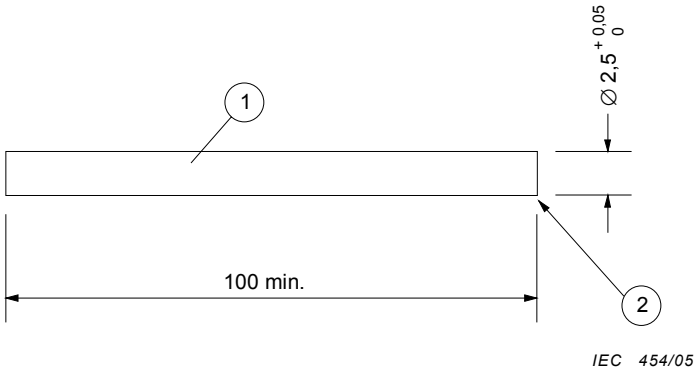
Cases a) and b) do not comply.

Cases c), d), e) and f) comply (compliance shall however also be checked with the requirements of 24.18, using the gauge shown in Figure 7).

Figure 9 – Examples of application of the gauge of Figure 7 in accordance with the requirements of 22.6

22.7 *A gauge according to Figure 10 applied with a force of 1 N shall not enter more than 1 mm from the upper part of any groove, hole or reverse taper or the like when the gauge is applied parallel to the mounting/supporting surface and at right angle to the part under test, as shown in Figure 11.*

The verification whether the gauge according to Figure 10 has entered more than 1 mm is made with reference to a surface perpendicular to face B and including the upper part of the outline of the grooves, holes, reverse tapers or the like.

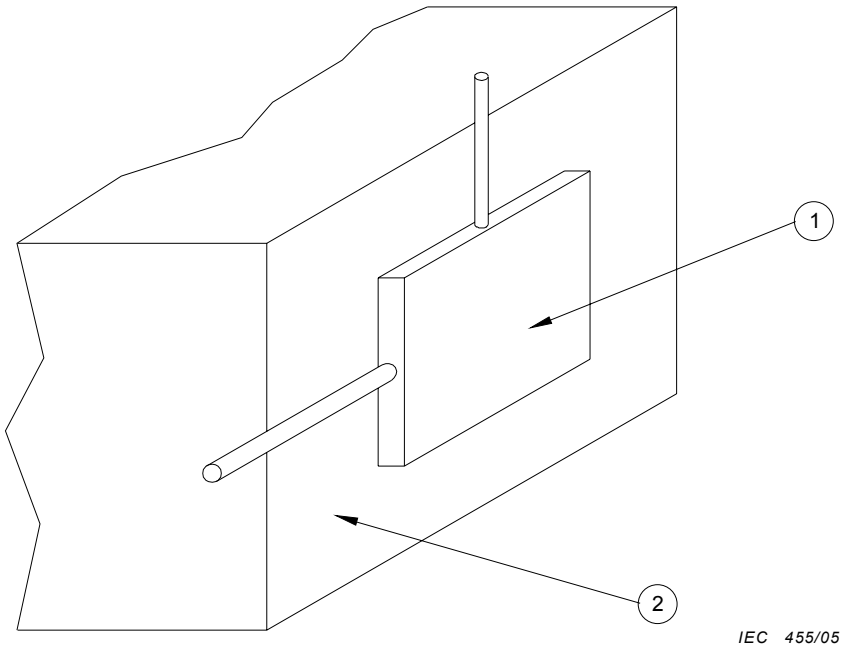


Dimensions in millimetres

(1) Test rod (metal)

(2) Right-angled sharp edges

Figure 10 – Gauge for verification of grooves, holes and reverse tapers



(1) DCL outlet

(2) Mounting surface

Figure 11 – Sketch showing the direction of application of the gauge of Figure 10

22.8 *DCLs are fitted with the flexible cable specified in 21.2 having the smallest nominal cross-sectional area specified in Table 11 and a free length of approximately 100 mm measured from the outer end of the guard.*

Terminal screws and assembly screws are tightened with a torque equal to two-thirds of that specified in 12.2.4, Table 5.

Non-rewirable accessories are tested as delivered, the flexible cable being cut so that a free length of about 100 mm projects from the accessory.

The specimens are individually subjected to test Ed: Free fall, procedure 2 of IEC 60068-2-32, the number of falls being:

– *50 if the mass of the specimen without flexible cable does not exceed 250 g,*

– *25 if the mass of the specimen without flexible cable exceeds 250 g.*

The barrel is turned at a rate of five revolutions per minute, 10 falls per minute thus taking place.

After the test, the specimens shall show no damage within the meaning of this standard. Provided that the protection against electric shock is not affected, small pieces which may have broken off the specimens are ignored.

The pins shall not be broken.

The pins shall not have become so deformed:

– *that the DCL plug cannot be introduced into a DCL outlet complying with the relevant standard sheet*

– *or fails to comply with the requirements of 10.3.*

Damage to the finish and small dents which do not reduce the creepage distances or clearances below the values specified in Table 14, subclause 25.1 are ignored.

23 Resistance to heat

DCL plugs and DCL outlets and surface mounting boxes shall be resistant to heat.

Compliance is checked:

a) for surface mounting boxes, separable covers, separable cover-plates and separable frames, by the test of 23.3;

b) for DCL plugs and DCL outlets, with the exception of the parts, if any, covered by item a) by the tests of 23.1 and 23.2 or 23.3.

Parts intended only for decorative purposes, such as certain lids, are not submitted to this test.

23.1 *The specimens are kept for 1 h in a heating cabinet at a temperature of (100 ± 2) °C.*

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

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

When the test finger, specified in IEC 61032, test probe B, is applied with a force not exceeding 5 N, there shall be no access to live parts when DCLs are mounted as for normal use.

After the test, marking shall still be legible.

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

23.2 *Parts of insulating material necessary to retain current-carrying parts and parts of the earthing circuit in position shall be subjected to a ball-pressure test by means of the apparatus as shown in Figure 12, except that insulating parts necessary to retain the earthing terminal in position in a box, shall be tested as specified in 23.3.*

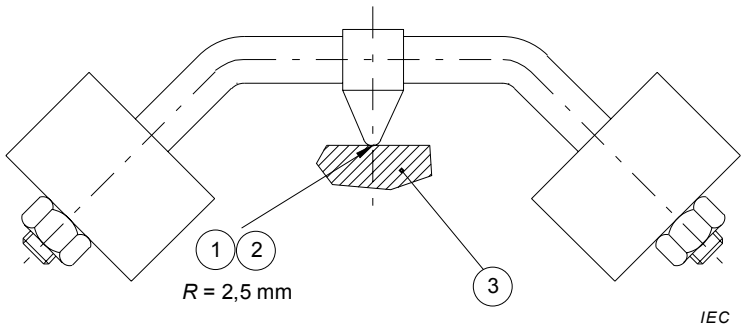
When it is not possible to carry out the test on the specimen under test, the test should be carried out on a specimen of the material at least 2 mm thick.

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

The test is made in a heating cabinet at a temperature of (125 ± 2) °C.

After 1 h, the ball is removed from the 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.



(1) Spherical

(2) Material: steel

(3) Specimen

Figure 12– Ball pressure test apparatus

23.3 *Parts of insulating material not necessary to retain current-carrying parts and parts of the earthing circuit in position, even though they are in contact with them, are subjected to a ball-pressure test in accordance with 23.2, but the test is made at a temperature of (70 ± 2) °C, or (40 ± 2) °C plus the highest temperature rise determined for the relevant part during the test of Clause 19, whichever is the higher.*

24 Screws, current-carrying parts and connections

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

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

Compliance is checked by inspection and, for screws and nuts transmitting contact pressure or which are operated when connecting up the DCL, by the following test:

The requirements for verification of terminals are given in Clause 12.

The screws or nuts are tightened and loosened:

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

Screws or nuts which are operated when connecting up DCL plugs and DCL outlets include screws for fixing covers or cover-plates, etc. but not connecting means for screwed conduits and screws for fixing the base of a fixed DCL outlet.

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

The test is made by means of a suitable screwdriver or other tool, a torque as specified in Table 5 being applied.

During the test, no damage impairing the further use of the screwed connections shall occur, such as breakage of screws or damage to the head slots (rendering the use of the appropriate screwdriver impossible), threads, washers or stirrups.

The shape of the blade of the test screwdriver must match the head of the screw to be tested. The screws and nuts shall not be tightened in jerks. Damage to covers is neglected.

Screwed connections are considered as partially checked by the tests of Clauses 21 and 22.

24.2 For screws in engagement with a thread of insulating material and which are operated when connecting the DCL plug or DCL outlet during installation, their correct introduction into the screw hole or nut shall be ensured.

Compliance is checked by inspection and by manual test.

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

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

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

Compliance is checked by inspection.

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

Compliance is checked by inspection and by manual test.

NOTE 1 Spring washers may provide satisfactory locking.

NOTE 2 For rivets, a non-circular shank or an appropriate notch may be sufficient.

NOTE 3 Sealing compound which softens on heating provides satisfactory locking only for screw connections not subjected to torsion in normal use.

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

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

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

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

NOTE 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 % copper for parts made from rolled sheet (in cold condition) or at least 50 % copper for other parts;
– stainless steel containing at least 13 % chromium and not more than 0,09 % carbon;
– steel provided with an electroplated coating of zinc according to ISO 2081, the coating having a thickness of at least 5 µm ISO service condition No. 1;
– steel provided with an electroplated coating of nickel and chromium according to ISO 1456, the coating having a thickness of at least 20 µm ISO service condition No. 2;
– steel provided with an electroplated coating of tin, according to ISO 2093, the coating having a thickness of at least 12 µm ISO service condition No. 2.

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

Compliance is checked by inspection.

NOTE A test for determining the resistance to corrosion is under consideration.

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

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

Compliance is checked by inspection.

25 Creepage distances, clearances and distances through sealing compound

25.1 Creepage distances, clearances, and distances through sealing compound shall be not less than the values shown in Table 14.

Compliance is checked by measurement.

Table 14 – Creepage distances and clearances

Description	mm
Creepage distance:	
1) between live parts of different polarity;	3
2) between live parts and:	
– accessible insulating and earthed metal parts;	
– parts of the earthing circuit;	
– metal frames supporting the base of flush·type DCL outlets;	
– screws or devices for fixing bases, covers or cover- plates of fixed DCL outlets;	
– external assembly screws, other than screws which are on the engagement face of DCL plugs and are isolated from the earthing circuit;	3
3) between pins of a DCL plug and metal parts connected to them, when fully engaged , and a DCL outlet having accessible unearthed metal parts[a], made according to the most unfavourable construction[b];	4,5
4) between the accessible unearthed metal parts[a] of an DCL outlet and a fully engaged DCL plug having pins and metal parts connected to them made according to the most unfavourable construction [b];	4,5
5) between live parts of a DCL outlet (without a plug) or of a DCL plug and its accessible unearthed metal parts [a].	4,5
Clearance:	
6) between live parts of different polarity;	3
7) between live parts and:	
– accessible surface of parts of insulating material;	
– accessible insulating and earthed metal parts not mentioned under Items 8 and 9;	
– parts of the earthing circuit;	
– metal frames supporting the base of flush-type DCL outlets;	
– screws or devices for fixing bases, covers or cover-plates of DCL outlets;	
– external assembly screws, other than screws which are on the engagement face of DCL plugs and are isolated from the earthing circuit;	3
8) between live parts and:	
– exclusively earthed metal boxes[c] with the DCL outlet mounted in the most unfavourable position;	
– unearthed metal boxes, without insulating lining, with the DCL outlet mounted in the most unfavourable position;	4,5
9) between live parts and the surface on which the base of a DCL outlet for surface mounting, is mounted;	6
10) between live parts and the bottom of any conductor recess if any, in the base of a DCL outlet for surface mounting.	3
Distance through insulating sealing compound:	
11) between live parts covered with at least 2 mm of sealing compound and the surface on which the base of an DCL outlet for surface mounting, is mounted;	3
12) between live parts covered with at least 2 mm of sealing compound and the bottom of any conductor recess, if any, in the base of an outlet for surface mounting.	2,5
[a] With the exception of screws and the like.	
[b] The most unfavourable construction may be checked by means of a gauge which is based on the standard sheets.	
[c] Exclusively earthed metal boxes are those suitable only for use in installations where earthing of metal boxes is required.	

For rewirable DCL plugs, the measurements are made on the specimens fitted with conductors of the largest cross-sectional area specified in Table 1, and also without conductors.

For non-rewirable DCL plugs, the measurements are made on the specimens as delivered.

DCL outlets are checked with and without a DCL plug in engagement.

Distances through slots or openings in external parts of insulating material are measured to metal foil in contact with the accessible surface other than the engagement face of DCL plugs; the foil is pushed into corners and the like by means of the test probe 11 of IEC 61032 but is not pressed into openings.

For surface-type DCL outlets, the most unfavourable conduit or cable is introduced for a distance of 1 mm into the enclosure in accordance with 13.13.

For flush-type DCL outlets, metal frames (if any) and the DCL outlet position in the box are adjusted to give the most unfavourable position.

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

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

The surface on which the base of a DCL outlet for surface mounting is mounted, includes any surface in contact with the base when the DCL outlet is installed. If the base is provided with a metal plate at the back, this plate is not regarded as the mounting surface.

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

Compliance is checked by inspection.

25.3 Surface-type DCL outlets shall not have bare current-carrying strips at the back.

Compliance is checked by inspection.

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

26.1 Resistance to abnormal heat and to fire

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

Compliance is checked by means of the following test.

The test is performed according to IEC 60695-2-11 under the following conditions:

– *for parts of insulating material, necessary to retain current-carrying parts and parts of the earthing circuit in position, by the test made at a temperature of 850 °C;*
– *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 tests specified have to be made at more than one place on the same specimen, care must 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 subclause.

The tests are not made on parts of ceramic material.

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

If possible, the specimen should be a complete DCL plug or DCL outlet.

If the test cannot be made on a complete DCL plug or DCL outlet, a suitable part may be cut from it for the purpose of the test.

The test is made on one specimen.

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

The test is made applying the glow-wire once.

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

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

The specimen 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 specimen 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.

26.2 Resistance to tracking

For accessories having an IP code higher than IPX0, parts of insulating material retaining live parts in position shall be of material resistant to tracking.

Compliance is checked according to IEC 60112.

Ceramic parts are not tested.

A flat surface of the part to be tested, if possible at least 15 mm × 15 mm, is placed in a horizontal position.

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

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

27 Resistance to rusting

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

Compliance is checked by the following test:

All grease is removed from the parts to be tested, by immersion in a cold chemical degreaser such as trichloroethane or petroleum ether for 10 min. The parts are then immersed for 10 min in a 10 % solution of ammonium chloride in water at a temperature of (20 ± 5) °C.

Without drying, but after shaking off any drops, the parts are placed for 10 min in a box containing air saturated with moisture at a temperature of (20 ± 5) °C.

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

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

NOTE 2 For small springs and the like, and for inaccessible parts exposed to abrasion, a layer of grease may provide sufficient protection against rusting. Such parts are 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.

28 EMC Requirements

28.1 Immunity

Devices for connecting luminaires within the scope of this standard are tolerant of electromagnetic disturbances and therefore no immunity tests are necessary.

28.2 Emission

Electromagnetic disturbances are not generated by devices for connecting luminaires within the scope of this standard and therefore no emission tests are necessary.

Bibliography

IEC 60083:2004, *Plugs and socket-outlets for domestic and similar general use standardized in member countries of IEC*

〈C〉 IEC 60228:1978, *Conductors of insulated cables*

NOTE Harmonized as HD 383 S2 (modified).
HD 383 S2 is superseded by EN 60228:2005, which is based on IEC 60228:2004 (not modified).

IEC 60470, *High-voltage alternating current contactors and contactor-based motor-starters*

NOTE Harmonized as EN 60470:2000 (not modified).

IEC 60598-1:2003, *Luminaires – Part 1: General requirements and tests*

NOTE Harmonized as EN 60598-1:2004 (modified).

IEC 60670-1:2002, *Boxes and enclosures for electrical accessories for household and similar fixed electrical installations – Part 1: General requirements*

NOTE Harmonized as EN 60670-1:2005 (modified).

IEC 60999-1:1999, *Connecting devices – Electrical copper connectors – Safety requirements for screw-type and screwless-type clamping units – General requirements and particular requirements for clamping units for conductors from 0,2 mm^2 up to 35 mm^2 (included)*

NOTE Harmonized as EN 60999-1:2000 (not modified).

IEC 61140:1997, *Protection against electric shock – Common aspects for installation and equipment*

NOTE Harmonized as EN 61140:2001 (not modified).

IEC 61995-2, *Devices for the connection of luminaires for household and similar purposes – Part 2: Standard sheets* [2]

ISO 1456:2003, *Metallic coatings – Electrodeposited coatings of nickel plus chromium and of copper plus nickel plus chromium*

ISO 2039-2:1987, *Plastics – Determination of hardness – Part 2: Rockwell hardness*

NOTE Harmonized as EN ISO 2039-2:1999 (not modified). 〈C〉

ISO 2081:1986, *Metallic coatings –Electroplated coatings of zinc on iron or steel*

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

2) Under consideration

Annex ZA
(normative)

Special national conditions

Special national condition: National characteristic or practice that cannot be changed even over a long period, e.g. climatic conditions, electrical earthing conditions.

NOTE If it affects harmonization, it forms part of the European Standard.

For the countries in which the relevant special national conditions apply these provisions are normative, for other countries they are informative.

Clause	Special national condition
1	**Belgium, France, Germany, Italy** Only DCL types with a standardised interface according to EN 61995-2 are used.
7.3.1.1	**Denmark** Only DCL plugs for connection of flexible cables are allowed.
9.2	**Denmark** For many years Denmark has had a supporting 10 A DCL system on the market. **Add** the following indent after the last indent: – be interchangeable with or create a hazardous situation with this special Danish DCL system
10.2.2	**Denmark** Due to the lack of an earthing conductor in many existing old buildings luminaires with DCL plugs requiring earth connection cannot normally be used.

Annex ZB
(normative)

Normative references to international publications with their corresponding European publications

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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 60068-2-32	1975	Environmental testing - Part 2: Tests - Test Ed: Free fall	EN 60068-2-32[1)]	1993
IEC 60068-2-75	1997	Environmental testing - Part 2: Tests - Test Eh: Hammer tests	EN 60068-2-75	1997
IEC 60112	-[2)]	Method for the determination of the proof and the comparative tracking indices of solid insulating materials	EN 60112	2003[3)]
IEC 60227-5	-[2) 4)]	Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V - Part 5: Flexible cables (cords)	-	-
IEC 60417	Data-base	Graphical symbols for use on equipment	-	-
IEC 60529	-[2)]	Degrees of protection provided by enclosures (IP Code)	EN 60529 + corr. May	1991[3)] 1993
IEC 60695-2-11	-[2)]	Fire hazard testing - Part 2-11: Glowing/hot-wire based test methods - Glow-wire flammability test method for end-products	EN 60695-2-11	2001[3)]
IEC 61032	1997	Protection of persons and equipment by enclosures - Probes for verification	EN 61032	1998

[1)] EN 60068-2-32 includes A2:1990 to IEC 60068-2-32.

[2)] Undated reference.

[3)] Valid edition at date of issue.

[4)] HD 21.5:1994 + A1:1999 + A2:2001, which is related to, but not directly equivalent with IEC 60227-5, applies instead.

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