

INTERNATIONAL STANDARD



**Appliance couplers for household and similar general purposes –
Part 1: General requirements**

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INTERNATIONAL STANDARD



**Appliance couplers for household and similar general purposes –
Part 1: General requirements**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**APPLIANCE COUPLERS FOR HOUSEHOLD
AND SIMILAR GENERAL PURPOSES –****Part 1: General requirements****FOREWORD**

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This commented version (CMV) of the official standard IEC 60320-1:2021 edition 4.0 allows the user to identify the changes made to the previous IEC 60320-1:2015+AMD1:2018 edition 3.1. Furthermore, comments from IEC SC 23G experts are provided to explain the reasons of the most relevant changes.

A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text. Experts' comments are identified by a blue-background number. Mouse over a number to display a pop-up note with the comment.

This publication contains the CMV and the official standard. The full list of comments is available at the end of the CMV.

IEC 60320-1 has been prepared by subcommittee 23G: Appliance couplers, of IEC technical committee 23: Electrical accessories. It is an International Standard.

This fourth edition cancels and replaces the third edition published in 2015 and Amendment 1:2018. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) introduction of necessary tolerances throughout this document;
- b) the heating test from edition 2 is reintroduced in 18.2;
- c) temperature rise added for plug connectors in Clause 21;
- d) change for better readability in 23.3;
- e) updated lateral pull test in 23.6 for connectors/plug connectors with separate front parts;
- f) revision of 24.1 for ball pressure test;
- g) Clause 27 for glow wire test is updated;
- h) revision of Annex C for test sequences;
- i) additional Annex E for additional tests and requirements for appliance couplers intended to be used in ambient temperatures above +35 °C.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
23G/464/FDIS	23G/467/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

A list of all the parts in the IEC 60320 series, under the general title *Appliance couplers for household and similar general purposes*, can be found on the IEC website.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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APPLIANCE COUPLERS FOR HOUSEHOLD AND SIMILAR GENERAL PURPOSES –

Part 1: General requirements

1 Scope

This part of IEC 60320 sets the general requirements for appliance couplers for two poles and two poles with earth contact and for the connection of electrical devices for household and similar onto the mains supply.

This document is also valid for appliance inlets/appliance outlets integrated or incorporated in appliances.

The rated voltage does not exceed 250 V (AC) and the rated current does not exceed 16 A.

Appliance couplers complying with this document are suitable for normal use at ambient temperatures not normally exceeding +40 °C, but their average over a period of 24 h does not exceed +35 °C, with a lower limit of the ambient air temperature of –5 °C.

Annex E provides test requirements for derating the operating current of an accessory when used in ambient temperatures above +35 °C up to and including +90 °C. **1**

Appliance couplers are not suitable for:

- use in place of plug and socket-outlet systems according to IEC 60884-1;
- use in place of devices for connecting luminaires (DCLs) according to IEC 61995 or luminaire supporting couplers (LSCs);
- use in place of installation couplers according to IEC 61535.

~~NOTE – Requirements for d.c. are under consideration.~~

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60068-2-31, *Environmental testing – Part 2-31: Tests – Test Ec: Rough handling shocks, primarily for equipment-type specimens*

IEC 60068-2-60, *Environmental testing – Part 2-60: Tests – Test Ke: Flowing mixed gas corrosion test*

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

IEC 60112:2020, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

IEC 60227 (all parts), *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V*

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

~~IEC 60320 (all parts), Appliance couplers for household and similar general purposes~~

IEC 60320-3:2014, *Appliance couplers for household and similar general purposes – Part 3: Standard sheets and gauges*
IEC 60320-3:2014/AMD1:2018

IEC 60417, *Graphical symbols for use on equipment* (available from: <http://www.graphical-symbols.info/equipment>)

IEC 60664-1:2007/2020, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

~~IEC 60695-2-10:2000, Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure~~

IEC 60695-2-11:2000/2014, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products (GWEPT)*

~~IEC 60695-2-12:2000, Fire hazard testing – Part 2-12: Glowing/hot-wire based test methods – Glow-wire flammability index (GWFI) test method for materials~~

~~IEC 60695-2-13:2000, Fire hazard testing – Part 2-13: Glowing/hot-wire based test methods – Glow-wire ignition temperature (GWIT) test method for materials~~

IEC 60695-10-2:2014, *Fire hazard testing – Part 10-2: Abnormal heat – Ball pressure test method*

IEC 60730-2-11:2019, *Automatic electrical controls – for household and similar use – Part 2-11: Particular requirements for energy regulators*

IEC 60999-1:1999, *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 1: General requirements and particular requirements for clamping units for conductors from 0,2 mm² up to 35 mm² (included)*

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

IEC 61058 (all parts), *Switches for appliances*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1

appliance coupler

means enabling the connection and disconnection of an appliance or equipment to the supply

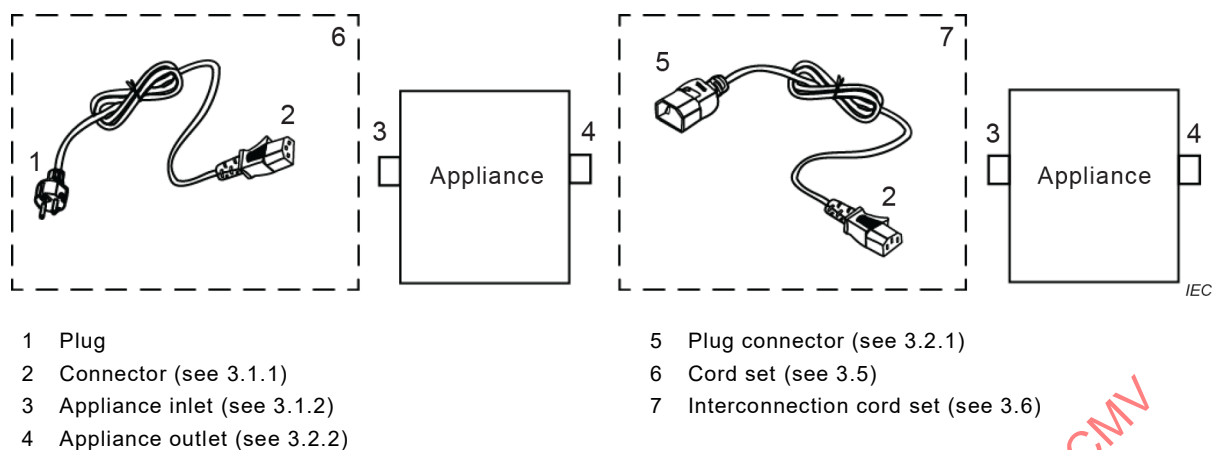


Figure 1 – Intended use of appliance couplers

3.1.1

connector (of an appliance coupler)

part of the appliance coupler integral with, or intended to be attached to, one cord connected to the supply

SEE: Figure 1.

[SOURCE: IEC 60050-442:1998, 442-07-02, modified – "the cord" has been replaced with "one cord" and a reference to Figure 1 has been added.]

3.1.2

appliance inlet

part of the appliance coupler integrated as a part of an appliance or incorporated as a separate part in the appliance or equipment or intended to be fixed to it

SEE: Figure 1.

3.2

interconnection coupler

appliance coupler enabling the connection and disconnection of an appliance or equipment to a cord leading to another appliance or equipment

SEE: Figure 1.

Note 1 to entry: An interconnection coupler is a type of appliance coupler.

3.2.1

plug connector

part of the interconnection coupler integral with or intended to be attached to one cord

SEE: Figure 1.

[SOURCE: IEC 60050-442:1998, 442-07-09, modified – "the flexible cable" has been replaced with "one cord" and a reference to Figure 1 has been added.]

3.2.2

appliance outlet

part of the interconnection coupler integrated in or incorporated in the appliance or equipment or intended to be fixed to it, and from which the supply is obtained

SEE: Figure 1.

[SOURCE: IEC 60050-442:1998, 442-07-08, modified – A reference to Figure 1 has been added.]

3.3

rewirable ~~accessory~~ appliance coupler

accessory so constructed that a cable or cord can be replaced

3.4

non-rewirable ~~accessory~~ appliance coupler

accessory so constructed that it forms a complete unit with flexible supply cable or cord after connection and assembly by the manufacturer of the accessory

3.5

cord set

assembly consisting of one cable or cord fitted with one non-rewirable plug and one non-rewirable connector, intended for the connection of an electrical appliance or equipment to the electrical supply

SEE: Figure 1.

3.6

interconnection cord set

assembly consisting of one cable or cord fitted with one non-rewirable plug connector and one non-rewirable connector, intended for the interconnection between two electrical appliances

SEE: Figure 1

Note 1 to entry: The definition is based on that of IEC 60050-442:1998, 442-07-06.

~~[SOURCE: IEC 60050-442:1998, 442-07-06, modified – “a” has been changed to “one” in two places and a reference to Figure 1 has been added.]~~

3.7

integrated appliance coupler

appliance coupler which is formed by the housing or enclosure of the appliance or equipment and that cannot be tested separately

3.8

~~incorporated appliance coupler~~

~~appliance coupler built in or fixed to an appliance or equipment, but that can be tested separately~~

3.8 **2**

standardized appliance coupler

appliance coupler with dimensions in accordance with the standard sheets of IEC 60320-3

3.9 **2**

non-standardized appliance coupler

appliance coupler with dimensions not in accordance with the standard sheets of IEC 60320-3

3.10**base of a pin**

part of the pin where it protrudes from the engagement face

3.11**retaining device**

mechanical provision or arrangement which holds a connector in proper engagement with a corresponding appliance inlet and prevents its unintentional withdrawal

3.12**rated voltage** (for accessories)

voltage assigned by the manufacturer for a specified operating condition of an accessory

[SOURCE: IEC 60050-442:1998, 442-01-03]

3.13**rated current** (for accessories)

current assigned by the manufacturer for a specified operating condition of an accessory

[SOURCE: IEC 60050-442:1998, 442-01-02]

3.14**terminal** (for accessories)

part of an accessory to which a conductor is attached, providing a re-usable connection

[SOURCE: IEC 60050-442:1998, 442-06-05]

3.15**termination**

part of an accessory to which a conductor is permanently attached

[SOURCE: IEC 60050-442:1998, 442-06-06]

3.16**thread-cutting screw**

screw having an interrupted thread which, by screwing in, makes a thread by removing material from the cavity

[SOURCE: IEC 60050-442:1998, 442-06-03]

3.17**type test**

test of one or more devices made to a certain design to show that the design meets certain requirements

~~[SOURCE: IEC 60050-811:1991, 811-10-04]~~

3.18**routine test**

~~test to which each individual device is subjected during and/or after manufacture to ascertain whether it complies with certain criteria~~

conformity test made on each individual item during or after manufacture

[SOURCE: ~~IEC 60050-811:1991, 811-10-05~~ IEC 60050-151:2001, 151-16-17]

4 General requirements

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

A non-standardized appliance coupler shall comply with all safety requirements of this document and shall be tested together with its counterpart.

Compliance is checked by carrying out all the tests specified.

~~Appliance couplers according to this standard are not intended to be used in portable accessories covered by IEC TC 23.~~

5 General notes on tests

5.1 General

Tests shall be made to prove compliance with the requirements set out in this document, where applicable.

Tests are as follows:

- 1) type tests shall be made on representative samples of each accessory.
- 2) routine tests shall be conducted by the manufacturer and made on each accessory.
- 3) unless otherwise specified, the tests are carried out in the order of the clauses in this document.
- 4) unless otherwise specified, appliance couplers are tested together with their counterparts that are in compliance with this document.
- 5) ~~Appliance inlets and appliance outlets integrated or incorporated in an appliance or equipment~~ integrated appliance couplers and incorporated appliances couplers are tested under the conditions of use of the equipment, the number of test samples then being the same as the number of test samples of equipment required according to the relevant standard for the equipment.
- 6) appliance couplers are considered to comply with this document if not more than one ~~failure of one test sample in one of the tests~~ test sample of a given set fails in a test due to an assembly or manufacturing fault. ~~If one test sample fails in a test,~~ That test and those preceding which may have influenced the result of that test are repeated on another set of test samples, all of which shall then comply with the repeated tests. **3**
- 7) in general, only the test which caused the failure needs to be repeated unless:
 - a) a failure occurs in one of the three test samples when tested in accordance with Clause 19, Clause 20, or Clause 21, in which case the tests are repeated from Clause 16 onwards; or
 - b) a failure occurs in one of the three test samples when tested in accordance with Clause 22 (with the exception of 22.3) or Clause 23, in which case the tests are repeated from Clause 18 onwards. **4**

Subclauses ~~5.2 to 5.3~~ are applicable to type tests. For the number of samples and test sequences, see Annex C.

5.2 Test samples

Unless otherwise specified, the test samples are tested as delivered and under normal conditions, assembled and installed as in normal use according to the manufacturer's instructions at an ambient temperature of $20\text{ °C} \pm 5\text{ °C}$; they are tested with a.c. at 50 Hz or 60 Hz. Tests shall not commence earlier than 168 h after manufacture.

Non-rewirable connectors and non-rewirable plug connectors, other than those forming part of a cord set, shall be submitted with a cord at least 1 m long.

5.3 Failures

~~In general, only the test which caused the failure need be repeated unless~~

- ~~a) a failure occurs to one of the three test samples when tested in accordance with Clauses, or, in which case the tests are repeated from Clause onwards; or~~
- ~~a) a failure occurs to one of the three test samples when tested in accordance with Clauses or (except), in which case the tests are repeated from Clause 18 onwards.~~

The applicant may submit, together with the first set of test samples, the additional set which may be ~~wanted~~ **should** necessary if one test sample **should** fail. The testing station will then, without further request, test the additional test samples and will only reject if a further failure occurs. If the additional set of test samples is not submitted at the same time, a failure of one test sample will entail a rejection.

5.3 Routine tests

Routine tests are specified in Annex B.

6 Standard ratings

6.1 The maximum permitted rated voltage is 250 V.

6.2 The maximum permitted rated current is 16 A.

Preferred rated currents for appliance couplers are 0,2 A, 2,5 A, 6 A, 10 A and 16 A.

NOTE For details of standard type ratings refer to IEC 60320-3.

7 Classification of appliance couplers

7.1 According to the maximum pin temperature at the base of the pins of the corresponding appliance inlet or the socket contacts of the corresponding appliance outlet:

- a) appliance couplers for cold conditions, pin temperature not exceeding 70 °C;
- b) appliance couplers for hot conditions, pin temperature not exceeding 120 °C;
- c) appliance couplers for very hot conditions, pin temperature not exceeding 155 °C.

NOTE Appliance couplers for hot conditions can also be used under cold conditions; appliance couplers for very hot conditions can also be used under cold or hot conditions.

7.2 According to the type of equipment to be connected:

- a) appliance couplers for class I equipment;
- b) appliance couplers for class II equipment.

NOTE 1 For a description of the classes, see IEC 61140.

NOTE 2 Appliance couplers for 0,2 A are intended only for the connection of small hand-held class II equipment, if allowed by the relevant standard for the equipment.

7.3 Connectors / plug connectors according to the method of connecting the cord:

- a) rewirable;
- b) non-rewirable.

7.4 According to the ambient temperature:

- a) appliance couplers for ambient temperatures up to and including +35 °C;
- b) appliance couplers for ambient temperatures up to and including +90 °C. This classification also requires a classification according to 7.1 b) or 7.1 c). **1**

8 Marking

8.1 General

Appliance couplers shall be marked with:

- name, trademark or identification mark of the manufacturer or responsible vendor;
- type reference.

NOTE The type reference can be a catalogue number.

8.2 Additional markings

Standardized connectors and plug connectors in accordance with IEC 60320-3 and all non-standardized appliance couplers shall be additionally marked with:

- rated current in amperes, except for 0,2 A connectors;
- rated voltage in volts;
- symbol for nature of supply;
- the marking as specified in IEC 60999-1 to identify the type of conductors suitable for screwless terminals.

8.3 Appliance couplers for class II equipment

Appliance couplers for class II equipment shall not be marked with the symbol for class II construction.

8.4 Symbols or alphanumeric notations

When symbols or alphanumeric notations are used, they shall be as follows:

amperes	A
volts	V
alternating current	AC or ~
protective earth	 [IEC 60417-5019 (2006-08)] or PE
earth	 [IEC 60417-5017 (2006-08)]
neutral terminal	N

For the marking of rated current and rated voltage, figures may be used alone, the figure for rated current being placed before or above that for rated voltage and separated from the latter by a line. The symbol for nature of supply shall be placed next to the marking for rated current and rated voltage.

NOTE 1 Examples for marking of current, voltage and nature of supply:

$$10 \text{ A } 250 \text{ V } \sim \text{ or } 10/250 \sim \text{ or } \frac{10}{250} \sim \text{ or } \left(\frac{10}{250} \sim \right)$$

NOTE 2 Lines formed by the construction of the tool are not considered as part of the marking.

8.5 Legibility of markings

The marking of connectors/plug connectors in accordance with 8.1 shall still be easily discernible when the connector/plug connector is wired and ready for use.

NOTE The term "ready for use" does not imply that the connector is in engagement with an appliance inlet.

8.6 Terminal markings and wiring instructions

In rewirable, non-reversible connectors/plug connectors, terminals shall be indicated as follows:

- earthing terminal: the symbol  or  or PE
- neutral terminal: the letter N

In non-rewirable, polarized connectors/plug connectors, no marking of contacts is necessary, but conductors shall be connected as specified in 22.1.

Appliance inlets/appliance outlets other than those integrated or incorporated in an appliance or equipment for use with connectors/plug connectors according to 8.6 shall have terminal markings to correspond with 8.6.

Rewirable connectors and rewirable plug connectors shall be supplied with the following instructions:

- a) a diagram illustrating the method of connection of the conductors, in particular the excess length of the earthing conductor;
- b) a diagram illustrating the method of the operation of the cord anchorage;
- c) a diagram showing the length of sleeving and insulation to be stripped back;
- d) the sizes and types of the suitable cable or cord.

~~NOTE~~ Connectors/plug connectors supplied directly to an equipment manufacturer do not need these instructions with each unit, but they ~~will~~ shall be made available to the equipment manufacturer.

8.7 Durability

The marking required by this document shall be easily legible and durable. The marking shall not be placed on screws, removable washers or other removable parts.

8.8 Test and inspection

Compliance with the requirements of 8.1 to 8.7 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.

After this test and all non-destructive tests of this document, the marking shall remain legible. It shall not be possible to remove labels easily and they shall not show curling.

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

9 Dimensions and compatibility

9.1 General

Appliance couplers shall be designed and constructed so that unintended or improper connection is prevented.

Compliance is checked by inspection and in case of doubt by the tests according to 9.2 to 9.5.

9.2 Single-pole connections

It shall not be possible to make single-pole connections between connectors/appliance outlets and appliance inlets/plug connectors.

Compliance is checked by manual test.

9.3 Compatibility

It shall not be possible to engage:

- connectors for class II equipment in appliance inlets/plug connectors for class I equipment;
- plug connectors for devices of the protection class I in connectors/appliance outlets for devices of the protection class II;
- connectors for cold conditions in appliance inlets/~~plug connectors~~ for hot or very hot conditions;
- plug connectors for cold conditions in appliance outlets for hot or very hot conditions;
- connectors for hot conditions in appliance inlets/~~plug connectors~~ for very hot conditions;
- plug connectors for hot conditions in appliance outlets for very hot conditions;
- connectors in appliance inlets/plug connectors having a higher rated current than the connector;
- plug connectors in appliance outlets having a lower rated current than the plug connector.

Engagement of a connector or plug connector is attempted in any unintended configuration using a force of 60 N for a minimum of 60 s.

During the test there shall be no contact of the pins.

Compliance is checked by inspection, by manual test according to 9.4 and by use of all components supplied by the manufacturer.

9.4 Dimensions for standardized appliance couplers

Standardized appliance couplers shall comply with the relevant standard sheets according to IEC 60320-3.

Dimensions are checked by means of gauges or by measurement. In case of doubt, gauges shall be used.

9.5 Dimensions for non-standardized appliance couplers

Non-standardized appliance couplers which do not refer to the dimensions specified in the standard sheets according to IEC 60320-3 are acceptable if they do not adversely affect the purpose and safety of appliance couplers complying with the standard sheets, especially with regard to interchangeability and non-interchangeability.

Small deviations from the dimensions as specified in the standard sheets, which give the impression of a standardized coupler ~~and lead to confusion with~~ which could lead to it being mistaken for a standardized appliance coupler, are not allowed.

Changes which adversely affect the contact-making ability are not allowed.

It shall not be possible to engage a part of a non-standardized appliance coupler with a complementary part of an appliance coupler complying with the standard sheets in any part of IEC 60320.

It shall not be possible to engage a part of a non-standardized appliance coupler with a complementary part of a standardized appliance coupler for direct current. **5**

NOTE The applicable documents for direct current, i.e., the IEC TS 63236 series, are under development.

It shall not be possible within a given system to make ~~improper~~ connections other than in the intended position or to make partial connections causing deformation which can impair the further use of the appliance for:

- a connector and associated appliance inlet;
- an appliance outlet with the associated plug connector.

Compliance is checked by manual test.

10 Protection against electric shock

10.1 Accessibility of live parts

Appliance couplers shall be so designed that live parts are not accessible when in partial or complete engagement.

Connectors/appliance outlets shall be so designed that live parts are not accessible when the connectors/appliance outlets are properly assembled and wired as in normal use.

Compliance is checked by inspection and by a test with the standard test probe B of IEC 61032.

The test probe is applied in every possible position, an electrical indicator being used to show contact with the relevant parts. For connectors with enclosures or bodies of elastomeric or thermoplastic material, the standard test finger is applied for a minimum of 30 s with a force of 20 N at all points where yielding of the insulating material could impair the safety of the connector.

NOTE An electrical indicator with a voltage between 24 V and 50 V is used to show contact with the relevant part.

10.2 Protection against single pole connection

It shall not be possible to make connection between a pin of an appliance inlet/plug connector and a contact of a connector/appliance outlet as long as any of the pins are accessible.

Compliance is checked by manual test followed by the test of 10.1.

10.3 Protection against access to live parts

It shall not be possible to remove parts preventing access to live parts without the aid of a tool.

Bushes, if any, in the entry holes for the pins shall be adequately fixed and it shall not be possible to remove them without dismantling the connector/appliance outlet.

Compliance is checked by inspection and by manual test.

10.4 External parts

External parts of connectors, appliance outlets and plug connectors, with the exception of assembly screws and the like, shall be of insulating material.

Compliance is checked by inspection.

10.5 Shrouds

The shroud and the base of appliance inlets without earthing contact and those of 2,5 A appliance inlets / appliance outlets with earthing contact, shall be of insulating material.

Compliance is checked by inspection.

NOTE The suitability of the insulating material is checked during the insulation tests of Clause 15.

11 Provision for earthing

Appliance couplers with protective earthing contact shall be so constructed that the protective earthing contact will make first and break last relative to any other contact.

Compliance is checked by inspection.

12 Terminals and terminations

12.1 General

For terminals and terminations, the requirements in the appropriate IEC International Standard apply.

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

12.2 Rewirable appliance couplers

Rewirable appliance couplers shall be provided with screw-type clamping units or screwless clamping units according to IEC 60999-1.

Compliance is checked by inspection.

12.3 Non-rewirable appliance couplers

Non-rewirable appliance couplers shall be provided with soldered, welded, crimped or equally effective screwless connections, which shall not allow the possibility to disconnect the conductor.

Compliance is checked by inspection.

13 Construction

13.1 Risk of accidental contact

Appliance couplers shall be so designed that there is no risk of accidental contact between the earthing contact of the appliance inlet/plug connector and the current-carrying contacts of the connector/appliance outlet.

13.2 Contact positions

In non-reversible connectors/plug connectors, the contact positions shall be established by looking at the engagement face of the connectors/plug connectors as shown in the standard sheets overview in Clause 4 of IEC 60320-3:2014 and IEC 60320-3:2014/AMD1:2018. Their position shall be as set out in Table 1.

Table 1 – Position of contacts

Type of contact	Position of contacts	
	Non-reversible connectors	Non-reversible plug connectors
Earthing contact	Preferably in a symmetrical arrangement	Preferably in a symmetrical arrangement
Line contact	Lower right-hand position	Lower left-hand position
Neutral contact	Lower left-hand position	Lower right-hand position

In non-reversible appliance couplers that do not comply with the standard sheets shown in Clause 4 of IEC 60320-3:2014 and IEC 60320-3:2014/AMD1:2018, the correct polarization shall be verified.

Compliance is checked by inspection.

NOTE Conformity to the standard sheets ensures compliance with this requirement.

13.3 Parts covering live parts

Parts covering live parts shall be adequately locked against loosening.

Compliance is checked by inspection and by the tests of Clause 18, Clause 20 and Clause 23.

13.4 Pin construction

13.4.1 Prevention of rotation

Pins of appliance inlets/plug connectors and contacts of connectors/appliance outlets shall be locked against rotation.

Compliance is checked by inspection and by manual test.

NOTE Clamping screws can serve to prevent contacts from rotating.

13.4.2 Pin retention

Pins of appliance inlets/plug connectors shall be securely retained and shall have adequate mechanical strength. It shall not be possible to remove them without the aid of a tool and they shall be surrounded by a shroud. The pins shall not protrude beyond the rim of the shroud.

A minimal movement of the pins is allowed.

The security of the pin retention is checked by inspection and, in case of doubt, by the following test.

The test sample is heated to the temperature according to the appropriate temperature class given in 7.1 for $1 \pm 60^{+5}_0$ min and is maintained at this temperature for the duration of the test, including the 5 min period after removal of the test load.

The appliance inlet/plug connector is held firmly in such a manner that there will be no undue squeezing or distortion of the body, and the means of holding shall not assist in maintaining the pins in their original position.

Each pin is subjected to a force of $60 \text{ N} \pm 0,6 \text{ N}$, applied without jerks, in a direction along the axis of the pin and maintained at this value for a period of $60 \pm 3_0$ s.

For all pins the force is applied, first in the direction away from the base of the appliance inlet/plug connector, and then in the direction towards the base of the appliance inlet/plug connector.

The attachment of the pins is deemed to be satisfactory if there is no movement exceeding 2,5 mm during the test on any pin, and provided that within 5 min after removal of the pushing-in test force or within 5 min after the removal of the pulling-out test force, all pins remain within the tolerances of the standard sheets or, for non-standardized appliance couplers, as specified by the manufacturer.

Compliance is checked by inspection and by manual test.

13.4.3 Non-solid pins

Non-solid pins are additionally tested according to the following test after all other tests have been completed.

The shroud is removed from the appliance inlet/plug connector and the pin supported as shown in Figure 2.

Dimensions in millimetres

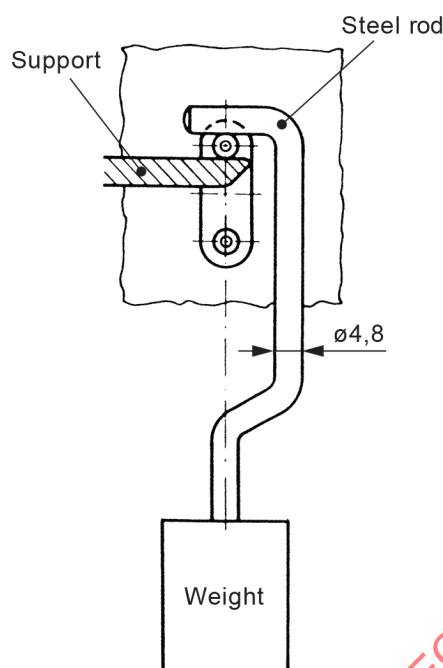


Figure 2 – Device for testing non-solid pins

A force of 100 N is exerted on the pin for $1 \text{ min } 60^{+3}_0 \text{ s}$ in a direction perpendicular to the axis of the pin, by means of a steel rod having a diameter of 4,8 mm, the axis of which is also at right angles to the axis of the pin.

After the test, there shall be no significant alteration in the shape of the pin.

13.4.4 Pins for appliance couplers for higher ambient temperatures up to +90 °C

Pins of plug connectors or appliance inlets for higher ambient temperatures shall be of solid material. **1**

13.5 Contact pressure

Contacts of connectors/appliance outlets shall be self-adjusting so as to provide adequate contact pressure.

For connectors/appliance outlets other than 0,2 A connectors, self-adjustment of the contacts shall not depend upon the resiliency of insulating material.

Compliance is checked by inspection and by the tests of Clause 16 to Clause 21 inclusive.

13.6 Enclosure

13.6.1 General

Parts of the body of connectors/plug connectors shall be reliably fixed to one another.

Compliance is checked by inspection, by manual test and by the test of 23.6.

13.6.2 Rewirable connectors and rewirable plug connectors

It shall not be possible to dismantle the connector/plug connector without the aid of a tool.

The enclosure of rewirable connectors/plug connectors shall completely enclose the terminals and the ends of the cord, at least as far as to the point from which the sheath has to be removed.

The construction shall be such that, from the point of separation of the cores, the conductors can be properly connected and that, when the connector/plug connector is assembled and wired as in normal use, there is no risk of

- pressing the cores together in such a way that it causes damage to the core insulation, likely to result in a break-down of the insulation;
- a core, the conductor of which is connected to a live terminal, being likely to be pressed against accessible metal parts;
- a core, the conductor of which is connected to the earthing terminals, being likely to be pressed against live parts.

For rewirable connectors, it shall not be possible to assemble the connector in such a way that the terminals are enclosed and the contacts are accessible.

~~NOTE — This requirement excludes the use of separate front pieces enclosing only the contacts.~~

For rewirable connectors/plug connectors, there shall be separate independent means for fixing and locating the parts of the body with respect to each other, at least one of which, for example a screw, can only be operated with the aid of a tool; thread-cutting screws shall not be used for this purpose.

The resiliency of the contacts shall not depend upon the assembly of the parts of the body.

Partial loosening of assembly screws or the like shall not allow the detachment of parts providing protection against electric shock.

Compliance is checked by inspection and by manual test.

13.6.3 Non-rewirable connectors and non-rewirable plug connectors

Non-rewirable accessories shall be such that:

- the flexible cable or cord cannot be separated from the accessory without making this permanently useless, and
- the accessory cannot be opened by hand or by using a general-purpose tool.

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

Compliance is checked by inspection and by manual test.

13.7 Earth connection

For connectors/plug connectors, the earthing contact/earthing pin shall be fixed to the body. If the earthing contact/earthing pin and the earthing terminal are not in one piece, the various parts shall be fixed together by riveting, welding or in a similar reliable manner.

Metal parts of appliance couplers shall be so designed that corrosion shall not impair safety with regard to electrical and mechanical characteristics.

The connection between the earthing contact/earthing pin and the earthing terminal shall be of metal and resistant to corrosion.

Compliance is checked by inspection.

13.8 Location of terminals and terminations

13.8.1 General

Terminals of rewirable accessories and terminations of non-rewirable accessories shall be so located or shielded that loose wires of a conductor in the accessory will not present a risk of electric shock.

For non-rewirable moulded-on accessories, means shall be provided to prevent loose wires of a conductor from reducing the minimum isolation distance requirements between such wires and all accessible external surfaces of the accessory, with the exception of the engagement face of the inlet.

Compliance is checked by the following:

- for rewirable accessories, the test of 13.8.2;
- for non-rewirable non-moulded-on accessories, the test of 13.8.3;
- for non-rewirable moulded-on accessories, by verification and inspection according to 13.8.4.

13.8.2 Free wire test for rewirable accessories

A length of 6 mm of insulation is removed from the end of a flexible conductor having a cross-sectional area of 0,75 mm². One wire of the flexible conductor is left free and the remaining wires are fully inserted into and clamped in the terminal, as for normal use.

The free wire is bent, without tearing the insulation back, in every possible direction, but without making sharp bends around the barriers.

NOTE The prohibition against making sharp bends around the barriers does not imply that the free wire has to be kept straight during the test. Sharp bends, moreover, are made if it is considered likely that such bends can occur during the normal assembly of the accessory, for example when a cover is pushed on.

The free wire of a conductor connected to a live terminal shall not touch any accessible metal part or be able to emerge from the enclosure when the accessory has been assembled.

The free wire of a conductor connected to an earthing terminal shall not touch a live part.

If necessary, the test is repeated with the free wire in another position.

13.8.3 Free wire test for non-rewirable non-moulded-on accessories

A length of insulation equivalent to the maximum designed stripping length declared by the manufacturer plus 2 mm is removed from the end of a flexible conductor having the cross-sectional area as fitted. One wire of the flexible conductor is left free in the worst position whilst the remaining wires are terminated in a manner as used in the construction of the accessory.

The free wire is bent, without tearing the insulation back, in every possible direction but without making sharp bends around the barriers.

NOTE The prohibition against making sharp bends around the barriers does not imply that the free wire has to be kept straight during the test. Sharp bends, moreover, ~~are~~ can be made if it is considered likely that such bends can occur during the normal assembly of the accessory, for example when a cover is pushed on.

The free wire of a conductor connected to a live termination shall not touch any accessible metal part or reduce the creepage distance and clearance through any constructional gap to the external surface below 1,5 mm.

The free wire of a conductor connected to an earth termination shall not touch any live parts.

13.8.4 Free wire verification for non-rewirable moulded-on accessories

Non-rewirable moulded-on accessories shall be inspected to verify that there are means to prevent stray wires of the conductor and/or live parts reducing the minimum distance through insulation to the external accessible surface (with the exception of the engagement face of inlets) below 1,5 mm.

NOTE The verification of means ~~may~~ can require the checking of the product construction or assembly method.

13.9 Connectors/plug connectors without earthing contact

Connectors/plug connectors without earthing contact and 2,5 A connectors/plug connectors with earthing contact shall be part of a cord set or an interconnection cord set.

Compliance is checked by inspection.

13.10 Fuses, relays, thermostats, thermal cut-outs and switches

Fuses, relays, thermostats and thermal cut-outs shall not be incorporated in connectors ~~and~~ or in plug connectors complying with the standard sheets of IEC 60320-3.

Fuses, relays, thermostats and thermal cut-outs incorporated in appliance inlets and in appliance outlets shall comply with the relevant IEC International Standards.

Switches incorporated in appliance couplers shall comply with IEC 61058 (all parts).

Energy regulators incorporated in appliance couplers shall comply with IEC 60730-2-11.

Compliance is checked by inspection and by testing the switches, fuses, relays, thermostats, thermal cut-outs and energy regulators according to the relevant IEC International Standard.

14 Moisture resistance

Appliance couplers shall be able to withstand humid conditions which may occur in normal use.

If such appliance couplers are used with equipment which is subject to spillage of liquid in normal use then the protection against moisture shall be provided by the equipment.

Compliance is checked by the humidity treatment described in Clause 14, followed immediately by the tests of Clause 15.

Connectors/plug connectors and appliance inlets/appliance outlets are not in engagement when subjected to the humidity treatment; rewirable connectors/plug connectors are not fitted with a cord.

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

Before being placed in the humidity cabinet, the test samples are brought to a temperature between t °C and $(t + 4)$ °C.

The test samples are kept in the cabinet for

- 168 h (7 days) for appliance couplers with earthing contact which are submitted as individual accessories and not incorporated in other equipment;
- 48 h (2 days) in all other cases.

NOTE 1 In most cases, the test samples can 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.

After this treatment, the test sample shall show no damage within the meaning of this document.

15 Insulation resistance and electric strength

15.1 General

Appliance couplers shall have adequate insulation resistance and dielectric strength.

Compliance is checked by the tests of 15.2 and 15.3 immediately after the humidity treatment according to Clause 14.

Indicators which might otherwise be damaged by the tests of 15.2 and 15.3, such as neon lamps, shall be disconnected at one pole prior to testing.

The insulation resistance is measured considering the following conditions:

- a) for appliance inlets with a connector in engagement, between the current-carrying contacts connected together and the body;
- b) for appliance inlets with a connector in engagement, between each pin in turn and the others connected together;
- c) for appliance outlets with a plug connector in engagement, between the current-carrying contacts connected together and the body;
- d) for appliance outlets without a plug connector in engagement, between the current-carrying contacts connected together and the body;
- e) for appliance outlets with a plug connector in engagement, between each pin in turn and the others connected together;
- f) for connectors, between the current-carrying contacts connected together and the body;
- g) for connectors, between each contact in turn and the others connected together;
- h) for plug connectors, between the current-carrying contacts connected together and the body;
- i) for plug connectors, between each contact in turn and the others connected together.

Additional test for rewirable connectors and rewirable plug connectors:

- j) for rewirable connectors, between any metal part of the cord anchorage, including clamping screws, and the earthing contact or earthing terminal;
- k) for rewirable connectors, between any metal part of the cord anchorage, excluding clamping screws, and a metal rod, of the maximum diameter of the cord as specified in Table 2, inserted in its place;

- l) for rewirable plug connectors, between any metal part of the cord anchorage, including clamping screws, and the earthing contact or earthing terminal;
- m) for rewirable plug connectors, between any metal part of the cord anchorage, excluding clamping screws, and a metal rod, of the maximum diameter of the cord as specified in Table 2, inserted in its place.

The term "body" used in items a), c), d), f) and h) above includes all accessible metal parts, fixing screws, external assembly screws and the like and a metal foil in contact with the outer surface of external parts of insulating material. In items d), f) and h) ~~including~~, the term "body" ~~includes~~ the engagement face of connectors or appliance outlets but excludes the engagement face of plug connectors.

The metal foil is wrapped round the outer surface of external parts of insulating material; however, it is not pressed into openings.

Table 2 – Maximum diameters of the cords

Type of cord	Number of conductors and nominal cross- sectional area	Maximum diameter
	mm ²	mm
60227 IEC 53	3 × 0,75	7,6
	3 × 1	8,0
	3 × 1,5	9,4
60245 IEC 53	3 × 0,75	8,1
	3 × 1	8,5
	3 × 1,5	10,4

The test voltage according to 15.2 and 15.3 is applied in the case of:

- functional insulation: between the different poles of the appliance coupler;
- basic insulation: between all live parts connected together and a metal foil covering the outer surface of the basic insulation and/or exposed conductive parts;
- supplementary insulation: between two metal foils covering separately the inner, normally inaccessible surface, of the supplementary insulation and its accessible surface;
- reinforced insulation: between all live parts connected together and a metal foil covering the accessible surface of the reinforced insulation.

The clearances and creepage distances shall be maintained when preparing the sample for this test.

In cases where basic insulation and supplementary insulation cannot be tested separately, the insulation provided is subjected to the test voltages specified for reinforced insulation.

15.2 Insulation resistance

The insulation resistance of the sample is measured with an applied DC voltage of 500^{+50}_0 V, the measurement being made $60\text{ s} \pm 5\text{ s}$ after application of the voltage. The insulation resistance shall not be less than that specified in Table 3.

Table 3 – Minimum insulation resistance

Insulation to be tested	Insulation resistance
	MΩ
Functional	2
Basic	2
Supplementary	5
Reinforced	7

NOTE Materials such as glazed ceramic or porcelain are considered to have insulation resistance and are not subjected to the insulation resistance tests.

15.3 Dielectric strength

The test sample is subjected to a voltage of substantially sine wave form, having a nominal frequency of 50 Hz or 60 Hz. The voltage is applied for 60 s ± 5 s across the insulation as specified in Table 4.

Initially, not more than half the ~~prescribed~~ specified voltage is applied, and then it is raised rapidly to the full value. No flashover or breakdown shall occur. Glow discharges without drop in voltage are neglected.

Table 4 – Dielectric strength

Insulation or disconnection to be tested ^b	Test voltage (RMS) ^a		
	Rated voltage up to and including 50 V V	Rated voltage above 50 V up to and including 130 V V	Rated voltage above 130 V up to and including 250 V V
Functional insulation ^c	500	1 300	1 500
Basic insulation ^d	500	1 300	1 500
Supplementary insulation ^d	500	1 300	1 500
Reinforced insulation ^{d,e}	500	2 600	3 000

NOTE 1 Up to and including 50 V: Not intended to be connected directly to the mains and not expected to be subjected to temporary overvoltages as defined in IEC 60364-4-44.

NOTE 2 Over 50 V: The values are based on IEC 60364-4-44. For functional, basic and supplementary insulation, the values are calculated with the formula: $U_0 + 1\,200\text{ V}$ and rounded. In this document, the maximum voltage considered between line and earth is $U_0 = 300\text{ V}$.

^a The high-voltage transformer used for the test shall be designed so that, when the output terminals are short-circuited after the output voltage has been adjusted to the test voltage, the output current is at least 200 mA. The overcurrent relay shall not trip when the output current is less than 100 mA. Care is taken that the RMS values of the test voltage are measured within ±3 %.

^b Special components which might render the test impractical such as discharge lamps, coils, windings, or capacitors are disconnected at one pole, or bridged, as appropriate to the insulation being tested.

^c An example is the insulation between poles.

^d For the test, all live parts are connected together and care is taken to ensure that all moving parts are in the most onerous position.

^e For appliance couplers incorporating reinforced insulation as well as double insulation, care is taken that the voltage applied to the reinforced insulation does not overstress the basic or the supplementary parts of the double insulation.

16 Forces necessary to insert and to withdraw the connector/appliance outlet

16.1 General

The construction of appliance couplers shall allow the easy insertion and withdrawal of the connector/appliance outlet and prevent the connector/appliance outlet from working itself out of the appliance inlet/plug connector in normal use.

Compliance is checked for connectors/appliance outlets by the following tests:

- in accordance with the test of 16.2 to ascertain that the maximum force necessary to withdraw the connector/appliance outlet from the appliance inlet/plug connector ~~shall~~ is not ~~be~~ higher than the maximum force specified in Table 5. For test purposes the relevant counterpart of the connector/appliance outlet shall be used (multi-pin gauge);
- in accordance with the test of 16.3 to ascertain that the minimum force necessary to withdraw a single pin from the individual contact assembly ~~shall~~ is not ~~be~~ lower than the minimum force specified in Table 5.

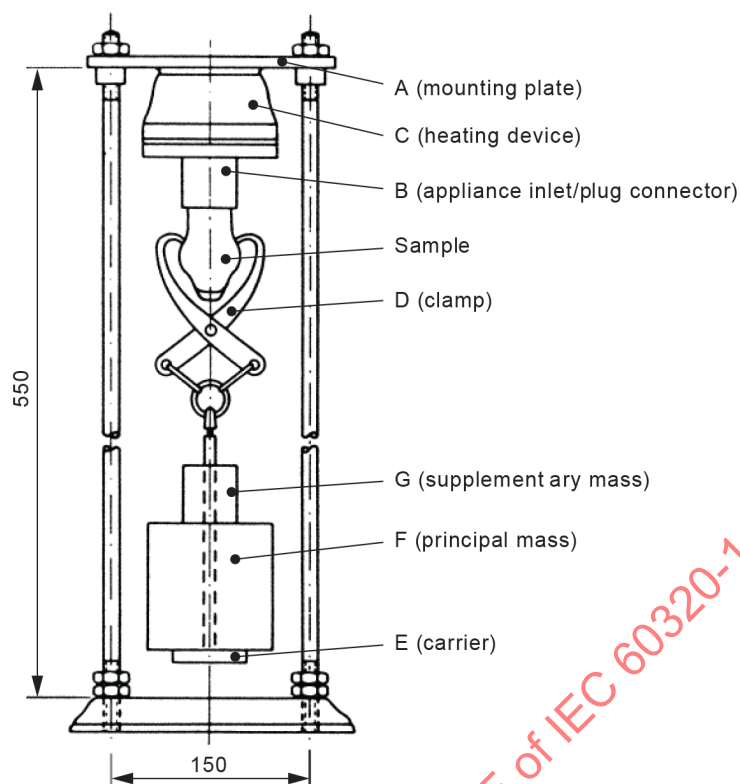
Table 5 – Maximum and minimum withdrawal forces

Type of connector/ appliance outlet	Withdrawal forces N	
	16.2 Multi-pin gauge maximum	16.3 Single-pin minimum
0,2 A, 2,5 A, 6 A and 10 A	50	1,5
16 A	60	2

Accessories with retaining devices are tested with the retaining device inoperative.

16.2 Verification of the maximum withdrawal force

The appliance inlet/plug connector is fixed to the mounting plate A of an apparatus as shown in Figure 3, so that the axes of the appliance inlet/plug connector pins are vertical and the free ends of the pins are downwards. The total mass consists of the principal mass, the supplementary mass, the clamp and the carrier.



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Figure 3 – Apparatus for checking the withdrawal force

The pins are wiped free from grease before each test using a cold chemical degreaser.

NOTE 1 When using the liquid specified for the test, adequate precautions can be taken to prevent inhalation of vapour.

The connector/appliance outlet is inserted to the full depth into, and withdrawn from, the appropriate appliance inlet/plug connector 10 times. It is then again inserted, a carrier E for a principal mass F and a supplementary mass G being attached to it by means of a suitable clamp D. The supplementary mass is such that it exerts a force equal to one tenth of the maximum withdrawal force specified in Table 5 and it shall be made in one piece.

The principal mass is hung on the connector/appliance outlet without jolting and the supplementary mass is allowed to fall once from a height of $50 \text{ mm} \pm 1 \text{ mm}$ on to the principal mass. The connector/appliance outlet shall ~~not remain in~~ disengage within 3 s from the appliance inlet/plug connector.

For standardized ~~types~~ appliance couplers:

The appliance inlet/plug connector has finely ground pins of hardened steel, having a surface roughness not exceeding $0,8 \text{ } \mu\text{m}$ over their active length and spaced at the nominal distance with a tolerance of $^{+0,02}_0 \text{ mm}$.

The pin dimensions have the maximum values, with a tolerance of $^{0}_{-0,01} \text{ mm}$, except that the pin length need only comply with the tolerance of the standard sheet, and the inner dimensions of the shroud have the minimum values, with a tolerance of $^{+0,1}_0 \text{ mm}$, specified in the relevant standard sheet.

NOTE 2 The maximum value is the nominal plus the maximum tolerance. The minimum value is the nominal minus the maximum tolerance.

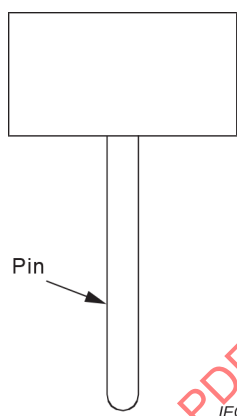
For non-standardized ~~types~~ appliance couplers:

The counterpart as specified by the manufacturer shall be used.

16.3 Verification of the minimum withdrawal force

The test pin gauge, as illustrated in Figure 4, is applied to each individual connector/appliance outlet contact with the contact axes vertical and the gauge hanging vertically downwards.

Dimensions according to the relevant standard sheet



The mass is to be equally positioned around the centre line(s) of the pin.

Figure 4 – Gauge for verification of the minimum withdrawal force

The total mass of the test equipment shall be such as to exert the applicable force as shown in Table 5.

The pin is wiped free from grease before each test using a cold chemical degreaser.

The test pin gauge is then inserted into the contact assembly. The test equipment is applied gently, and care is taken not to knock the assembly when checking the minimum withdrawal force.

The test equipment shall not fall from the contact assembly within 3 s.

For standardized ~~types~~ appliance couplers:

The test pin gauge is made of hardened steel, having a surface roughness not exceeding 0,8 µm over its active length.

The pin portion of the gauge shall have dimensions equal to the minimum shown in the appropriate appliance inlet/plug connector standard sheet, with a tolerance of $^{+0,01}_0$ mm, except that the pin length need only comply with the tolerance of the standard sheet.

For non-standardized ~~types~~ appliance couplers:

The test pin is a single pin with minimum dimensions as specified by the manufacturer.

17 Operation of contacts

Contacts and pins of appliance couplers shall make connection with a sliding action. The contacts of connectors/appliance outlets shall provide adequate contact pressure and shall not deteriorate in normal use.

The effectiveness of the pressure between contacts and pins and earthing contacts and earthing pins shall not depend upon the resiliency of the insulating material on which they are mounted.

Compliance with the requirements is checked by inspection and by taking into consideration the requirements of Clause 16, Clause 19, Clause 20 and Clause 21.

18 Resistance to heating of appliance couplers for hot conditions or very hot conditions

18.1 General

Appliance couplers as classified according to 7.1 shall withstand the heating to which they may be subjected by an appliance or other equipment.

Connectors/plug connectors shall be so constructed that the insulation of the conductors is not subjected to excessive heating.

Additionally, the spring contacts of appliance outlets and connectors shall not be negatively affected by thermal relaxation due to excessive heating.

Compliance is checked for connectors/plug connectors, by the test of 18.2, and, for appliance inlets/appliance outlets, by the test of 18.3.

18.2 Heating test for connectors/plug connectors

Rewirable connectors/plug connectors are fitted with a ~~three-core~~ cord according to Table 9, having the minimum allowed cross-sectional area. Non-rewirable connectors/plug connectors are tested with the cord as delivered.

The connector/plug connector is inserted in a suitable appliance inlet/appliance outlet, ~~following the manufacturer's instructions and then placed in a heating cabinet for 96 h at a temperature of~~ of an appropriate test apparatus, an example of which is given in Figure 5, where it remains for 96 h (four days). Throughout this period, the temperature at the base of the pins or contacts is maintained at: **6**

- $120\text{ °C} \pm 2\text{ °C}$ for connectors/plug connectors for hot conditions classified in 7.1 b);
- $155\text{ °C} \pm 2\text{ °C}$ for connectors/plug connectors for very hot conditions classified in 7.1 c).

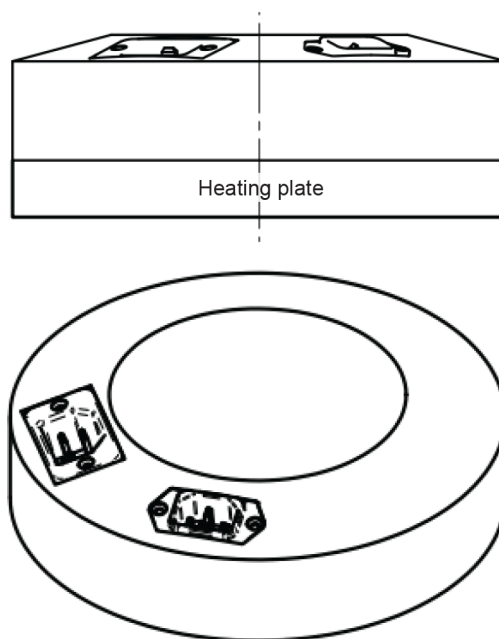


Figure 5 – Example of an apparatus for heating test (see 18.2)

Also a heating cabinet can be used to heat the base of the pins or contacts.

The appliance inlet/appliance outlet is flush mounted and has a shroud of insulating material.

The appliance inlets/appliance outlets are of a type corresponding to the connector/plug connector to be tested and have pins or contacts made of copper alloy.

After removal from the ~~heating cabinet~~ test apparatus, the connectors/plug connectors are then allowed to cool down to approximately ambient air temperature ~~and are inserted into and withdrawn from the appliance inlet/appliance outlet 10 times.~~

Plug connectors are then inserted into and withdrawn from the appliance outlet 10 times. Connectors are subjected to the test of Clause 16.

The test samples shall show:

- no damage affecting the protection against electric shock;
- no loosening of electrical or mechanical connections;
- no cracks, swelling, shrinkage or the like.

18.3 Heating test for appliance inlets/appliance outlets

Appliance inlets/appliance outlets for hot conditions and those for very hot conditions, other than those integrated ~~or incorporated~~ in an appliance or equipment, are kept in a heating cabinet for 96 h at a temperature of:

- 120 °C ± 2 °C for appliance inlets/appliance outlets for hot conditions classified in 7.1 b);
- 155 °C ± 2 °C for appliance inlets/appliance outlets for very hot conditions classified in 7.1 c).

~~After the test, the test sample shall show no damage impairing its further use.~~

After removal from the heating cabinet, appliance inlets/appliance outlets are then allowed to cool down to approximately ambient air temperature. **7**

Appliance outlets are then subjected to the test of Clause 16.

The test samples shall show:

- no damage affecting the protection against electric shock;
- no loosening of electrical or mechanical connections;
- no cracks, swelling, shrinkage or the like.

19 Breaking capacity

Appliance couplers shall have adequate breaking capacity.

Compliance is checked, for connectors/appliance outlets, by the following test.

The connector or appliance outlet is mounted in an appropriate test apparatus, which incorporates the corresponding appliance inlet or plug connector.

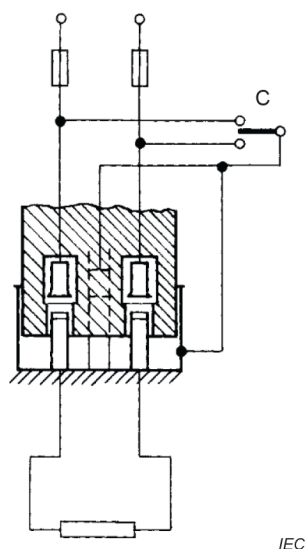
For standardized types, the appliance inlet or plug connector shall have polished, hardened steel pins, and dimensions as specified in the relevant standard sheet. The ends of the pins shall be rounded for rectangular pins and they shall be hemispherical for round pins as shown in the standard sheets.

For non-standardized types, the counterpart as specified by the manufacturer shall be used.

Connectors and appliance outlets for up to 0,2 A are not tested.

The appliance inlet/plug connector is positioned so that the plane through the axes of the pins is horizontal and the earthing pin, if any, is uppermost.

The test apparatus shall be designed and adjusted so as to simulate as far as possible disconnection in normal use (see Figure 6 for circuit diagram).



Key

C selector switch

Figure 6 – Circuit diagram for breaking capacity and normal operation tests

For testing 10 A and 16 A connectors with earthing contact, the shroud of the appliance inlet shall be of metal. For testing other connectors and appliance outlets the shroud shall be of insulating material.

Ratings for the tests are taken from Table 6.

Table 6 – Ratings for the tests of Clause 19

Rated current A	Test voltage V	Test current A	Power factor (cos Φ)	Number of strokes
> 0,2 to < 10	1,1 × rated voltage	1,25 × rated current	0,6 ± 0,05	100
≥ 10	1,1 × rated voltage	1,25 × rated current	0,95 ± 0,05	100
~~NOTE 1~~ Strokes are applied at a rate of 28 to 30 ~~strokes~~ per minute with continuous movement. ~~NOTE 2~~ Current flow period: $1,5^{+0,5}_0$ s. ~~NOTE 3~~ A stroke is an engagement or a disengagement of the sample under test into the counterpart. ~~NOTE 4~~ The test sample is fully inserted into and withdrawn from its counterpart during each cycle.				

No current is passed through the earthing circuit, if any.

The selector switch C, connecting the earthing circuit and accessible metal parts to one of the poles of the supply, is operated after half the number of strokes.

During the test, there shall be no flashover between live parts of different polarity or between live parts and parts of the earthing circuit, if any, nor shall there be any sustained arcing.

After the test, the test sample shall show no damage impairing its further use.

20 Normal operation

Appliance couplers shall withstand, without excessive wear or other harmful effects, the mechanical, electrical and thermal stresses occurring in normal use.

Compliance is checked by testing the connectors/appliance outlets in the apparatus described in Clause 19.

Appliance inlets and plug connectors are not tested.

Ratings for the tests are taken from Table 7.

The selector switch C, connecting the earthing circuit and accessible metal parts to one of the poles of the supply, is operated after half the number of strokes at rated current.

Table 7 – Ratings for the tests of Clause 20

Rated current A	Test voltage V	Test current A	Power factor (cos ϕ)	Minimum number of strokes
$\leq 0,2$	–	no current	–	4 000
$> 0,2$ to < 10	rated voltage	rated current	$0,6 \pm 0,05$	2 000
	–	no current	–	6 000
≥ 10	rated voltage	rated current	$0,95 \pm 0,05$	2 000
	–	no current	–	6 000

NOTE 1 — Strokes are applied 28 to 30 strokes per minute with continuous movement.

NOTE 2 — Current flow period: $1,5^{+0,5}_0$ s.

NOTE 3 — A stroke is an engagement or a disengagement of the sample under test into the counterpart.

NOTE 4 — The test sample is fully inserted into and withdrawn from its counterpart during each cycle.

After the test, the test samples shall withstand an electric strength test as specified in 15.3. The test voltage is reduced to 50 % of the value of Table 4 without humidity treatment.

The test sample shall not show any:

- wear impairing its further use;
- deterioration of enclosures or barriers;
- damage to the entry holes for the pins that might impair proper working;
- loosening of electrical or mechanical connections;
- seepage of sealing compound.

The electrical safety shall not be impaired.

21 Temperature rise

Contacts and other current-carrying parts shall be so designed as to prevent excessive temperature rise due to the passage of current.

Compliance is checked, for connectors/appliance outlets and plug connectors, by the following test.

Rewirable connectors/plug connectors are fitted with ~~polyvinyl chloride insulated~~ cords according to Table 9 having a length of 1 m and a cross sectional area according to Table 8. **8**

Appliance outlets are fitted with insulated conductors according to Table 8.

The terminal screws, if any, are tightened with two-thirds of the torque specified in the appropriate column of Table 13.

Table 8 – Cords and conductors for the tests of Clause 21

Type of coupler	Rated current A	Conductor mm ²	Test current A
Connectors	≤ 0,2	–	not tested
Non-rewirable connectors/plug connectors	> 0,2 to ≤ 16	with cord as delivered	1,25 × rated current
Rewirable connectors / plug connectors	≤ 10	1,0	1,25 × rated current
	> 10	1,5	
Appliance outlets	> 0,2 to ≤ 6	0,75	1,25 × rated current
	> 6 to ≤ 10	1,0	
	> 10	1,5	

The connector is inserted into an appliance inlet having brass pins with the minimum dimensions specified in the relevant standard sheet, a tolerance of +0,02 mm being allowed, the distance between pin centres having the value specified in the standard sheet.

Appliance outlets are connected to a plug connector.

Plug connectors are inserted into an appliance outlet.

For non-standardized appliance couplers, the counterpart specified by the manufacturer is used.

An alternating current of 1,25 times the rated current is passed through the current-carrying contacts for 1 h.

For connectors/appliance outlets and plug connectors with earthing contact, the current is then passed through one current-carrying contact and the earthing contact for 1 h.

The temperature rise of terminals and contacts shall not exceed 45 K.

After this test, the test samples shall withstand the test of Clause 16.

22 Cords and their connection

22.1 Cords for non-rewirable connectors/plug connectors

Non-rewirable connectors/plug connectors shall be provided with a ~~cord complying with Table 9 or equivalent. Non-rewirable connectors/plug connectors shall be provided with a~~ type of cord complying with the International Standard indicated in Table 9 for the type of connector/plug connector and, in addition, the cord shall have a cross-sectional area not less than that specified in Table 9.

Table 9 – Type and nominal cross-sectional area of cords

Type of connector/plug connector	Type of cord ^a	Nominal cross-sectional area mm ²
0,2 A	60227 IEC 41 ^b	–
2,5 A for class I equipment	60227 IEC 52	0,75
2,5 A for class II equipment	60227 IEC 52	0,75 ^c
6 A	60227 IEC 52	0,75
10 A for cold conditions	60227 IEC 53 or 60245 IEC 53	0,75 ^d
10 A for hot conditions	60245 IEC 53 60245 IEC 89	0,75 ^d
10 A for very hot conditions	60245 IEC 53 60245 IEC 89	0,75 ^d
16 A for cold conditions	60227 IEC 53 or 60245 IEC 53	1,0 ^d
16 A for very hot conditions	60245 IEC 53 60245 IEC 89	1,0 ^d

NOTE For a cross-sectional area using American Wire Gauge (AWG), see Annex D.

^a Other cable or cord with equivalent properties may also be used.

^b In length not exceeding 2 m.

^c If the cord has a length not exceeding 2 m, a nominal cross-sectional area of 0,5 mm² is allowed.

^d If the cord has a length exceeding 2 m, nominal cross-sectional areas shall be minimum:

- 1,0 mm² for 10 A connectors;
- 1,5 mm² for 16 A connectors.

Non-rewirable connectors/plug connectors with earthing contact shall be provided with a three-core cord.

In non-rewirable, non-reversible connectors/plug connectors the cores of the cord shall be connected to the contacts in the following manner:

- green/yellow core to the earthing contact;
- brown core to the line contact;
- light blue core to the neutral contact.

Compliance is checked by inspection and by measurement.

22.2 Cord anchorage

22.2.1 General

Connectors/plug connectors shall be provided with a cord anchorage such that the conductors are relieved from strain, including twisting, where they are connected to the terminals or terminations, and that their outer covering is protected from abrasion.

NOTE—Cord anchorages of the "labyrinth" type are allowed, provided they withstand the relevant tests.

22.2.2 Additional requirements for rewirable connectors and rewirable plug connectors

Additional requirements for rewirable connectors/plug connectors are:

- it shall be clear how the relief from strain and the prevention of twisting is intended to be effected;
- the cord anchorage, or at least a part of it, shall be integral with or fixed to one of the other component parts of the connector/plug connector;
- makeshift methods, such as tying the cord into a knot or tying the ends with string, shall not be used;
- cord anchorages shall be suitable for the different types of cord which may be connected, and their effectiveness shall not depend upon the assembly of the parts of the body;
- cord anchorages shall be of insulating material or be provided with an insulating lining fixed to the metal parts;
- it shall not be possible for the cord to touch the clamping screws of the cord anchorage if these screws are accessible with the test probe B of IEC 61032 (standard test finger) or are electrically connected to accessible metal parts;
- metal parts of the cord anchorage, including its screws, shall be insulated from the earthing circuit.

22.2.3 Pull test for cable anchorage

Compliance with the requirements of 22.2.1 and 22.2.2 is checked by inspection and by a pull test in an apparatus similar to that shown in Figure 7 followed by a torque test.

Dimensions in millimetres

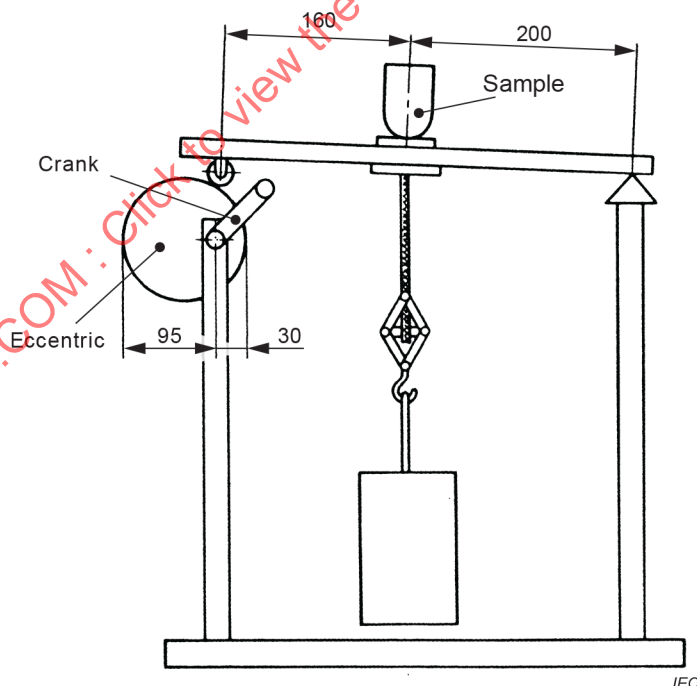


Figure 7 – Apparatus for testing the cord anchorage

Non-rewirable connectors/plug connectors are tested with the cord as delivered; rewirable connectors/plug connectors are tested first with one and then with the other type of cord, as specified in Table 10.

Table 10 – Types of cord for the rewirable connector/plug connector test

Type of connector/plug connector	Type of cord ^a	Cross-sectional area mm ²	
		Pull test according to 22.2.3	Flexing test according to 22.3
10 A for cold conditions	60227 IEC 53 60227 IEC 53	0,75 1,0	1,0
10 A for hot conditions	60245 IEC 53 60245 IEC 53	0,75 1,0	1,0
10 A for very hot conditions	60245 IEC 53 60245 IEC 53	0,75 1,0	1,0
16 A for cold conditions	60227 IEC 53 60227 IEC 53	1,0 1,5	1,5
16 A for very hot conditions	60245 IEC 53 60245 IEC 53	1,0 1,5	1,5
^a Other cable or cord with equivalent properties may also be used.			

Conductors of the cord of rewirable connectors/plug connectors are introduced into the clamping units, and the screws of clamping units, if any, are tightened just sufficiently to prevent the conductors from easily changing their position.

The cord anchorage is used in the normal way, clamping screws being tightened with a torque equal to two-thirds of the torque specified in the appropriate column of Table 13. After assembly of the test sample, the component parts shall fit snugly and it shall not be possible to push the cord into the connector/plug connector to any appreciable extent.

The test sample is fixed in the test apparatus so that the axis of the cord is vertical where it enters the connector/plug connector.

The cord is then subjected 100 times to a pull of 50 N for connectors/plug connectors having a rated current not exceeding 2,5 A and 60 N for other connectors/plug connectors. The pulls are applied without jerks, each time for $1 \pm 0,5$ s.

Connectors/plug connectors provided with flat twin tinsel cords are not subjected to the torque test.

Immediately afterwards, the cord is subjected for 60 ± 5 s to a torque of:

- 0,1 N·m for cords, other than flat twin tinsel cords, having a nominal cross-sectional area not exceeding 0,5 mm²;
- 0,15 N·m for two-core cords having a nominal cross-sectional area of 0,75 mm²;
- 0,25 N·m in all other cases.

During the tests, the cord shall not be damaged.

After the tests, the cord shall not have been displaced by more than 2 mm. For rewirable connectors/plug connectors, the ends of the conductors shall not have moved noticeably in the terminals; for non-rewirable connectors/plug connectors, there shall be no break in the electrical connections.

For the measurement of the longitudinal displacement, a mark is made on the cord before starting the test while subjecting it to a preliminary pull of the value specified; the mark is made at a distance of approximately 2 cm from the end of the connector/plug connector or the cord guard. If, for non-rewirable connectors/plug connectors, there is no definite end to the connector/plug connector or the cord guard, an additional mark is made on the body, from which the distance to the other mark is measured.

After the tests, the displacement of the mark on the cord in relation to the connector/plug connector or the cord guard is measured while the cord is subjected to a pull of the value specified.

22.3 Flexing test

Connectors/plug connectors shall be so designed that the cord cannot be subjected to excessive bending where it enters the connector/plug connector.

Guards provided for this purpose shall be of insulating material and shall be fixed in a reliable manner.

Helical metal springs, whether bare or covered with insulating material, are not allowed as cord guards.

Compliance is checked by inspection and the following test.

For rewirable connectors/plug connectors, before this test is started, the guards are subjected to an accelerated ageing test as specified in:

- 24.2.2, if of elastomeric material;
- 24.2.3, if of thermoplastic material.

Connectors/plug connectors are subjected to a test in an apparatus having an oscillating member similar to that shown in Figure 8.

Dimensions in millimetres

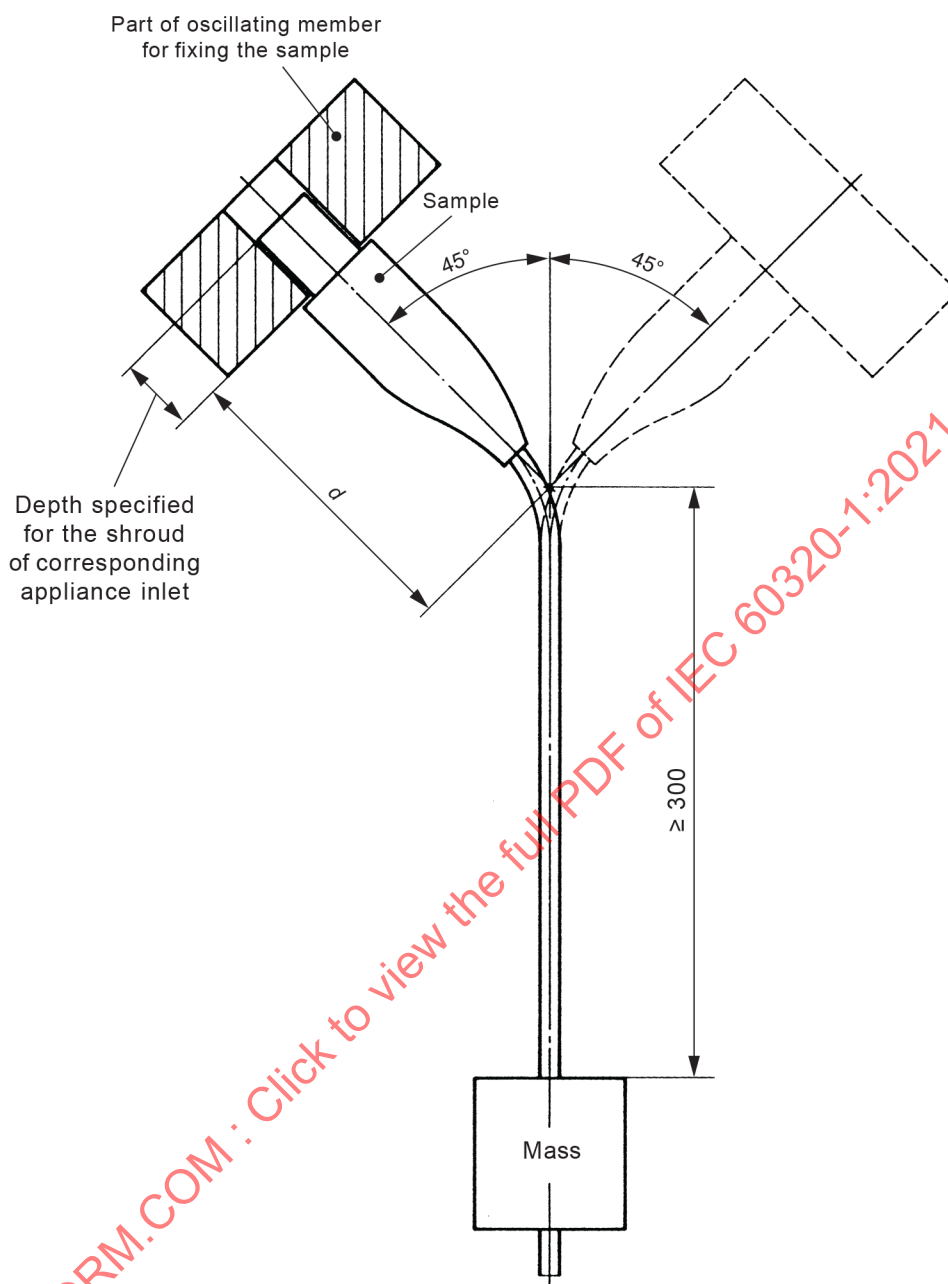


Figure 8 – Apparatus for the flexing test

Rewirable connectors/plug connectors are fitted with a cord as specified in Table 10, having an appropriate length and strands of the largest diameter allowed for that type of flexible cord. The cord guard, if any, is put in place.

Non-rewirable connectors/plug connectors are tested with the cord as delivered.

The test sample is fixed to the oscillating member of the apparatus so that, when this is at the middle of its travel, the axis of the cord, where it enters the connector/plug connector, is vertical and passes through the axis of oscillation.

The part of the connector/plug connector which, in normal use, is inside the appliance inlet/appliance outlet, is fixed in the test apparatus.

The oscillating member is, by variation of distance d shown in Figure 8, so positioned that the cord makes the minimum lateral movement when the oscillating member of the test apparatus is moved over its full travel.

Test samples with flat cords are mounted so that the major axis of the section is parallel to the axis of oscillation.

The cord is loaded so that the force applied is:

- 20 N for rewirable connectors/plug connectors, and for non-rewirable connectors/plug connectors with cords having a nominal cross-sectional area exceeding 0,75 mm²;
- 10 N for other non-rewirable connectors/plug connectors.

A current equal to the rated current of the connectors/plug connectors is passed through the conductors, the voltage between them being equal to the rated voltage. No current is passed through the earthing conductor, if any.

The oscillating member is moved backwards and forwards through an angle of $90^\circ \pm 3^\circ$ ($45^\circ \pm 3^\circ$ on either side of the vertical), the number of flexings being 10 000 and the rate of flexing being 60 ± 3 per minute.

Test samples with circular-section cords are turned through 90° in the oscillating member after half the required number of flexings; test samples with flat cords are only bent in a direction perpendicular to the plane containing the axes of the cores.

During the test there shall be no interruption of the test current, and no short-circuit between conductors.

After the test, the test sample shall show no damage within the meaning of this document; the guard, if any, shall not have separated from the body and the insulation of the cord shall show no sign of abrasion or wear. Moreover, for non-rewirable connectors/plug connectors, broken strands of the conductors shall not have pierced the insulation so as to become accessible.

NOTE 1 A flexing is one movement, either backwards or forwards.

NOTE 2 The test is carried out on test samples not subjected to any other test.

NOTE 3 A short-circuit between the conductors of the cord is considered to occur if the current attains a value equal to twice the rated current of the connector.

23 Mechanical strength

23.1 General

Appliance couplers shall have adequate mechanical strength.

~~Compliance is checked~~

- ~~— for connectors/plug connectors, by the test of 23.2;~~
- ~~— for connectors/plug connectors with a rating exceeding 0,2 A, by the tests of 23.3 and 23.6;~~
- ~~— for appliance couplers intended for surface mounting and the shrouds of plug connectors, by the tests of 23.4;~~
- ~~— for connectors according to standard sheet C7 of IEC 60320-3, by the additional test of 23.5.~~

Compliance is checked in accordance with the subclauses shown in Table 11. **9**

Table 11 – Applicable tests

Test	Appliance outlet	Plug connector	Connector	Appliance inlet
23.2 Free fall test		X	X	
23.3 Lateral pull test for contacts	X		X ^d	
23.4 Impact test	X	X		X ^a
23.5 Deformation test			X ^b	
23.6 Pull tests for connectors/plug connectors with a separate front part		X ^c	X ^{c, d}	
^a For appliance inlets designed for surface-mounting. ^b For connectors according to standard sheet C7 as per IEC 60320-3. ^c For connectors/plug connectors with a separate front part. ^d Connectors with a rating of up to and including 0,2 A are not tested.				

23.2 Free fall test

Rewirable connectors/plug connectors are fitted with the cord, specified in 22.3, having the smallest cross-sectional area 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 the torque specified in the appropriate column of Table 14.

Non-rewirable connectors/plug connectors are tested with the cord as delivered, the cord being cut so that a free length of approximately 100 mm projects from the outer end of the guard.

The test samples shall be subjected one at a time to the free fall test procedure 2 according to IEC 60068-2-31, the number of falls being:

- 500 if the mass of the test sample without cord or cord guard does not exceed 200 g, and
- 100 in all other cases.

After the test, the test samples shall show no damage and no part shall have become detached or loosened which may influence the electrical safety.

NOTE 1—Small pieces can be broken off without causing rejection, provided that protection against electric shock is not affected.

NOTE 2—Damage to finish and small dents which do not reduce the creepage distances or clearances below the values specified in Clause 26 are neglected.

NOTE 3—The approximate 100 mm length can be reduced in order to ensure free fall.

23.3 Lateral pull test for contacts

~~After the test of 23.2, the connector/plug connector is inserted into the corresponding appliance inlet/appliance outlet.~~

~~The appliance inlet/appliance outlet is mounted in an appropriate test apparatus with the pins/contacts pointing upwards.~~

The purpose of this test is to verify that the contacts of connectors and appliance outlets have sufficient mechanical strength. **10**

For testing connectors, a corresponding appliance inlet is mounted in an appropriate test apparatus with the pins pointing upwards and the connector being inserted.

For testing appliance outlets, they are mounted in the appropriate test apparatus with the contacts pointing upwards and a corresponding plug connector being inserted.

An example of the test apparatus is shown in Figure 9 a).

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Dimensions in millimetres

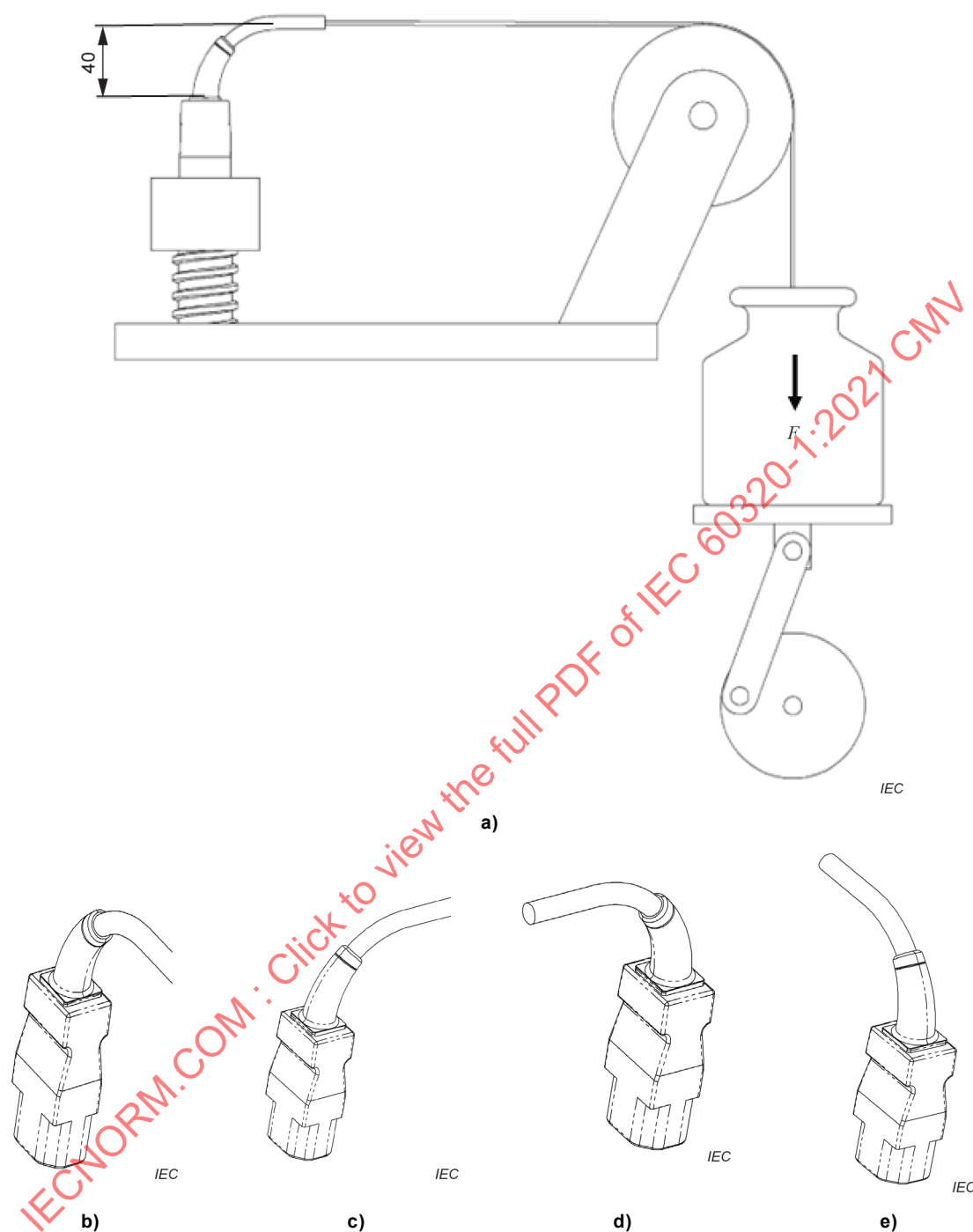


Figure 9 – Example of apparatus for pulling test

A lateral pull force is applied in steps of $90^\circ \pm 5^\circ$ as shown in Figure 8a), b), c), d) and e) parallel with the plane containing the axes of the current-carrying pins/contacts and parallel with the engagement face of the connector/plug connector.

A lateral pull force, in parallel with the engagement face, is applied to the cable of the connector/plug connector in four directions in steps of $90^\circ \pm 5^\circ$, as shown in Figure 9 a), b), c), d) and e).

NOTE For angled connectors/plug connectors, the force is not applied in the opposite direction of the cord entry.

A pull force according to Table 12 is applied 50 times in each direction to the cord for $1 \text{ s} \pm 0,5 \text{ s}$.

Table 12 – Values for the lateral pulls applied

Rated current A	Pull force N ($\pm 5 \%$)
2,5	6
6	35
10	35
16	50

If necessary, the connector/plug connector is prevented from coming out of the appliance inlet/appliance outlet but shall be free to move inside the appliance inlet/appliance outlet.

After the test, the connector/~~plug connectors~~ appliance outlet shall show no damage and the test samples shall comply with 16.3.

23.4 Impact test

~~Appliance inlets designed for surface mounting, and the shrouds of plug connectors and appliance outlets of insulating~~ The following parts of appliance couplers, of a material other than elastomeric material, are ~~tested~~ subjected to an impact test by means of a vertical hammer or spring hammer according to IEC 60068-2-75:

- all accessible surfaces covering live parts of appliance outlets;
- shrouds of appliance inlets for surface mounting;
- shrouds of plug connectors.

The hammer head has a hemispherical face with a radius of 10 mm.

The impact energy is $0,5 \text{ J} \pm 0,05 \text{ J}$.

The hammer head has a hemispherical face of polyamide having a Rockwell hardness of HR 85 to 100.

The test sample is rigidly supported and 12 impacts are applied, three to each of four places chosen so as to include the weakest areas.

After the test, the test sample shall show no damage within the meaning of this document.

23.5 Deformation test

For 2,5 A connectors for class II equipment according to standard sheet C7 of IEC 60320-3, the area where the switch cam(s) can touch the connector shall be sufficiently resistant to deformation.

NOTE This area is indicated by "3)" on standard sheet C7.

Compliance is checked by the following test, which is made by means of an apparatus having a rectangular blade as shown in IEC 60320-3:2014, Figure 9. The test is made with blade A and with blade B successively, which are pressed against the connector body in the area to be checked, with the force as specified in IEC 60320-3:2014, Figure 9.

The apparatus with the test sample in position is kept in a heating cabinet at a temperature of $70\text{ °C} \pm 2\text{ °C}$ for 2 h.

The test sample is then removed from the apparatus and cooled down within 10 s to approximately room temperature by immersion in cold water.

The thickness of the connector body is measured immediately at the point of impression. The difference between the thickness values before and after the test shall be not more than 0,2 mm.

23.6 ~~Torque and~~ Pull tests for connectors/plug connectors with a separate front part

23.6.1 General 11

The external parts of connectors/plug connectors with a separate front part enclosing the contacts shall be reliably fixed to one another.

Compliance is checked for all connectors and plug connectors by the following tests.

Rewirable connectors/plug connectors are fitted with the cord specified in 22.3, having the smallest cross-sectional area.

Non-rewirable connectors/plug connectors are tested with the cord as delivered.

23.6.2 Straight pull test

The front part and the rear part of the connectors/plug connectors are securely fixed to two claws which are so arranged that they can separate from each other in a straight line. ~~A pull force following Table 12 is applied in the axial direction without jerks to the claws. The force is maintained for 1 min. After having removed the force, a torque following Table 12 is applied twice to the connector, first for 1 min twisting the connector in a direction perpendicular to the axis of the previous applied force and then for 1 min bending the connector in a direction perpendicular to the axis of the previous applied force and torque.~~ A pull force according to Table 13 is applied in the direction of the axes of the pins/contacts without jerks to the claws. The force is maintained for $60^{+0,5}_0$ s.

23.6.3 Lateral pull test

The front part of the connectors/plug connectors is clamped to a test fixture.

A lateral pull force according to Table 13, in parallel with the engagement face, is applied to the cable of the connector/plug connector in four directions in steps of $90^\circ \pm 5^\circ$, as shown in Figure 9 b), c), d) and e).

The force is maintained for $60^{+0,5}_0$ s in each direction.

For angled connectors/plug connectors, the force is not applied in the opposite direction of the cord entry.

After the tests of 23.6.2 and 23.6.3, the two parts of the connectors/plug connectors shall neither have been detached, nor shall parts providing protection against electric shock have been loosened or live parts have become accessible.

Table 12 – Values for torque and pull forces

Rated current A	Torque N·m	Pull N
0,2	$0,2 \pm 0,02$	75 ± 2
2,5	$0,2 \pm 0,02$	75 ± 2
6	$0,5 \pm 0,02$	75 ± 2
10	$0,5 \pm 0,02$	100 ± 2
16	$0,5 \pm 0,02$	100 ± 2

Table 13 – Values for pull forces

Rated current A	Straight pull N	Lateral pull N
0,2	50 ± 2	25 ± 2
2,5 Class II	50 ± 2	50 ± 2
2,5 Class I	75 ± 2	75 ± 2
6	75 ± 2	75 ± 2
10	100 ± 2	75 ± 2
16	100 ± 2	100 ± 2

~~After the test, the two parts of the connectors/plug connectors shall not have been detached, nor shall parts providing protection against electric shock have loosened or live parts become accessible.~~

24 Resistance to heat and ageing

24.1 Resistance to heat

Appliance couplers shall be sufficiently resistant to heat.

~~Parts of the cord anchorage and the cord guard, parts not immediately surrounding the socket contacts of connectors moulded together with the cord, parts of ceramic and 0,2 A connectors are not subjected to this test.~~

Compliance is checked with new samples using the ball pressure test according to IEC 60695-10-2 at the following temperatures:

- $155\text{ °C} \pm 2\text{ °C}$ for parts of appliance couplers classified according to 7.1 c) (very hot conditions) which retain current-carrying parts and parts of the earthing contact in position and the front part of connectors and shrouds of plug connectors;
- $125\text{ °C} \pm 2\text{ °C}$ for parts of appliance couplers classified according to 7.1 b) (hot conditions) which retain current-carrying parts and parts of the earthing contact in position and the front part of connectors and shrouds of plug connectors;
- $125\text{ °C} \pm 2\text{ °C}$ for parts of ~~accessories~~ appliance couplers classified according to 7.1 a) (cold conditions) which retain current-carrying parts and parts of the earthing ~~circuit in position (with the exception of 0,2 A appliance inlets)~~ contact in position and shrouds of plug connectors; **12**
- $75\text{ °C} \pm 2\text{ °C}$ for all other parts of ~~accessories classified according to (cold conditions) and all parts of 0,2 A appliance inlets~~ appliance couplers.

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

Compliance is checked by inspection.

The following parts are not subjected to this test:

- parts of the cord anchorage and the cord guard;
- parts of connectors, not immediately surrounding the socket contacts, moulded together with the cord;
- parts of plug connectors, not immediately surrounding the pins, moulded together with the cord;
- connectors with a rated current $\leq 0,2$ A;
- parts of ceramic.

NOTE 1 The front part is that part of a connector or a plug connector which can be fully engaged with its counterpart.

NOTE 2 The shroud of a plug connector can be a separate front part.

24.2 Resistance to ageing

24.2.1 General

~~Connectors/plug connectors~~ Appliance couplers of elastomeric or thermoplastic material shall be sufficiently resistant to ageing.

Compliance is checked:

- for ~~connectors/plug connectors~~ appliance couplers of elastomeric material, by the tests of 24.2.2 and 24.2.4;
- for ~~connectors/plug connectors~~ appliance couplers of thermoplastic material, by the tests of 24.2.3 and 24.2.4.

For the tests of 24.2.2 to 24.2.4, one new test sample is used.

For the tests of 24.2.2 and 24.2.3, the use of an electrically heated cabinet is recommended.

NOTE 1 Natural air circulation can be provided by holes in the walls of the cabinet.

NOTE 2 Temperature can be measured by means of thermometers.

24.2.2 Ageing test for elastomeric materials

~~Connectors/plug connectors~~ Appliance couplers of elastomeric material are subjected to an accelerated ageing test made in an atmosphere having the composition and pressure of the ambient air. The test samples are suspended freely in a heating cabinet, ventilated by natural air circulation. They are kept in the cabinet, which is maintained at a temperature of $70\text{ °C} \pm 2\text{ °C}$, for 240 h (10 days).

24.2.3 Ageing test for thermoplastic materials

~~Connectors/plug connectors~~ Appliance couplers of thermoplastic material are subjected to an accelerated ageing test made in an atmosphere having the composition and pressure of the ambient air. The test samples are suspended freely in a heating cabinet, ventilated by natural circulation. They are kept in the cabinet, which is maintained at a temperature of $80\text{ °C} \pm 2\text{ °C}$, for 168 h (7 days).

During the test, the connectors/plug connectors are in engagement with a corresponding appliance inlet/appliance outlet according to the relevant standard sheet.

24.2.4 Ageing test assessment

After the tests of 24.2.2 or 24.2.3, the test samples are allowed to attain approximately ambient temperature and are then examined. They shall show no crack visible to the naked eye, nor shall the material have become sticky or greasy, this being judged as follows.

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

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

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

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

The test sample is placed on one of the pans of a balance and the other pan is loaded with a mass equal to the mass of the test sample plus 500 g. Equilibrium is then restored by pressing the test sample with the forefinger, wrapped in the piece of cloth.

25 Screws, current-carrying parts and connections

25.1 General

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

Screws and nuts for the connection of conductors shall be in engagement with a metal thread.

Screws for mounting parts of appliance couplers shall not be a thread-cutting type.

Screws or nuts for fixing the base of the appliance inlet/appliance outlet on an appliance can be any type. Screws of insulating material shall not be used in cases when the replacement with metal screws could impair the insulation of the appliance coupler.

Compliance is checked by inspection and by the following test.

The screws and nuts are tightened and loosened:

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

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 test screwdriver or spanner applying a torque as declared by the manufacturer; if a torque is not declared then the values shown in Table 14 are used.

When testing the terminal screws of connectors/plug connectors, a flexible conductor is placed in the terminal. The conductor is moved each time the screw or nut is loosened.

The nominal cross-sectional area of this conductor is 1 mm² for 10 A connectors/plug connectors and 1,5 mm² for 16 A connectors/plug connectors.

The screws and nuts shall be tightened smoothly.

Table 14 – Torque applied for the tightening and loosening test

Nominal diameter of thread mm	Torque N·m	
	I	II
Up to and including 2,8	0,2	0,4
Over 2,8 up to and including 3,0	0,25	0,5
Over 3,0 up to and including 3,2	0,3	0,6
Over 3,2 up to and including 3,6	0,4	0,8
Over 3,6 up to and including 4,1	0,7	1,2
Over 4,1 up to and including 4,7	0,8	1,8
Over 4,7 up to and including 5,3	0,8	2,0

Torque, Column I applies to screws without heads which, when tightened, do 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.

Torque, Column II applies to other screws and to nuts.

For screws having a hexagonal head with a slot, only the test with the screwdriver is carried out.

During the test, the screwed connection shall not work loose and there shall be no damage, such as breakage of screws or damage to the head slots, threads, washers or stirrups, which will impair the further use of the accessory.

25.2 Electrical connections

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

Compliance is checked by inspection.

NOTE For electrical connections up to 0,2 A the contact pressure can be obtained by insulating material that ensures reliable and permanent contact under all conditions of normal use.

25.3 Securement of connections

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

Connections between terminals and other parts shall be so designed that they will not work loose in normal use.

Compliance is checked by inspection and manual test.

NOTE 1 Spring washers can provide satisfactory locking.

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

25.4 Metallic parts

Current-carrying parts and earthing contacts shall be of a metal having, under conditions occurring in the appliance coupler, adequate mechanical strength and resistance to corrosion.

Parts which may be subjected to mechanical wear shall not be made of steel provided with electroplated coating.

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

Under moist conditions, metals having a great difference of electro-chemical potential with respect to each other shall not be used in contact with each other.

NOTE 1 Examples of suitable metals, when used within the permissible temperature range and under normal conditions of chemical pollution are (this list is not exhaustive):

- copper;
- an alloy containing at least 58 % copper for parts that are worked cold 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 a 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 a 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 a coating of tin according to ISO 2093, the coating having a thickness equal to at least 12 µm (ISO Service Condition No. 2).

NOTE 2 Screws, nuts, washers, clamping plates and similar parts of terminals are not regarded as current-carrying parts.

26 Clearances, creepage distances and solid insulation

26.1 General

Appliance couplers shall be constructed so that the clearances, creepage distances and solid insulation are adequate to withstand the electrical, mechanical and thermal stresses under the environmental influences that may occur during the anticipated life of the appliance couplers and interconnection couplers.

Compliance is checked by inspection and by the tests of 26.2, 26.3 and 26.4.

NOTE The requirements and tests are based on IEC 60664-1.

26.2 Clearances

26.2.1 Dimensioning

The clearances shall be dimensioned to withstand the rated impulse voltage declared by the manufacturer.

For a standard appliance coupler, the minimum rated impulse voltage is 2 500 V. For other rated impulse voltages, see Table 15.

Table 15 – Rated impulse withstand voltage for appliance couplers energized directly from the low voltage mains

Voltage line to neutral derived from nominal voltages AC up to and including V	Rated impulse withstand voltage kV		
	Overvoltage category		
	I	II	III
50	0,33	0,5	0,8
100	0,5	0,8	1,5
150	0,8	1,5	2,5
300	1,5	2,5	4,0

NOTE 1 For more detailed information, see IEC 60664-1. For example, for the overvoltage category, see 4.3.3.2 of IEC 60664-1:2007/2020.

~~NOTE 2~~ Appliance couplers are considered to fall within overvoltage category II. Overvoltage category I is applicable if special precautions against transient overvoltages are taken.

For the measurements, the following provisions apply.

Parts which can be removed without the use of a tool shall be removed and parts which can be assembled in different orientations are placed in the most unfavourable position.

NOTE Movable parts are for example hexagonal nuts, the position of which cannot be controlled throughout an assembly.

Distances through slots or openings in the surfaces of the insulating material are measured to a metal foil in contact with the surface. The foil is pushed into corners and the like by means of test probe 11 according to IEC 61032, but it is not pressed into openings.

A force of 2 N is applied to bare conductors and 30 N for accessible surfaces in order to attempt to reduce clearances when making the measurement.

The force is applied by means of test probe 11 according to IEC 61032.

26.2.2 Minimum values for clearances

The clearance for basic insulation, supplementary insulation and functional insulation shall not be less than the values specified in Table 16.

Except when the dimensions specified in the relevant standard sheet according to the IEC 60320 series lead to smaller distances, the clearances for reinforced insulation shall not be less than the values specified for basic insulation in Table 16, but using the next higher step for the rated impulse withstand voltage.

Compliance is checked by measurement.

Table 16 – Minimum clearances for basic insulation

Rated impulse withstand voltage ^a V	Minimum clearances in air up to 2 000 m above sea-level ^b mm	
	Pollution degree 1	Pollution degree 2
500	0,04	0,2
800	0,10	0,2
1 500	0,5	0,5
2 500	1,5	1,5
4 000 ^c	3	3

^a This voltage is:

- for functional insulation: the maximum impulse voltage expected to occur across the clearance;
- for basic insulation directly exposed to or significantly influenced by transient overvoltage from the low-voltage mains: the rated impulse withstand voltage of the appliance couplers and interconnection couplers;
- for other basic insulation: the highest impulse voltage that can occur in the circuit.

^b Clearances for altitudes higher than 2 000 m above sea-level shall be multiplied by the altitude correction factor in accordance with IEC 60664-1.

^c This voltage is only applicable when determining reinforced insulation for a rated impulse withstand voltage of 2,5 kV.

26.3 Creepage distances

26.3.1 Dimensioning

The creepage distances shall be dimensioned for the voltage which is expected to occur in normal use taking into account pollution degree 2 and the material group. Locally pollution degree 1 may be achieved by encapsulation of the creepage distances.

For the measurements, the following provisions apply.

Parts which can be removed without the use of a tool shall be removed and parts which can be assembled in different orientations are placed in the most unfavourable position.

NOTE 1 Movable parts are for example hexagonal nuts, the position of which cannot be controlled throughout an assembly.

Distances through slots or openings in the surfaces of the insulating material are measured to a metal foil in contact with the surface. The foil is pushed into corners and the like by means of test probe 11 according to IEC 61032, but it is not pressed into openings.

A force of 2 N is applied to bare conductors and 30 N for accessible surfaces in order to attempt to reduce creepage distances when making the measurement.

The force is applied by means of test probe 11 according to IEC 61032.

NOTE 2 A creepage distance cannot be less than the associated clearance.

The material group is determined according to Annex A.

26.3.2 Minimum creepage distances

The creepage distances for basic insulation, supplementary insulation and functional insulation shall not be less than the values specified in Table 17.

Except when the dimensions specified in the relevant standard sheet according to the IEC 60320 series lead to smaller distances, the creepage distances for reinforced insulation shall not be less than double the values specified for basic insulation in Table 17.

Compliance is checked by measurement.

Table 17 – Minimum creepage distances for basic and functional insulation

Voltage RMS ^a V	Pollution degree 1 ^b	Creepage distances mm		
		Pollution degree 2 ^b		
		Material group		
		I	II	III ^c
50	0,18	0,6	0,85	1,2
63	0,2	0,63	0,9	1,25
80	0,22	0,67	0,95	1,3
100	0,25	0,74	1	1,4
125	0,28	0,75	1,05	1,5
160	0,32	0,8	1,1	1,6
200	0,42	1	1,4	2
250	0,56	1,25	1,8	2,5

^a This voltage is the voltage rationalized by Table F.45 of IEC 60664-1:2007/2020.
Interpolation for intermediate values is allowed.

^b Pollution degree 1 – No pollution or only dry, non-conductive pollution occurs. The pollution has no influence.
Pollution degree 2 – Only non-conductive pollution occurs except that occasionally a temporary conductivity caused by condensation is to be expected.

^c Material group III includes IIIa and IIIb.

26.4 Solid insulation

Solid insulation shall be capable of durably withstanding electrical and mechanical stresses as well as thermal and environmental influences which may occur during the anticipated life of the appliance couplers.

Compliance is checked by measurement and during the tests of Clause 15.

The distance through accessible supplementary solid insulation shall have a minimum value of 0,8 mm.

The distance through accessible reinforced solid insulation shall have the following minimum values:

- for rated impulse withstand voltage 1 500 V: 0,8 mm;
- for rated impulse withstand voltage 2 500 V: 1,5 mm.

NOTE No minimum thickness is specified for functional, basic, inaccessible supplementary and inaccessible reinforced solid insulation.

Compliance is checked by inspection and by measurement.

27 Resistance of insulating material to heat, fire and tracking

27.1 Resistance to heat and fire

27.1.1 General

Parts made of insulating material which might be exposed to thermal stresses due to electric effects and whose deterioration might impair safety shall not be unduly affected by heat and fire generated within the accessory.

For accessories with a rated current exceeding 0,2 A, compliance is checked by the glow-wire flammability test method for end-products (GWEPT) according to ~~27.1.2 to 27.1.11~~ IEC 60695-2-11. **13**

Appliance inlets/appliance outlets integrated or incorporated in an appliance or equipment are tested in accordance with the relevant appliance standard.

27.1.2 Objective of the test

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 made of insulating material, which might be ignited by the heated test wire under defined conditions, burns for a limited time only and without spreading fire by flame, or burning parts, or drops falling down from the part under test.

27.1.3 General description of the test

The test is made on one test sample only.

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

The test is carried out by applying the glow-wire once only. The test sample shall be positioned during the test in the most unfavourable position of its intended use (with the surface tested in a vertical position).

The tip of the glow-wire shall be applied to the specified surface of the test sample, taking into account the conditions of the intended use under which a hot part may come into contact with the test sample.

If the test cannot be made on the complete test sample, a suitable part may be cut from it.

If the specified tests are carried out at several places on the same test sample, any deterioration caused by previous tests shall not affect the results of the test to be carried out.

Small parts as defined in IEC 60695-2-11:2014, 4.4 are not subjected to this test.

~~27.1.4 Description of test apparatus~~

~~Clause 5 of IEC 60695-2-10:2000 is applicable. The pinewood board covered with a layer of wrapping tissue shall be used.~~

27.1.4 Degree of severity

The following test temperatures, ~~selected from the preferred test temperatures specified in Clause 6 of IEC 60695-2-11:2000, Clause 6 of IEC 60695-2-12:2000 and Clause 6 of IEC 60695-2-13:2000,~~ are applicable:

- 750 °C for parts made of insulating material intended to retain current-carrying parts and parts of the earthing circuit in position;
- 650 °C for all other parts made of insulating material.

~~27.1.6 Verification of the thermocouple~~

~~Subclause 6.2 of IEC 60695-2-10:2000 is applicable.~~

~~27.1.7 Preconditioning~~

~~Clause 7 of IEC 60695-2-10:2000 is applicable.~~

~~27.1.8 Initial measurements~~

~~Clause 8 of IEC 60695-2-11:2000, Clause 8 of IEC 60695-2-12:2000 and Clause 8 of IEC 60695-2-13:2000 are applicable.~~

~~27.1.9 Test procedure~~

~~Clause 8 of IEC 60695-2-10:2000 is applicable.~~

~~27.1.10 Observations and measurements~~

~~Clause 11 of IEC 60695-2-11:2000, Clause 11 of IEC 60695-2-12:2000 and Clause 11 of IEC 60695-2-13:2000 are applicable.~~

27.1.5 Evaluation of test results

~~Clause 12 of IEC 60695-2-11:2000, Clause 12 of IEC 60695-2-12:2000 and Clause 12 of IEC 60695-2-13:2000 are applicable.~~

The test specimen is considered to pass the test if:

- 1) there is no ignition, or
- 2) all the following situations apply when ignition has occurred:
 - a) if flames or glowing combustion of the test specimen extinguish within 30 s after removal of the glow wire;
 - b) the specified layer placed underneath the test specimen does not ignite.

27.2 Resistance to tracking

Insulating parts supporting, or in contact with, live parts of appliance couplers for hot conditions and of appliance couplers for very hot conditions shall be of material resistant to tracking, with a minimum proof tracking index (PTI) of 175 V.

NOTE An end product standard can require a higher PTI value and/or also values for appliance couplers for cold conditions.

For materials other than ceramic, compliance is checked by the test of Annex A.

28 Resistance to rusting

Ferrous parts shall be adequately protected against rusting.

Compliance is checked by the following test.

The sample is degreased by immersion in white spirit or an equivalent degreasing agent for 10 min. The parts are then immersed for 10 min in a 10 % solution of ammonium chloride at a temperature of $20\text{ °C} \pm 5\text{ °C}$.

Without drying, but after shaking off any drops, the parts are placed for 10 min in a box containing air saturated with moisture at a temperature of $20\text{ °C} \pm 5\text{ °C}$.

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

An alternative test method is as follows.

After degreasing, the sample is submitted to a test according to IEC 60068-2-60 using test method 1 with a test duration of 4 days.

After exposure, the surface shall show no areas of red rust. White rust (zinc oxide) and traces of red rust which are removable by rubbing as well as traces of rust at the surface of cuts, bent edges and welded joints are ignored.

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

29 Electromagnetic compatibility (EMC) requirements

NOTE Requirements for accessories incorporating electronic components are not included as the need has not yet been established.

29.1 Immunity – Accessories not incorporating electronic components

These accessories are not sensitive to normal electromagnetic disturbances and therefore no immunity tests are required.

29.2 Emission – Accessories not incorporating electronic components

These accessories do not generate electromagnetic disturbances; consequently no emission tests are necessary.

NOTE These accessories ~~may only~~ do not generate electromagnetic disturbances other than those which can occur during occasional operations of insertion and withdrawal of the accessories. The frequency, the level and the consequences of these emissions are considered as part of the normal electromagnetic environment.

Annex A (normative)

Proof tracking test

The proof tracking test is carried out in accordance with IEC 60112.

NOTE If the surface 15 mm × 15 mm cannot be obtained because of the small dimensions of the appliance couplers, special test samples made with the same manufacturing procedure can be used.

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Annex B (normative)

Routine tests for factory wired appliance couplers related to safety

B.1 General

All factory wired accessories shall be subjected to the following tests as shown in Table B.1.

Table B.1 – Test overview

Type of accessory	Test to be performed according to ...
Two-pole accessories	Clause B.2, B.4.1
Accessories with more than two poles	Clause B.2, Clause B.3, Clause B.4

Failed samples ~~have to~~ **shall** be treated in such a way that they cannot fulfil the intended function or be separated from satisfactory products in such a way that they cannot be released for sale.

It shall be possible to identify that appliance couplers released for sale have been subjected to the routine test.

The manufacturer shall maintain a record of the tests carried out which shows:

- type of product;
- date of test;
- place of manufacture (if manufactured in more than one place);
- tested quantity;
- number of failures and actions taken, i.e. destroyed/repaired.

The test equipment shall be checked before and after each period of use and for periods of continuous use, at least every 24 h. During these checks the equipment shall show that it indicates faults when known faulty products are inserted or simulated faults are applied.

Products manufactured prior to a check shall only be released for sale if the check is found satisfactory.

Test apparatus/equipment shall be verified/calibrated at least once a year.

Records shall be kept of all checks and any adjustments found necessary.

B.2 Polarized systems: **Phase Line (L)** and neutral (N) – Correct connection

For polarized systems the test shall be made by applying a current for a period of not less than 2 s between the remote end of the L and N conductors of the flexible cord independently and the corresponding L and N pin or contact of the appliance coupler.

The period of 2 s may be reduced to not less than 1 s on test equipment with automatic timing.

Polarity shall be correct.

B.3 Earth (PE) continuity

The test shall be made applying a current for a period of not less than 2 s between the remote end of the PE conductor of the flexible cord and the PE pin or contact of the appliance coupler, as appropriate.

The period of 2 s may be reduced to not less than 1 s on test equipment with automatic timing.

Other suitable tests may be used.

Continuity shall be present.

B.4 Short-circuit/wrong connection and reduction in creepage distance and clearance

B.4.1 Accessible surface safety check

For non-rewirable appliance couplers it shall be checked that live parts, for example, loose strands, are not coming through the accessible surface.

If this danger cannot be prevented by the construction and/or suitable manufacturing processes, the following test or a similar one (e.g. impulse voltage test) shall be performed.

The accessible surface of appliance couplers except the engagement face of connectors and plug connectors are scanned by adjusted electrodes with a pressure force of 20 N.

Through the live parts and the surface of the appliance coupler, an AC voltage of $2\,000\text{ V} \pm 200\text{ V}$ shall be applied for at least 1 s.

Neither a flash-over nor a breakdown shall occur.

B.4.2 Short-circuit/wrong connection

The test shall be made between the L and N conductors and the E conductor by applying at the supply end an AC voltage of $2\,000\text{ V} \pm 200\text{ V}$, 50 Hz or 60 Hz for a period of not less than 2 s or by an impulse voltage test using 1,2/50 μs wave form, 4 kV peak value, three impulses for each pole, with intervals of not less than 1 s, the test voltage being applied at the supply end.

The period of 2 s may be reduced to not less than 1 s on test equipment with automatic timing.

The L and N conductors may be connected together for this test.

No flashover shall occur.

Annex C (normative)

Test schedule

See Table C.1.

Table C.1 – Test schedule

Group	Clause/subclause	Description of the tests	Appliance inlet connector	Appliance outlet plug-connector
4 3 samples	8	Marking	X	X
	9	Dimensions and compatibility	X	X
	10	Protection against electrical shock	X	X
	11	Provision for earthing	X	X
	12	Terminals and terminations	X	X
	13	Construction	X	X
	16	Forces necessary to insert and to withdraw the connector/appliance outlet		X
	17	Operation of contacts	X	X
	18	Resistance to heating of appliance couplers for hot and very hot conditions	X	
	23	Mechanical strength	X	X
	23.2	Free fall test		X
	23.3	Lateral pull test		X
	25	Screws, current-carrying parts and connections	X	X
	26	Clearances, creepage distances and solid insulation	X	X
	28	Resistance to rusting	X	X
	29	Electromagnetic compatibility (EMC) requirements	X	X
2 3 samples ^a	14	Moisture resistance	X	X
	15	Insulation resistance and electrical strength	X	X
	16	Forces necessary to insert and to withdraw the connector/appliance outlet		X
	19	Breaking capacity		X
	20	Normal operation		X
	21	Temperature rise		X
3 3 samples ^b	22	Cords and their connections		X
4 3 samples ^b	22.3	Flexing test		X

Group	Clause/subclause	Description of the tests	Appliance inlet	Connector	Appliance outlet	Plug connector
5 ~~1 sample^a~~	24.1	Resistance to heat	x	x	x	x
6 ~~1 sample^a~~	24.2	Resistance to ageing	x	x	x	x
7 ~~2 samples^a~~	27	Resistance of insulating material to heat, fire and tracking				
	27.1.5	Degree of severity (glow wire test 750 °C (sample 1))	x	x	x	x
	27.1.5	Degree of severity (glow wire test 650 °C (sample 2))	x	x	x	x
8 ~~3 samples^a~~	27	Resistance of insulating material to heat, fire and tracking				
	27.2	Resistance to tracking	x	x	x	x
^a — Sample of each different material.						
^b — Sample of each type of cable, cross sectional area and manufacturer of the cable.						

Group	Clause/subclause	Description of the tests	Appliance inlet	Connector	Appliance outlet	Plug connector
1 3 samples	8	Marking	x	x	x	x
	9	Dimensions and compatibility	x	x	x	x
	10	Protection against electric shock	x	x	x	x
	11	Provision for earthing	x	x	x	x
	12	Terminals and terminations	x	x	x	x
	13	Construction	x	x	x	x
	23	Mechanical strength	x	x	x	x
	25	Screws, current-carrying parts and connections	x	x	x	x
	26	Clearances, creepage distances and solid insulation	x	x	x	x
	28	Resistance to rusting	x	x	x	x
2 3 samples ^a	14	Moisture resistance	x	x	x	x
	15	Insulation resistance and electrical strength	x	x	x	x
	16	Forces necessary to insert and to withdraw the connector/appliance outlet		x	x	
	19	Breaking capacity		x	x	

Group	Clause/ subclause	Description of the tests	Appliance inlet	Connector	Appliance outlet	Plug connector
	20	Normal operation		x	x	
	21	Temperature rise		x	x	
	17	Operation of contacts	x	x	x	x
3 3 samples^b	22 E.6	Cords and their connections		x		x
4 3 samples^b	22.3	Flexing test		x		x
5 2 samples^a	24.1 E.5.1	Resistance to heat	x	x	x	x
6 2 samples^a	24.2	Resistance to ageing	x	x	x	x
7 2 samples^a	24.2.2 or 24.2.3	Ageing test for appliance couplers made of elastomeric or thermoplastic materials	x	x	x	x
8 2 samples^a	27.1.4	Degree of severity (glow wire test 750 °C (sample 1))	x	x	x	x
	27.1.4	Degree of severity (glow wire test 650 °C (sample 2))	x	x	x	x
9 3 samples^a	27.2, E.5.3	Resistance to tracking	x	x	x	x
10 3 samples^a	18	Resistance to heating of appliance couplers for hot and very hot conditions	x	x	x	x
11 3 samples^a	E.4	Determination of I_a and the rated and derated current in relation to the ambient temperature		x	x	x
12 3 samples^a	E.5.2.2	Ageing test for connectors/appliance outlets		x	x	
	E.5.2.3	Ageing test for appliance inlets/plug connectors	x			x

^a Sample of each different material.

^b Sample of each type of cable, cross-sectional area and manufacturer of the cable.

Annex D (informative)

Comparison of typical conductor cross-sectional areas

Table D.1 provides a comparison of the conductor cross-sectional areas of the American Wire Gauge (AWG) with square millimetres, square inches, and circular mils.

Table D.1 – Comparison of conductor sizes

Wire size	Gauge no.	Cross-sectional area		DC resistance of copper at 20 °C	Circular mils
		mm ²	in ²		
mm ²	(AWG)	mm ²	in ²	Ω/km	
0,2		0,196	0,000 304	91,62	387
	24	0,205	0,000 317	87,60	404
0,3		0,283	0,000 438	63,46	558
	22	0,324	0,000 504	55,44	640
0,5		0,500	0,000 775	36,70	987
	20	0,519	0,000 802	34,45	1 020
0,75		0,750	0,001 162	24,80	1 480
	18	0,823	0,001 272	20,95	1 620
1,0		1,000	0,001 550	18,20	1 973
	16	1,31	0,002 026	13,19	2 580
1,5		1,500	0,002 325	12,20	2 960
	14	2,08	0,003 228	8,442	4 110
2,5		2,500	0,003 875	7,56	4 934
	12	3,31	0,005 129	5,315	6 530
4		4,000	0,006 200	4,700	7 894
	10	5,26	0,008 152	3,335	10 380
6		6,000	0,009 300	3,110	11 841
	8	8,37	0,012 967	2,093	16 510
10		10,000	0,001 550	1,840	19 735
	6	13,3	0,020 610	1,320	26 240
16		16,000	0,024 800	1,160	31 576
	4	21,1	0,032 780	0,829 5	41 740
25		25,000	0,038 800	0,734 0	49 338
	2	33,6	0,052 100	0,521 1	66 360
35		35,000	0,054 200	0,529 0	69 073
	1	42,4	0,065 700	0,413 9	83 690
50		47,000	0,072 800	0,391 0	92 756

Annex E 1 (normative)

Additional tests and requirements for appliance couplers intended to be used in ambient temperatures above +35 °C up to and including +90 °C

E.1 General

As given in the scope, appliance couplers for household and similar purposes complying with the main part of this document are suitable for use at ambient temperatures not normally exceeding +40 °C, but their average over a period of 24 h does not exceed +35 °C, with a lower limit of the ambient air temperature of –5 °C.

This Annex E provides a methodology for derating the operating current of an accessory when used in ambient temperatures above +35 °C up to and including +90 °C and includes various tests.

E.2 General requirements on tests

E.2.1 General

Unless otherwise specified, appliance couplers are tested with their counterparts that are in compliance with this document. Corresponding counterparts shall be of identical rating (as per Clause 6) and classification (as per Clause 7).

The additional tests according to Clause E.4 shall be conducted on 3 new specimens.

E.2.2 Test setup

The measurement shall be carried out in an electrically heated cabinet in air as undisturbed as possible. The specimen shall be arranged in the enclosure in a horizontal plane, 50^{+10}_0 mm above the bottom of the enclosure and at least 150 mm below the top and equidistant from the sides. As far as possible, the specimen shall be in free suspension. If this is not possible, a thermal insulating material with a thermal conductivity ≤ 2 W/mK may be used, provided that not more than 20 % of the surface of the specimen is in contact with the insulating material.

Each accessory is wired and connected according to Clause 21 and placed in a heating cabinet.

NOTE A counterpart according to Clause 21 can be a gauge.

In order to reduce external heat dissipation to a minimum, a length of $0,5^{+0,1}_0$ m of the connected cable shall be within the measuring enclosure. The L and N terminal of the mating counterpart are connected together with a connection as short as possible.

E.2.3 Conditions of temperature measurement

If temperatures are measured with temperature probes, the probe leads shall pass through the walls of the heating cabinet. Other methods of temperature measurement are permissible.

The measuring point for measuring the ambient temperature shall be located in a horizontal plane passing through the axis of the specimen. It shall be located 50^{+5}_0 mm from the mid-point of the edge of the longest side of the specimen.

Care shall be taken to protect the probe against radiant heat.

The points for measuring the temperature of the specimen shall be on the L and N connection terminals of the mating appliance inlet, appliance outlet or plug connector.

E.2.4 Method of measurement

The specimen shall be arranged in the enclosure as described in E.2.2 and its terminals are connected to a regulated power supply through an ampere meter.

The current shall be maintained for a period of approximately 30 min after thermal stability is achieved at each of the selected current levels. This is defined as when three consecutive values of temperature rise, taken at 5 min intervals, do not differ by more than 2 K of each other.

The average value of the 6 measurements on the 3 specimens shall be taken.

E.3 Markings

Appliance couplers, except standardized appliance inlets, in compliance with the requirements of Annex E shall be marked with t_a as defined in Clause E.4 if the value of t_a is $+40\text{ }^{\circ}\text{C}$ or higher. The marked t_a value shall be in increments of $5\text{ }^{\circ}\text{C}$ and rounded down to the lower value, for example, $+40\text{ }^{\circ}\text{C}$, $+45\text{ }^{\circ}\text{C}$, $+50\text{ }^{\circ}\text{C}$, etc.

Example: t_a measured value $47\text{ }^{\circ}\text{C}$, declared and marked value $t_a\text{ }45\text{ }^{\circ}\text{C}$

Example of marking: 10 A 250 V $t_a\text{ }45$

For products declared as suitable for use at a temperature above $35\text{ }^{\circ}\text{C}$, the manufacturer shall provide information about derated current I_d , at given ambient temperatures t_d .

The ambient temperature(s) can be declared above $+35\text{ }^{\circ}\text{C}$ and not exceeding $+90\text{ }^{\circ}\text{C}$ in multiples of $5\text{ }^{\circ}\text{C}$.

For rewirable appliance couplers this information shall be additionally available in the manufacturer's wiring instructions.

Depending on the application, appropriate current limiting devices may be needed to protect the circuit and in this case the information shall be available in the manufacturer's instructions.

Markings are checked by inspection and by the test of 8.8.

E.4 Determination of t_a and the rated and derated current in relation to the ambient temperature

E.4.1 Determination of the maximum ambient temperature (t_a) for operation of the accessory at the rated current

The maximum ambient temperature at rated current (t_a) is determined as follows:

Each appliance coupler is loaded at rated current and the temperature in the heating cabinet is adjusted until the highest temperature measured at the terminals is maintained at $+90\text{ °C} \pm 1\text{ °C}$ for a period of 30 min.

The adjusted value of the heating cabinet required to maintain the highest measured temperature of the terminals at $+90\text{ °C} \pm 1\text{ °C}$ for 30 min is defined as t_a . The t_a should be the mean value of the three tested specimens.

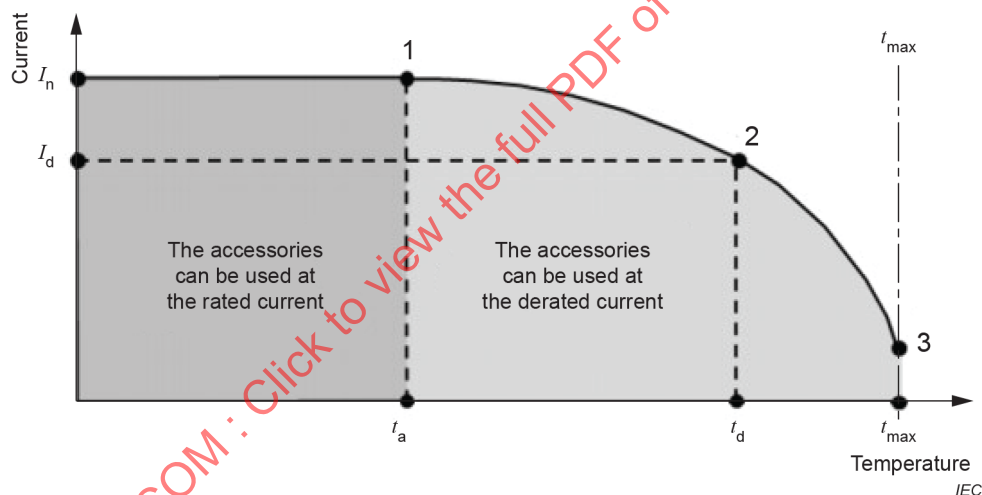
E.4.2 Determination of the derated operating currents for ambient temperatures above t_a

The temperature of the heating cabinet is then increased by steps of maximum 5 °C , the test current being reduced in order to keep the highest measured temperature at the terminals constant at $+90\text{ °C} \pm 1\text{ °C}$.

For each step, the measured derated operating current (I_d) is recorded. The I_d should be the mean value of the three tested specimens.

This procedure is continued until the highest measured temperature at the terminals and the heating cabinet is maintained at $+90\text{ °C} \pm 1$ for a period of 30 min.

An example is shown in Figure E.1.



- 1) Up to the ambient temperature t_a , the appliance couplers can be used at the rated current I_n .
- 2) At an ambient temperature t_d , the appliance couplers can be used up to the derated current I_d .
- 3) $t_{\max}$ is the maximum ambient temperature surrounding the appliance coupler.

Figure E.1 – Schematic drawing of a derating curve with an example of a derated current I_d at the operating ambient temperature t_d

NOTE Derated current value I_d at the operating ambient temperature t_d can be given for example by graph shown in Figure E.1, or a table with fixed values in increments of 5 K.

E.5 Test to evaluate the long-term behaviour of the appliance couplers in ambient temperatures above $+35\text{ °C}$ up to and including $+90\text{ °C}$

E.5.1 Resistance to heat

Appliance couplers for use in ambient temperatures above $+35\text{ °C}$ up to and including $+90\text{ °C}$ shall be sufficiently resistant to heat.

Compliance is checked with three new samples using the ball pressure test according to IEC 60695-10-2 at $125\text{ °C} \pm 2\text{ °C}$ for the following parts of appliance couplers for use in ambient temperatures up to $+90\text{ °C}$:

- parts which retain current-carrying parts;
- parts of the earthing contact in position;
- front part of connectors;
- shrouds of plug connectors for appliance couplers.

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

Compliance is checked by inspection.

The following parts are not subjected to this test:

- parts of the cord anchorage and the cord guard;
- parts of connectors, not immediately surrounding the socket contacts, moulded together with the cord;
- parts of plug connectors, not immediately surrounding the pins, moulded together with the cord;
- parts of ceramic.

NOTE 1 The front part is that part of a connector or a plug connector which can be fully engaged with its counterpart.

NOTE 2 The shroud of a plug connector can be a separate front part.

E.5.2 Resistance to ageing

E.5.2.1 General

Appliance couplers for use in ambient temperatures above $+35\text{ °C}$ up to and including $+90\text{ °C}$ shall be sufficiently resistant to ageing.

Compliance is checked:

- for connectors and appliance outlets, by the tests of E.5.2.2;
- for appliance inlets/plug connectors, by the tests of E.5.2.3.

For the tests of E.5.2.2 and E.5.2.3, three new test samples are used, which are first subjected to the test of Clause 16.

For the tests of E.5.2.2 and E.5.2.3, the use of an electrically heated cabinet is recommended.

NOTE 1 Natural air circulation can be provided by holes in the walls of the cabinet.

NOTE 2 Temperature can be measured by means of thermometers.

E.5.2.2 Ageing test for connectors/appliance outlets

Connectors/appliance outlets are subjected to an accelerated ageing test carried out in an atmosphere having the composition and pressure of the ambient air.

The test samples are suspended freely in a heating cabinet, ventilated by natural air circulation.

They are kept in the cabinet, which is maintained at a temperature of $100\text{ °C} \pm 2\text{ °C}$, for 336 h (14 days).

During the test, the connectors/appliance outlets are in engagement with a corresponding appliance inlet/plug connector according to the relevant standard sheet.

E.5.2.3 Ageing test for appliance inlets/plug connectors

Appliance inlets/plug connectors are subjected to an accelerated ageing test carried out in an atmosphere having the composition and pressure of the ambient air.

The test samples are suspended freely in a heating cabinet, ventilated by natural circulation. They are kept in the cabinet, which is maintained at a temperature of $100\text{ °C} \pm 2\text{ °C}$, for 336 h (14 days).

E.5.2.4 Ageing test assessment

After the tests of E.5.2.2 or E.5.2.3, the specimens are taken out of the cabinet and kept at a room temperature in a relative humidity between 45 % and 55 % for at least four days (96 h) and are then examined.

The specimens shall show no crack visible with normal or corrected vision without additional magnification, nor shall the material have become sticky or greasy, this being judged as follows:

- with the forefinger wrapped in a dry piece of rough cloth the specimen is pressed with a force of 5 N;
- no traces of the cloth shall remain on the specimen and the material of the specimen shall not stick to the cloth.

Then an appliance inlet/plug connector with the same rated current as the cord connector/appliance outlet is fully inserted and withdrawn 3 times, any lid is opened and closed each time.

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

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

The test sample is placed on one of the pans of a balance and the other pan is loaded with a mass equal to the mass of the test sample plus 500 g. Equilibrium is then restored by pressing the test sample with the forefinger, wrapped in the piece of cloth.

E.5.3 Resistance to tracking

Insulating parts supporting, or in contact with, live parts of appliance couplers for use in ambient temperatures above $+35\text{ °C}$ up to and including $+90\text{ °C}$ shall be of material resistant to tracking, with a minimum PTI of 175 V.

For materials other than ceramic, compliance is checked by the test of Annex A.

NOTE An end product standard can require a higher PTI value and/or also values for appliance couplers for cold conditions.

E.6 Cords and their connections

The type of cords shall be according to the requirements of Table 9 and Table 10, but shall be of rubber or an equivalent elastomeric type and rated for a maximum conductor insulation temperature of $+90\text{ °C}$ or higher for appliance couplers for use in ambient temperatures up to $+90\text{ °C}$.

NOTE 1 Such a cord is for example: H05BBF rated at 90 °C , similar to the cords of IEC 60245 (all parts).

For non-standardized appliance couplers for use in ambient temperatures up to +90 °C, the type of cords shall be of PVC, rubber or an equivalent elastomeric type and rated for a maximum conductor insulation temperature of +90 °C or higher.

NOTE 2 Such a cord is for example 60227 IEC 57 rated at 90 °C.

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¹ Under preparation. Stage at time of publication: IEC TS PUB 63236-1:2021.

² Under preparation. Stage at time of publication: IEC TS PUB 63236-2:2021.

³ Under preparation. Stage at time of publication: IEC TS PUB 63236-3:2021.

List of comments

- 1 Annex E and related paragraphs added or modified for ambient temperatures up to 90 °C of appliance couplers to meet the market need due to climate change mandates.
 - 2 Definitions of standardized and non-standardized appliance coupler were added for easier understanding of the requirements.
 - 3 The text was modified to distinguish between process control failure and manufacturing fault. Process control failures are not accepted.
 - 4 This editorial change relocated the old Clause 5.3 to Clause 5.1 General for better flow in the text.
 - 5 This change was added to address the compatibility with appliance couplers for DC.
 - 6 The heating test from edition 2.0 is reintroduced for better reproducibility, but with the example figure changed. The test in edition 3.0 was not practical in relation to the requirements.
 - 7 The previously compliance clause was insufficient and is now modified.
 - 8 Temperature rise test has been added for plug connectors. This requirement was added to bring it line with the requirements of connectors.
 - 9 Table 11 was added for better overview of necessary tests.
 - 10 This change aimed to clarify that the test is for contacts and the text was modified for better readability.
 - 11 Clause 23.6 is rearranged, and the test is slightly modified to reflect the actual risk with pull forces to the cord and to make it clear how to perform the test.
 - 12 Clarification of which parts of appliance couplers that are submitted to ball-pressure test. Modified also to refer to the Standard instead of repeating text.
 - 13 Clause 27 is updated to refer to the Standard IEC 60695-2-11 for glow wire test, instead of unnecessary repeating the text.
-

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Appliance couplers for household and similar general purposes –
Part 1: General requirements**

**Connecteurs pour usages domestiques et usages généraux analogues –
Partie 1: Exigences générales**

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**APPLIANCE COUPLERS FOR HOUSEHOLD
AND SIMILAR GENERAL PURPOSES –****Part 1: General requirements****FOREWORD**

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IEC 60320-1 has been prepared by subcommittee 23G: Appliance couplers, of IEC technical committee 23: Electrical accessories. It is an International Standard.

This fourth edition cancels and replaces the third edition published in 2015 and Amendment 1:2018. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) introduction of necessary tolerances throughout this document;
- b) the heating test from edition 2 is reintroduced in 18.2;
- c) temperature rise added for plug connectors in Clause 21;
- d) change for better readability in 23.3;
- e) updated lateral pull test in 23.6 for connectors/plug connectors with separate front parts;

- f) revision of 24.1 for ball pressure test;
- g) Clause 27 for glow wire test is updated;
- h) revision of Annex C for test sequences;
- i) additional Annex E for additional tests and requirements for appliance couplers intended to be used in ambient temperatures above +35 °C.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
23G/464/FDIS	23G/467/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

A list of all the parts in the IEC 60320 series, under the general title *Appliance couplers for household and similar general purposes*, can be found on the IEC website.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition or
- amended.

APPLIANCE COUPLERS FOR HOUSEHOLD AND SIMILAR GENERAL PURPOSES –

Part 1: General requirements

1 Scope

This part of IEC 60320 sets the general requirements for appliance couplers for two poles and two poles with earth contact and for the connection of electrical devices for household and similar onto the mains supply.

This document is also valid for appliance inlets/appliance outlets integrated or incorporated in appliances.

The rated voltage does not exceed 250 V (AC) and the rated current does not exceed 16 A.

Appliance couplers complying with this document are suitable for normal use at ambient temperatures not normally exceeding +40 °C, but their average over a period of 24 h does not exceed +35 °C, with a lower limit of the ambient air temperature of –5 °C.

Annex E provides test requirements for derating the operating current of an accessory when used in ambient temperatures above +35 °C up to and including +90 °C.

Appliance couplers are not suitable for:

- use in place of plug and socket-outlet systems according to IEC 60884-1;
- use in place of devices for connecting luminaires (DCLs) according to IEC 61995 or luminaire supporting couplers (LSCs);
- use in place of installation couplers according to IEC 61535.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60068-2-31, *Environmental testing – Part 2-31: Tests – Test Ec: Rough handling shocks, primarily for equipment-type specimens*

IEC 60068-2-60, *Environmental testing – Part 2-60: Tests – Test Ke: Flowing mixed gas corrosion test*

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

IEC 60112:2020, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

IEC 60227 (all parts), *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V*

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

IEC 60320-3:2014, *Appliance couplers for household and similar general purposes – Part 3: Standard sheets and gauges*
IEC 60320-3:2014/AMD1:2018

IEC 60417, *Graphical symbols for use on equipment* (available from: <http://www.graphical-symbols.info/equipment>)

IEC 60664-1:2020, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 60695-2-11:2014, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products (GWEPT)*

IEC 60695-10-2:2014, *Fire hazard testing – Part 10-2: Abnormal heat – Ball pressure test method*

IEC 60730-2-11:2019, *Automatic electrical controls – Part 2-11: Particular requirements for energy regulators*

IEC 60999-1:1999, *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 1: General requirements and particular requirements for clamping units for conductors from 0,2 mm² up to 35 mm² (included)*

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

IEC 61058 (all parts), *Switches for appliances*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1

appliance coupler

means enabling the connection and disconnection of an appliance or equipment to the supply

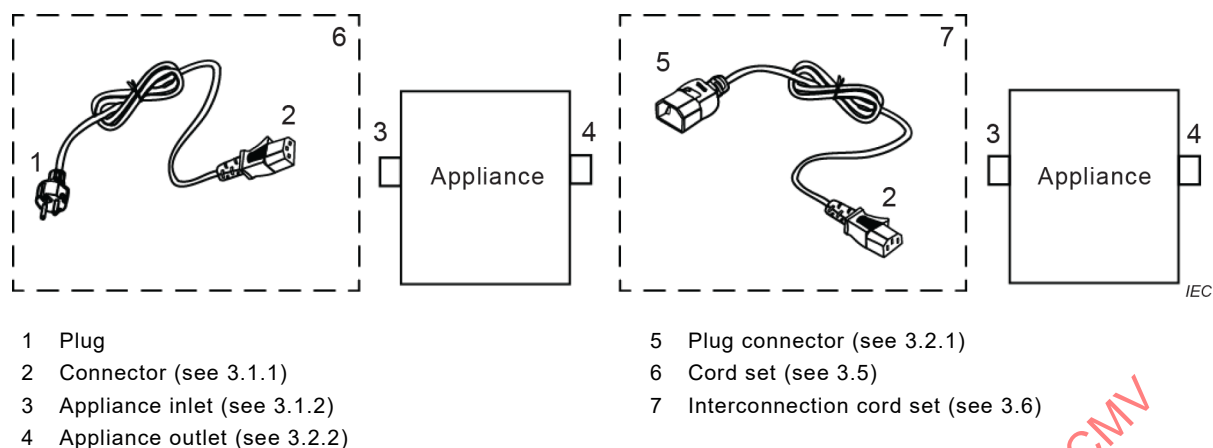


Figure 1 – Intended use of appliance couplers

3.1.1

connector (of an appliance coupler)

part of the appliance coupler integral with, or intended to be attached to, one cord connected to the supply

SEE: Figure 1.

[SOURCE: IEC 60050-442:1998, 442-07-02, modified – "the cord" has been replaced with "one cord" and a reference to Figure 1 has been added.]

3.1.2

appliance inlet

part of the appliance coupler integrated as a part of an appliance or incorporated as a separate part in the appliance or equipment or intended to be fixed to it

SEE: Figure 1.

3.2

interconnection coupler

appliance coupler enabling the connection and disconnection of an appliance or equipment to a cord leading to another appliance or equipment

SEE: Figure 1.

Note 1 to entry. An interconnection coupler is a type of appliance coupler.

3.2.1

plug connector

part of the interconnection coupler integral with or intended to be attached to one cord

SEE: Figure 1.

[SOURCE: IEC 60050-442:1998, 442-07-09, modified – "the flexible cable" has been replaced with "one cord" and a reference to Figure 1 has been added.]

3.2.2

appliance outlet

part of the interconnection coupler integrated in or incorporated in the appliance or equipment or intended to be fixed to it, and from which the supply is obtained

SEE: Figure 1.

[SOURCE: IEC 60050-442:1998, 442-07-08, modified – A reference to Figure 1 has been added.]

3.3

rewirable appliance coupler

accessory so constructed that a cable or cord can be replaced

3.4

non-rewirable appliance coupler

accessory so constructed that it forms a complete unit with flexible supply cable or cord after connection and assembly by the manufacturer of the accessory

3.5

cord set

assembly consisting of one cable or cord fitted with one non-rewirable plug and one non-rewirable connector, intended for the connection of an electrical appliance or equipment to the electrical supply

SEE: Figure 1.

3.6

interconnection cord set

assembly consisting of one cable or cord fitted with one non-rewirable plug connector and one non-rewirable connector, intended for the interconnection between two electrical appliances

SEE: Figure 1

Note 1 to entry: The definition is based on that of IEC 60050-442:1998, 442-07-06.

3.7

integrated appliance coupler

appliance coupler which is formed by the housing or enclosure of the appliance or equipment and that cannot be tested separately

3.8

standardized appliance coupler

appliance coupler with dimensions in accordance with the standard sheets of IEC 60320-3

3.9

non-standardized appliance coupler

appliance coupler with dimensions not in accordance with the standard sheets of IEC 60320-3

3.10

base of a pin

part of the pin where it protrudes from the engagement face

3.11

retaining device

mechanical provision or arrangement which holds a connector in proper engagement with a corresponding appliance inlet and prevents its unintentional withdrawal

3.12**rated voltage** (for accessories)

voltage assigned by the manufacturer for a specified operating condition of an accessory

[SOURCE: IEC 60050-442:1998, 442-01-03]

3.13**rated current** (for accessories)

current assigned by the manufacturer for a specified operating condition of an accessory

[SOURCE: IEC 60050-442:1998, 442-01-02]

3.14**terminal** (for accessories)

part of an accessory to which a conductor is attached, providing a re-usable connection

[SOURCE: IEC 60050-442:1998, 442-06-05]

3.15**termination**

part of an accessory to which a conductor is permanently attached

[SOURCE: IEC 60050-442:1998, 442-06-06]

3.16**thread-cutting screw**

screw having an interrupted thread which, by screwing in, makes a thread by removing material from the cavity

[SOURCE: IEC 60050-442:1998, 442-06-03]

3.17**type test**

test of one or more devices made to a certain design to show that the design meets certain requirements

3.18**routine test**

conformity test made on each individual item during or after manufacture

[SOURCE: IEC 60050-151:2001, 151-16-17]

4 General requirements

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

A non-standardized appliance coupler shall comply with all safety requirements of this document and shall be tested together with its counterpart.

Compliance is checked by carrying out all the tests specified.

5 General notes on tests

5.1 General

Tests shall be made to prove compliance with the requirements set out in this document, where applicable.

Tests are as follows:

- 1) type tests shall be made on representative samples of each accessory.
- 2) routine tests shall be conducted by the manufacturer and made on each accessory.
- 3) unless otherwise specified, the tests are carried out in the order of the clauses in this document.
- 4) unless otherwise specified, appliance couplers are tested together with their counterparts that are in compliance with this document.
- 5) integrated appliance couplers and incorporated appliances couplers are tested under the conditions of use of the equipment, the number of test samples then being the same as the number of test samples of equipment required according to the relevant standard for the equipment.
- 6) appliance couplers are considered to comply with this document if not more than one test sample of a given set fails in a test due to an assembly or manufacturing fault. That test and those preceding which may have influenced the result of that test are repeated on another set of test samples, all of which shall then comply with the repeated tests.
- 7) in general, only the test which caused the failure needs to be repeated unless:
 - a) a failure occurs in one of the three test samples when tested in accordance with Clause 19, Clause 20, or Clause 21, in which case the tests are repeated from Clause 16 onwards; or
 - b) a failure occurs in one of the three test samples when tested in accordance with Clause 22 (with the exception of 22.3) or Clause 23, in which case the tests are repeated from Clause 18 onwards.

Subclause 5.2 is applicable to type tests. For the number of samples and test sequences, see Annex C.

5.2 Test samples

Unless otherwise specified, the test samples are tested as delivered and under normal conditions, assembled and installed as in normal use according to the manufacturer's instructions at an ambient temperature of $20\text{ °C} \pm 5\text{ °C}$; they are tested with a.c. at 50 Hz or 60 Hz. Tests shall not commence earlier than 168 h after manufacture.

Non-rewirable connectors and non-rewirable plug connectors, other than those forming part of a cord set, shall be submitted with a cord at least 1 m long.

The applicant may submit, together with the first set of test samples, the additional set which may be necessary if one test sample should fail. The testing station will then, without further request, test the additional test samples and will only reject if a further failure occurs. If the additional set of test samples is not submitted at the same time, a failure of one test sample will entail a rejection.

5.3 Routine tests

Routine tests are specified in Annex B.

6 Standard ratings

6.1 The maximum permitted rated voltage is 250 V.

6.2 The maximum permitted rated current is 16 A.

Preferred rated currents for appliance couplers are 0,2 A, 2,5 A, 6 A, 10 A and 16 A.

NOTE For details of standard type ratings refer to IEC 60320-3.

7 Classification of appliance couplers

7.1 According to the maximum pin temperature at the base of the pins of the corresponding appliance inlet or the socket contacts of the corresponding appliance outlet:

- a) appliance couplers for cold conditions, pin temperature not exceeding 70 °C;
- b) appliance couplers for hot conditions, pin temperature not exceeding 120 °C;
- c) appliance couplers for very hot conditions, pin temperature not exceeding 155 °C.

NOTE Appliance couplers for hot conditions can also be used under cold conditions; appliance couplers for very hot conditions can also be used under cold or hot conditions.

7.2 According to the type of equipment to be connected:

- a) appliance couplers for class I equipment;
- b) appliance couplers for class II equipment.

NOTE 1 For a description of the classes, see IEC 61140.

NOTE 2 Appliance couplers for 0,2 A are intended only for the connection of small hand-held class II equipment, if allowed by the relevant standard for the equipment.

7.3 Connectors / plug connectors according to the method of connecting the cord:

- a) rewirable;
- b) non-rewirable.

7.4 According to the ambient temperature:

- a) appliance couplers for ambient temperatures up to and including +35 °C;
- b) appliance couplers for ambient temperatures up to and including +90 °C. This classification also requires a classification according to 7.1 b) or 7.1 c).

8 Marking

8.1 General

Appliance couplers shall be marked with:

- name, trademark or identification mark of the manufacturer or responsible vendor;
- type reference.

NOTE The type reference can be a catalogue number.

8.2 Additional markings

Standardized connectors and plug connectors in accordance with IEC 60320-3 and all non-standardized appliance couplers shall be additionally marked with:

- rated current in amperes, except for 0,2 A connectors;

- rated voltage in volts;
- symbol for nature of supply;
- the marking as specified in IEC 60999-1 to identify the type of conductors suitable for screwless terminals.

8.3 Appliance couplers for class II equipment

Appliance couplers for class II equipment shall not be marked with the symbol for class II construction.

8.4 Symbols or alphanumeric notations

When symbols or alphanumeric notations are used, they shall be as follows:

amperes	A
volts	V
alternating current	AC or ~
protective earth	 [IEC 60417-5019 (2006-08)] or PE
earth	 [IEC 60417-5017 (2006-08)]
neutral terminal	N

For the marking of rated current and rated voltage, figures may be used alone, the figure for rated current being placed before or above that for rated voltage and separated from the latter by a line. The symbol for nature of supply shall be placed next to the marking for rated current and rated voltage.

NOTE 1 Examples for marking of current, voltage and nature of supply:

$$10 \text{ A } 250 \text{ V} \quad \text{or} \quad 10/250 \quad \sim \quad \text{or} \quad \frac{10}{250} \quad \sim \quad \text{or} \quad \left(\frac{10}{250} \right) \sim$$

NOTE 2 Lines formed by the construction of the tool are not considered as part of the marking.

8.5 Legibility of markings

The marking of connectors/plug connectors in accordance with 8.1 shall still be easily discernible when the connector/plug connector is wired and ready for use.

NOTE The term "ready for use" does not imply that the connector is in engagement with an appliance inlet.

8.6 Terminal markings and wiring instructions

In rewirable, non-reversible connectors/plug connectors, terminals shall be indicated as follows:

- earthing terminal: the symbol  or  or PE
- neutral terminal: the letter N

In non-rewirable, polarized connectors/plug connectors, no marking of contacts is necessary, but conductors shall be connected as specified in 22.1.

Appliance inlets/appliance outlets other than those integrated or incorporated in an appliance or equipment for use with connectors/plug connectors according to 8.6 shall have terminal markings to correspond with 8.6.

Rewirable connectors and rewirable plug connectors shall be supplied with the following instructions:

- a) a diagram illustrating the method of connection of the conductors, in particular the excess length of the earthing conductor;
- b) a diagram illustrating the method of the operation of the cord anchorage;
- c) a diagram showing the length of sleeving and insulation to be stripped back;
- d) the sizes and types of the suitable cable or cord.

Connectors/plug connectors supplied directly to an equipment manufacturer do not need these instructions with each unit, but they shall be made available to the equipment manufacturer.

8.7 Durability

The marking required by this document shall be easily legible and durable. The marking shall not be placed on screws, removable washers or other removable parts.

8.8 Test and inspection

Compliance with the requirements of 8.1 to 8.7 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.

After this test and all non-destructive tests of this document, the marking shall remain legible. It shall not be possible to remove labels easily and they shall not show curling.

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

9 Dimensions and compatibility

9.1 General

Appliance couplers shall be designed and constructed so that unintended or improper connection is prevented.

Compliance is checked by inspection and in case of doubt by the tests according to 9.2 to 9.5.

9.2 Single-pole connections

It shall not be possible to make single-pole connections between connectors/appliance outlets and appliance inlets/plug connectors.

Compliance is checked by manual test.

9.3 Compatibility

It shall not be possible to engage:

- connectors for class II equipment in appliance inlets/plug connectors for class I equipment;
- plug connectors for devices of the protection class I in connectors/appliance outlets for devices of the protection class II;
- connectors for cold conditions in appliance inlets for hot or very hot conditions;

- plug connectors for cold conditions in appliance outlets for hot or very hot conditions;
- connectors for hot conditions in appliance inlets for very hot conditions;
- plug connectors for hot conditions in appliance outlets for very hot conditions;
- connectors in appliance inlets/plug connectors having a higher rated current than the connector;
- plug connectors in appliance outlets having a lower rated current than the plug connector.

Engagement of a connector or plug connector is attempted in any unintended configuration using a force of 60 N for a minimum of 60 s.

During the test there shall be no contact of the pins.

Compliance is checked by inspection, by manual test according to 9.4 and by use of all components supplied by the manufacturer.

9.4 Dimensions for standardized appliance couplers

Standardized appliance couplers shall comply with the relevant standard sheets according to IEC 60320-3.

Dimensions are checked by means of gauges or by measurement. In case of doubt, gauges shall be used.

9.5 Dimensions for non-standardized appliance couplers

Non-standardized appliance couplers which do not refer to the dimensions specified in the standard sheets according to IEC 60320-3 are acceptable if they do not adversely affect the purpose and safety of appliance couplers complying with the standard sheets, especially with regard to interchangeability and non-interchangeability.

Small deviations from the dimensions as specified in the standard sheets, which give the impression of a standardized coupler which could lead to it being mistaken for a standardized appliance coupler, are not allowed.

Changes which adversely affect the contact-making ability are not allowed.

It shall not be possible to engage a part of a non-standardized appliance coupler with a complementary part of an appliance coupler complying with the standard sheets in any part of IEC 60320.

It shall not be possible to engage a part of a non-standardized appliance coupler with a complementary part of a standardized appliance coupler for direct current.

NOTE The applicable documents for direct current, i.e., the IEC TS 63236 series, are under development.

It shall not be possible within a given system to make connections other than in the intended position or to make partial connections causing deformation which can impair the further use of the appliance for:

- a connector and associated appliance inlet;
- an appliance outlet with the associated plug connector.

Compliance is checked by manual test.

10 Protection against electric shock

10.1 Accessibility of live parts

Appliance couplers shall be so designed that live parts are not accessible when in partial or complete engagement.

Connectors/appliance outlets shall be so designed that live parts are not accessible when the connectors/appliance outlets are properly assembled and wired as in normal use.

Compliance is checked by inspection and by a test with the standard test probe B of IEC 61032.

The test probe is applied in every possible position, an electrical indicator being used to show contact with the relevant parts. For connectors with enclosures or bodies of elastomeric or thermoplastic material, the standard test finger is applied for a minimum of 30 s with a force of 20 N at all points where yielding of the insulating material could impair the safety of the connector.

NOTE An electrical indicator with a voltage between 24 V and 50 V is used to show contact with the relevant part.

10.2 Protection against single pole connection

It shall not be possible to make connection between a pin of an appliance inlet/plug connector and a contact of a connector/appliance outlet as long as any of the pins are accessible.

Compliance is checked by manual test followed by the test of 10.1.

10.3 Protection against access to live parts

It shall not be possible to remove parts preventing access to live parts without the aid of a tool.

Bushes, if any, in the entry holes for the pins shall be adequately fixed and it shall not be possible to remove them without dismantling the connector/appliance outlet.

Compliance is checked by inspection and by manual test.

10.4 External parts

External parts of connectors, appliance outlets and plug connectors, with the exception of assembly screws and the like, shall be of insulating material.

Compliance is checked by inspection.

10.5 Shrouds

The shroud and the base of appliance inlets without earthing contact and those of 2,5 A appliance inlets / appliance outlets with earthing contact, shall be of insulating material.

Compliance is checked by inspection.

NOTE The suitability of the insulating material is checked during the insulation tests of Clause 15.

11 Provision for earthing

Appliance couplers with protective earthing contact shall be so constructed that the protective earthing contact will make first and break last relative to any other contact.

Compliance is checked by inspection.

12 Terminals and terminations

12.1 General

For terminals and terminations, the requirements in the appropriate IEC International Standard apply.

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

12.2 Rewirable appliance couplers

Rewirable appliance couplers shall be provided with screw-type clamping units or screwless clamping units according to IEC 60999-1.

Compliance is checked by inspection.

12.3 Non-rewirable appliance couplers

Non-rewirable appliance couplers shall be provided with soldered, welded, crimped or equally effective screwless connections, which shall not allow the possibility to disconnect the conductor.

Compliance is checked by inspection.

13 Construction

13.1 Risk of accidental contact

Appliance couplers shall be so designed that there is no risk of accidental contact between the earthing contact of the appliance inlet/plug connector and the current-carrying contacts of the connector/appliance outlet.

13.2 Contact positions

In non-reversible connectors/plug connectors, the contact positions shall be established by looking at the engagement face of the connectors/plug connectors as shown in the standard sheets overview in Clause 4 of IEC 60320-3:2014 and IEC 60320-3:2014/AMD1:2018. Their position shall be as set out in Table 1.

Table 1 – Position of contacts

Type of contact	Position of contacts	
	Non-reversible connectors	Non-reversible plug connectors
Earthing contact	Preferably in a symmetrical arrangement	Preferably in a symmetrical arrangement
Line contact	Lower right-hand position	Lower left-hand position
Neutral contact	Lower left-hand position	Lower right-hand position

In non-reversible appliance couplers that do not comply with the standard sheets shown in Clause 4 of IEC 60320-3:2014 and IEC 60320-3:2014/AMD1:2018, the correct polarization shall be verified.

Compliance is checked by inspection.

NOTE Conformity to the standard sheets ensures compliance with this requirement.

13.3 Parts covering live parts

Parts covering live parts shall be adequately locked against loosening.

Compliance is checked by inspection and by the tests of Clause 18, Clause 20 and Clause 23.

13.4 Pin construction

13.4.1 Prevention of rotation

Pins of appliance inlets/plug connectors and contacts of connectors/appliance outlets shall be locked against rotation.

Compliance is checked by inspection and by manual test.

NOTE Clamping screws can serve to prevent contacts from rotating.

13.4.2 Pin retention

Pins of appliance inlets/plug connectors shall be securely retained and shall have adequate mechanical strength. It shall not be possible to remove them without the aid of a tool and they shall be surrounded by a shroud. The pins shall not protrude beyond the rim of the shroud.

A minimal movement of the pins is allowed.

The security of the pin retention is checked by inspection and, in case of doubt, by the following test.

The test sample is heated to the temperature according to the appropriate temperature class given in 7.1 for 60^{+5}_0 min and is maintained at this temperature for the duration of the test, including the 5 min period after removal of the test load.

The appliance inlet/plug connector is held firmly in such a manner that there will be no undue squeezing or distortion of the body, and the means of holding shall not assist in maintaining the pins in their original position.

Each pin is subjected to a force of $60 \text{ N} \pm 0,6 \text{ N}$, applied without jerks, in a direction along the axis of the pin and maintained at this value for a period of 60^{+3}_0 s.

For all pins the force is applied, first in the direction away from the base of the appliance inlet/plug connector, and then in the direction towards the base of the appliance inlet/plug connector.

The attachment of the pins is deemed to be satisfactory if there is no movement exceeding 2,5 mm during the test on any pin, and provided that within 5 min after removal of the pushing-in test force or within 5 min after the removal of the pulling-out test force, all pins remain within the tolerances of the standard sheets or, for non-standardized appliance couplers, as specified by the manufacturer.

Compliance is checked by inspection and by manual test.

13.4.3 Non-solid pins

Non-solid pins are additionally tested according to the following test after all other tests have been completed.

The shroud is removed from the appliance inlet/plug connector and the pin supported as shown in Figure 2.

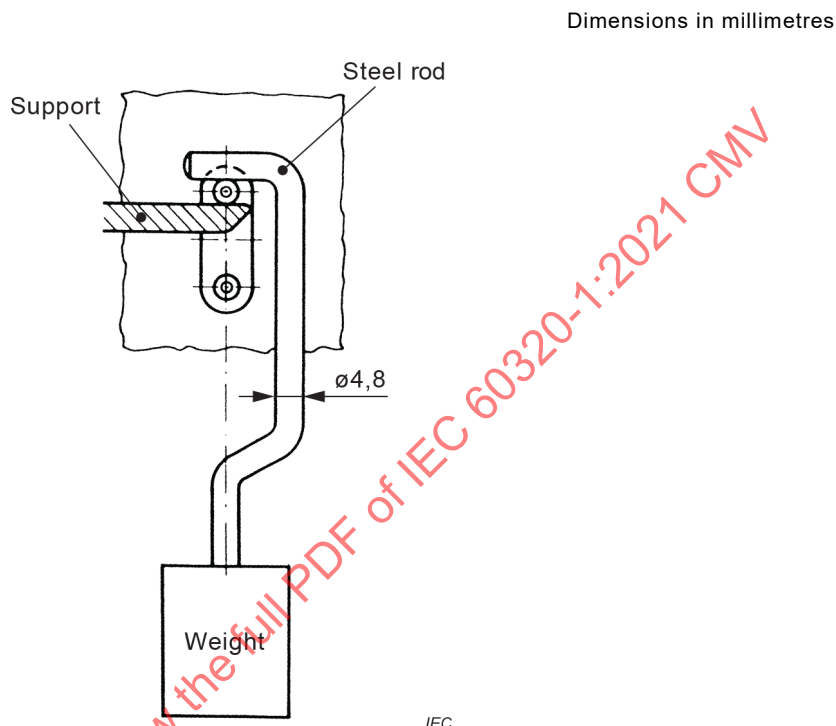


Figure 2 – Device for testing non-solid pins

A force of 100 N is exerted on the pin for 60^{+3}_0 s in a direction perpendicular to the axis of the pin, by means of a steel rod having a diameter of 4,8 mm, the axis of which is also at right angles to the axis of the pin.

After the test, there shall be no significant alteration in the shape of the pin.

13.4.4 Pins for appliance couplers for higher ambient temperatures up to +90 °C

Pins of plug connectors or appliance inlets for higher ambient temperatures shall be of solid material.

13.5 Contact pressure

Contacts of connectors/appliance outlets shall be self-adjusting so as to provide adequate contact pressure.

For connectors/appliance outlets other than 0,2 A connectors, self-adjustment of the contacts shall not depend upon the resiliency of insulating material.

Compliance is checked by inspection and by the tests of Clause 16 to Clause 21 inclusive.

13.6 Enclosure

13.6.1 General

Parts of the body of connectors/plug connectors shall be reliably fixed to one another.

Compliance is checked by inspection, by manual test and by the test of 23.6.

13.6.2 Rewirable connectors and rewirable plug connectors

It shall not be possible to dismantle the connector/plug connector without the aid of a tool.

The enclosure of rewirable connectors/plug connectors shall completely enclose the terminals and the ends of the cord, at least as far as to the point from which the sheath has to be removed.

The construction shall be such that, from the point of separation of the cores, the conductors can be properly connected and that, when the connector/plug connector is assembled and wired as in normal use, there is no risk of

- pressing the cores together in such a way that it causes damage to the core insulation, likely to result in a break-down of the insulation;
- a core, the conductor of which is connected to a live terminal, being likely to be pressed against accessible metal parts;
- a core, the conductor of which is connected to the earthing terminals, being likely to be pressed against live parts.

For rewirable connectors, it shall not be possible to assemble the connector in such a way that the terminals are enclosed and the contacts are accessible.

For rewirable connectors/plug connectors, there shall be separate independent means for fixing and locating the parts of the body with respect to each other, at least one of which, for example a screw, can only be operated with the aid of a tool; thread-cutting screws shall not be used for this purpose.

The resiliency of the contacts shall not depend upon the assembly of the parts of the body.

Partial loosening of assembly screws or the like shall not allow the detachment of parts providing protection against electric shock.

Compliance is checked by inspection and by manual test.

13.6.3 Non-rewirable connectors and non-rewirable plug connectors

Non-rewirable accessories shall be such that:

- the flexible cable or cord cannot be separated from the accessory without making this permanently useless, and
- the accessory cannot be opened by hand or by using a general-purpose tool.

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

Compliance is checked by inspection and by manual test.

13.7 Earth connection

For connectors/plug connectors, the earthing contact/earthing pin shall be fixed to the body. If the earthing contact/earthing pin and the earthing terminal are not in one piece, the various parts shall be fixed together by riveting, welding or in a similar reliable manner.

Metal parts of appliance couplers shall be so designed that corrosion shall not impair safety with regard to electrical and mechanical characteristics.

The connection between the earthing contact/earthing pin and the earthing terminal shall be of metal and resistant to corrosion.

Compliance is checked by inspection.

13.8 Location of terminals and terminations

13.8.1 General

Terminals of rewirable accessories and terminations of non-rewirable accessories shall be so located or shielded that loose wires of a conductor in the accessory will not present a risk of electric shock.

For non-rewirable moulded-on accessories, means shall be provided to prevent loose wires of a conductor from reducing the minimum isolation distance requirements between such wires and all accessible external surfaces of the accessory, with the exception of the engagement face of the inlet.

Compliance is checked by the following:

- for rewirable accessories, the test of 13.8.2;
- for non-rewirable non-moulded-on accessories, the test of 13.8.3;
- for non-rewirable moulded-on accessories, by verification and inspection according to 13.8.4.

13.8.2 Free wire test for rewirable accessories

A length of 6 mm of insulation is removed from the end of a flexible conductor having a cross-sectional area of 0,75 mm². One wire of the flexible conductor is left free and the remaining wires are fully inserted into and clamped in the terminal, as for normal use.

The free wire is bent, without tearing the insulation back, in every possible direction, but without making sharp bends around the barriers.

NOTE The prohibition against making sharp bends around the barriers does not imply that the free wire has to be kept straight during the test. Sharp bends, moreover, are made if it is considered likely that such bends can occur during the normal assembly of the accessory, for example when a cover is pushed on.

The free wire of a conductor connected to a live terminal shall not touch any accessible metal part or be able to emerge from the enclosure when the accessory has been assembled.

The free wire of a conductor connected to an earthing terminal shall not touch a live part.

If necessary, the test is repeated with the free wire in another position.

13.8.3 Free wire test for non-rewirable non-moulded-on accessories

A length of insulation equivalent to the maximum designed stripping length declared by the manufacturer plus 2 mm is removed from the end of a flexible conductor having the cross-sectional area as fitted. One wire of the flexible conductor is left free in the worst

position whilst the remaining wires are terminated in a manner as used in the construction of the accessory.

The free wire is bent, without tearing the insulation back, in every possible direction but without making sharp bends around the barriers.

NOTE The prohibition against making sharp bends around the barriers does not imply that the free wire has to be kept straight during the test. Sharp bends, moreover, can be made if it is considered likely that such bends can occur during the normal assembly of the accessory, for example when a cover is pushed on.

The free wire of a conductor connected to a live termination shall not touch any accessible metal part or reduce the creepage distance and clearance through any constructional gap to the external surface below 1,5 mm.

The free wire of a conductor connected to an earth termination shall not touch any live parts.

13.8.4 Free wire verification for non-rewirable moulded-on accessories

Non-rewirable moulded-on accessories shall be inspected to verify that there are means to prevent stray wires of the conductor and/or live parts reducing the minimum distance through insulation to the external accessible surface (with the exception of the engagement face of inlets) below 1,5 mm.

NOTE The verification of means can require the checking of the product construction or assembly method.

13.9 Connectors/plug connectors without earthing contact

Connectors/plug connectors without earthing contact and 2,5 A connectors/plug connectors with earthing contact shall be part of a cord set or an interconnection cord set.

Compliance is checked by inspection.

13.10 Fuses, relays, thermostats, thermal cut-outs and switches

Fuses, relays, thermostats and thermal cut-outs shall not be incorporated in connectors or in plug connectors complying with the standard sheets of IEC 60320-3.

Fuses, relays, thermostats and thermal cut-outs incorporated in appliance inlets and in appliance outlets shall comply with the relevant IEC International Standards.

Switches incorporated in appliance couplers shall comply with IEC 61058 (all parts).

Energy regulators incorporated in appliance couplers shall comply with IEC 60730-2-11.

Compliance is checked by inspection and by testing the switches, fuses, relays, thermostats, thermal cut-outs and energy regulators according to the relevant IEC International Standard.

14 Moisture resistance

Appliance couplers shall be able to withstand humid conditions which may occur in normal use.

If such appliance couplers are used with equipment which is subject to spillage of liquid in normal use then the protection against moisture shall be provided by the equipment.

Compliance is checked by the humidity treatment described in Clause 14, followed immediately by the tests of Clause 15.

Connectors/plug connectors and appliance inlets/appliance outlets are not in engagement when subjected to the humidity treatment; rewirable connectors/plug connectors are not fitted with a cord.

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

Before being placed in the humidity cabinet, the test samples are brought to a temperature between t °C and $(t + 4)$ °C.

The test samples are kept in the cabinet for

- 168 h (7 days) for appliance couplers with earthing contact which are submitted as individual accessories and not incorporated in other equipment;
- 48 h (2 days) in all other cases.

NOTE 1 In most cases, the test samples can 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.

After this treatment, the test sample shall show no damage within the meaning of this document.

15 Insulation resistance and electric strength

15.1 General

Appliance couplers shall have adequate insulation resistance and dielectric strength.

Compliance is checked by the tests of 15.2 and 15.3 immediately after the humidity treatment according to Clause 14.

Indicators which might otherwise be damaged by the tests of 15.2 and 15.3, such as neon lamps, shall be disconnected at one pole prior to testing.

The insulation resistance is measured considering the following conditions:

- a) for appliance inlets with a connector in engagement, between the current-carrying contacts connected together and the body;
- b) for appliance inlets with a connector in engagement, between each pin in turn and the others connected together;
- c) for appliance outlets with a plug connector in engagement, between the current-carrying contacts connected together and the body;
- d) for appliance outlets without a plug connector in engagement, between the current-carrying contacts connected together and the body;
- e) for appliance outlets with a plug connector in engagement, between each pin in turn and the others connected together;
- f) for connectors, between the current-carrying contacts connected together and the body;
- g) for connectors, between each contact in turn and the others connected together;
- h) for plug connectors, between the current-carrying contacts connected together and the body;
- i) for plug connectors, between each contact in turn and the others connected together.

Additional test for rewirable connectors and rewirable plug connectors:

- j) for rewirable connectors, between any metal part of the cord anchorage, including clamping screws, and the earthing contact or earthing terminal;
- k) for rewirable connectors, between any metal part of the cord anchorage, excluding clamping screws, and a metal rod, of the maximum diameter of the cord as specified in Table 2, inserted in its place;
- l) for rewirable plug connectors, between any metal part of the cord anchorage, including clamping screws, and the earthing contact or earthing terminal;
- m) for rewirable plug connectors, between any metal part of the cord anchorage, excluding clamping screws, and a metal rod, of the maximum diameter of the cord as specified in Table 2, inserted in its place.

The term "body" used in items a), c), d), f) and h) above includes all accessible metal parts, fixing screws, external assembly screws and the like and a metal foil in contact with the outer surface of external parts of insulating material. In items d), f) and h), the term "body" includes the engagement face of connectors or appliance outlets but excludes the engagement face of plug connectors.

The metal foil is wrapped round the outer surface of external parts of insulating material; however, it is not pressed into openings.

Table 2 – Maximum diameters of the cords

Type of cord	Number of conductors and nominal cross- sectional area	Maximum diameter
	mm ²	mm
60227 IEC 53	3 × 0,75	7,6
	3 × 1	8,0
	3 × 1,5	9,4
60245 IEC 53	3 × 0,75	8,1
	3 × 1	8,5
	3 × 1,5	10,4

The test voltage according to 15.2 and 15.3 is applied in the case of:

- functional insulation: between the different poles of the appliance coupler;
- basic insulation: between all live parts connected together and a metal foil covering the outer surface of the basic insulation and/or exposed conductive parts;
- supplementary insulation: between two metal foils covering separately the inner, normally inaccessible surface, of the supplementary insulation and its accessible surface;
- reinforced insulation: between all live parts connected together and a metal foil covering the accessible surface of the reinforced insulation.

The clearances and creepage distances shall be maintained when preparing the sample for this test.

In cases where basic insulation and supplementary insulation cannot be tested separately, the insulation provided is subjected to the test voltages specified for reinforced insulation.

15.2 Insulation resistance

The insulation resistance of the sample is measured with an applied DC voltage of 500^{+50}_0 V, the measurement being made $60\text{ s} \pm 5\text{ s}$ after application of the voltage. The insulation resistance shall not be less than that specified in Table 3.

Table 3 – Minimum insulation resistance

Insulation to be tested	Insulation resistance
	MΩ
Functional	2
Basic	2
Supplementary	5
Reinforced	7

NOTE Materials such as glazed ceramic or porcelain are considered to have insulation resistance and are not subjected to the insulation resistance tests.

15.3 Dielectric strength

The test sample is subjected to a voltage of substantially sine wave form, having a nominal frequency of 50 Hz or 60 Hz. The voltage is applied for $60\text{ s} \pm 5\text{ s}$ across the insulation as specified in Table 4.

Initially, not more than half the specified voltage is applied, and then it is raised rapidly to the full value. No flashover or breakdown shall occur. Glow discharges without drop in voltage are neglected.

Table 4 – Dielectric strength

Insulation or disconnection to be tested ^b	Test voltage (RMS) ^a		
	Rated voltage up to and including 50 V V	Rated voltage above 50 V up to and including 130 V V	Rated voltage above 130 V up to and including 250 V V
Functional insulation ^c	500	1 300	1 500
Basic insulation ^d	500	1 300	1 500
Supplementary insulation ^d	500	1 300	1 500
Reinforced insulation ^{d,e}	500	2 600	3 000
NOTE 1 Up to and including 50 V: Not intended to be connected directly to the mains and not expected to be subjected to temporary overvoltages as defined in IEC 60364-4-44. NOTE 2 Over 50 V: The values are based on IEC 60364-4-44. For functional, basic and supplementary insulation, the values are calculated with the formula: $U_0 + 1\,200\text{ V}$ and rounded. In this document, the maximum voltage considered between line and earth is $U_0 = 300\text{ V}$. ^a The high-voltage transformer used for the test shall be designed so that, when the output terminals are short-circuited after the output voltage has been adjusted to the test voltage, the output current is at least 200 mA. The overcurrent relay shall not trip when the output current is less than 100 mA. Care is taken that the RMS values of the test voltage are measured within $\pm 3\%$. ^b Special components which might render the test impractical such as discharge lamps, coils, windings, or capacitors are disconnected at one pole, or bridged, as appropriate to the insulation being tested. ^c An example is the insulation between poles. ^d For the test, all live parts are connected together and care is taken to ensure that all moving parts are in the most onerous position. ^e For appliance couplers incorporating reinforced insulation as well as double insulation, care is taken that the voltage applied to the reinforced insulation does not overstress the basic or the supplementary parts of the double insulation.			

16 Forces necessary to insert and to withdraw the connector/appliance outlet

16.1 General

The construction of appliance couplers shall allow the easy insertion and withdrawal of the connector/appliance outlet and prevent the connector/appliance outlet from working itself out of the appliance inlet/plug connector in normal use.

Compliance is checked for connectors/appliance outlets by the following tests:

- in accordance with the test of 16.2 to ascertain that the maximum force necessary to withdraw the connector/appliance outlet from the appliance inlet/plug connector is not higher than the maximum force specified in Table 5. For test purposes the relevant counterpart of the connector/appliance outlet shall be used (multi-pin gauge);
- in accordance with the test of 16.3 to ascertain that the minimum force necessary to withdraw a single pin from the individual contact assembly is not lower than the minimum force specified in Table 5.

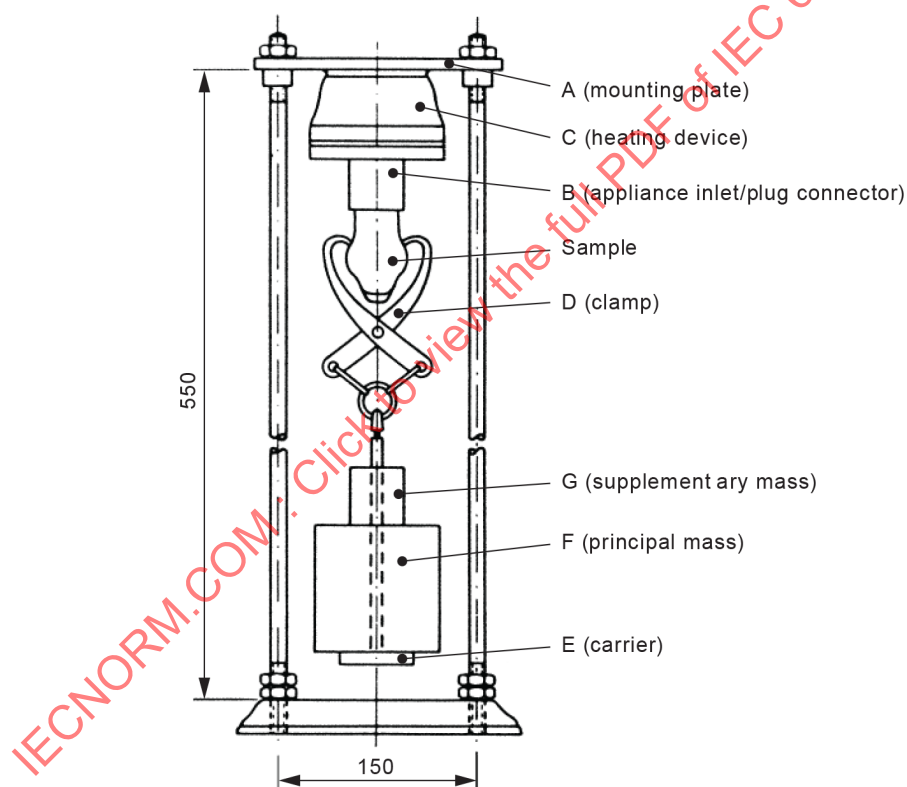
Table 5 – Maximum and minimum withdrawal forces

Type of connector/ appliance outlet	Withdrawal forces N	
	16.2 Multi-pin gauge maximum	16.3 Single-pin minimum
0,2 A, 2,5 A, 6 A and 10 A	50	1,5
16 A	60	2

Accessories with retaining devices are tested with the retaining device inoperative.

16.2 Verification of the maximum withdrawal force

The appliance inlet/plug connector is fixed to the mounting plate A of an apparatus as shown in Figure 3, so that the axes of the appliance inlet/plug connector pins are vertical and the free ends of the pins are downwards. The total mass consists of the principal mass, the supplementary mass, the clamp and the carrier.



IEC

Figure 3 – Apparatus for checking the withdrawal force

The pins are wiped free from grease before each test using a cold chemical degreaser.

NOTE 1 When using the liquid specified for the test, adequate precautions can be taken to prevent inhalation of vapour.

The connector/appliance outlet is inserted to the full depth into, and withdrawn from, the appropriate appliance inlet/plug connector 10 times. It is then again inserted, a carrier E for a principal mass F and a supplementary mass G being attached to it by means of a suitable clamp D. The supplementary mass is such that it exerts a force equal to one tenth of the maximum withdrawal force specified in Table 5 and it shall be made in one piece.

The principal mass is hung on the connector/appliance outlet without jolting and the supplementary mass is allowed to fall once from a height of 50 mm $\pm$ 1 mm on to the principal mass. The connector/appliance outlet shall disengage within 3 s from the appliance inlet/plug connector.

For standardized appliance couplers:

The appliance inlet/plug connector has finely ground pins of hardened steel, having a surface roughness not exceeding 0,8 μ m over their active length and spaced at the nominal distance with a tolerance of $^{+0,02}_0$ mm.

The pin dimensions have the maximum values, with a tolerance of $^{0}_{-0,01}$ mm, except that the pin length need only comply with the tolerance of the standard sheet, and the inner dimensions of the shroud have the minimum values, with a tolerance of $^{+0,1}_0$ mm, specified in the relevant standard sheet.

NOTE 2 The maximum value is the nominal plus the maximum tolerance. The minimum value is the nominal minus the maximum tolerance.

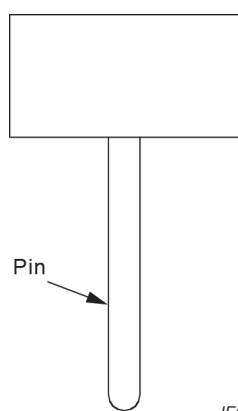
For non-standardized appliance couplers:

The counterpart as specified by the manufacturer shall be used.

16.3 Verification of the minimum withdrawal force

The test pin gauge, as illustrated in Figure 4, is applied to each individual connector/appliance outlet contact with the contact axes vertical and the gauge hanging vertically downwards.

Dimensions according to the relevant standard sheet



The mass is to be equally positioned around the centre line(s) of the pin.

Figure 4 – Gauge for verification of the minimum withdrawal force

The total mass of the test equipment shall be such as to exert the applicable force as shown in Table 5.

The pin is wiped free from grease before each test using a cold chemical degreaser.

The test pin gauge is then inserted into the contact assembly. The test equipment is applied gently, and care is taken not to knock the assembly when checking the minimum withdrawal force.

The test equipment shall not fall from the contact assembly within 3 s.

For standardized appliance couplers:

The test pin gauge is made of hardened steel, having a surface roughness not exceeding 0,8 µm over its active length.

The pin portion of the gauge shall have dimensions equal to the minimum shown in the appropriate appliance inlet/plug connector standard sheet, with a tolerance of $^{+0,01}_0$ mm, except that the pin length need only comply with the tolerance of the standard sheet.

For non-standardized appliance couplers:

The test pin is a single pin with minimum dimensions as specified by the manufacturer.

17 Operation of contacts

Contacts and pins of appliance couplers shall make connection with a sliding action. The contacts of connectors/appliance outlets shall provide adequate contact pressure and shall not deteriorate in normal use.

The effectiveness of the pressure between contacts and pins and earthing contacts and earthing pins shall not depend upon the resiliency of the insulating material on which they are mounted.

Compliance with the requirements is checked by inspection and by taking into consideration the requirements of Clause 16, Clause 19, Clause 20 and Clause 21.

18 Resistance to heating of appliance couplers for hot conditions or very hot conditions

18.1 General

Appliance couplers as classified according to 7.1 shall withstand the heating to which they may be subjected by an appliance or other equipment.

Connectors/plug connectors shall be so constructed that the insulation of the conductors is not subjected to excessive heating.

Additionally, the spring contacts of appliance outlets and connectors shall not be negatively affected by thermal relaxation due to excessive heating.

Compliance is checked for connectors/plug connectors, by the test of 18.2, and, for appliance inlets/appliance outlets, by the test of 18.3.

18.2 Heating test for connectors/plug connectors

Rewirable connectors/plug connectors are fitted with a cord according to Table 9, having the minimum allowed cross-sectional area. Non-rewirable connectors/plug connectors are tested with the cord as delivered.

The connector/plug connector is inserted in a suitable appliance inlet/appliance outlet of an appropriate test apparatus, an example of which is given in Figure 5, where it remains for 96 h (four days). Throughout this period, the temperature at the base of the pins or contacts is maintained at:

- $120\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for connectors/plug connectors for hot conditions classified in 7.1 b);
- $155\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for connectors/plug connectors for very hot conditions classified in 7.1 c).

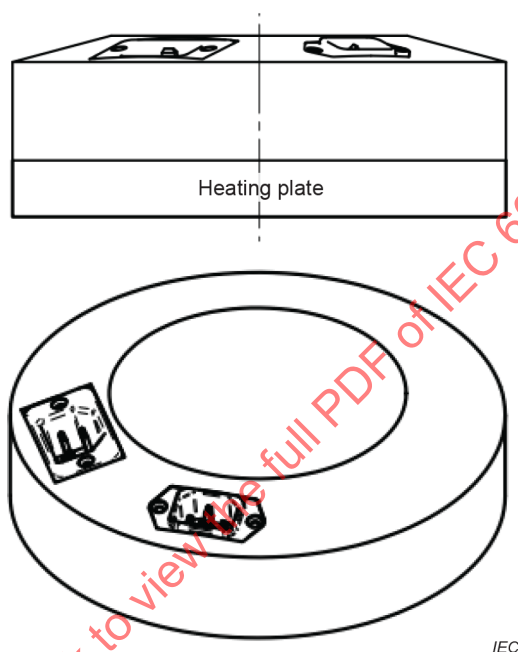


Figure 5 – Example of an apparatus for heating test (see 18.2)

Also a heating cabinet can be used to heat the base of the pins or contacts.

The appliance inlet/appliance outlet is flush mounted and has a shroud of insulating material.

The appliance inlets/appliance outlets are of a type corresponding to the connector/plug connector to be tested and have pins or contacts made of copper alloy.

After removal from the test apparatus, the connectors/plug connectors are then allowed to cool down to approximately ambient air temperature.

Plug connectors are then inserted into and withdrawn from the appliance outlet 10 times. Connectors are subjected to the test of Clause 16.

The test samples shall show:

- no damage affecting the protection against electric shock;
- no loosening of electrical or mechanical connections;
- no cracks, swelling, shrinkage or the like.

18.3 Heating test for appliance inlets/appliance outlets

Appliance inlets/appliance outlets for hot conditions and those for very hot conditions, other than those integrated in an appliance or equipment, are kept in a heating cabinet for 96 h at a temperature of:

- $120\text{ °C} \pm 2\text{ °C}$ for appliance inlets/appliance outlets for hot conditions classified in 7.1 b);
- $155\text{ °C} \pm 2\text{ °C}$ for appliance inlets/appliance outlets for very hot conditions classified in 7.1 c).

After removal from the heating cabinet, appliance inlets/appliance outlets are then allowed to cool down to approximately ambient air temperature.

Appliance outlets are then subjected to the test of Clause 16.

The test samples shall show:

- no damage affecting the protection against electric shock;
- no loosening of electrical or mechanical connections;
- no cracks, swelling, shrinkage or the like.

19 Breaking capacity

Appliance couplers shall have adequate breaking capacity.

Compliance is checked, for connectors/appliance outlets, by the following test.

The connector or appliance outlet is mounted in an appropriate test apparatus, which incorporates the corresponding appliance inlet or plug connector.

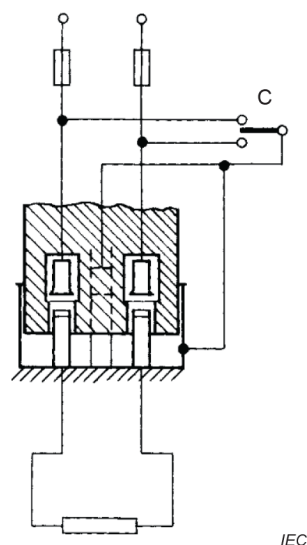
For standardized types, the appliance inlet or plug connector shall have polished, hardened steel pins, and dimensions as specified in the relevant standard sheet. The ends of the pins shall be rounded for rectangular pins and they shall be hemispherical for round pins as shown in the standard sheets.

For non-standardized types, the counterpart as specified by the manufacturer shall be used.

Connectors and appliance outlets for up to 0,2 A are not tested.

The appliance inlet/plug connector is positioned so that the plane through the axes of the pins is horizontal and the earthing pin, if any, is uppermost.

The test apparatus shall be designed and adjusted so as to simulate as far as possible disconnection in normal use (see Figure 6 for circuit diagram).

**Key**

C selector switch

Figure 6 – Circuit diagram for breaking capacity and normal operation tests

For testing 10 A and 16 A connectors with earthing contact, the shroud of the appliance inlet shall be of metal. For testing other connectors and appliance outlets the shroud shall be of insulating material.

Ratings for the tests are taken from Table 6.

Table 6 – Ratings for the tests of Clause 19

Rated current A	Test voltage V	Test current A	Power factor (cos Φ)	Number of strokes
> 0,2 to < 10	1,1 × rated voltage	1,25 × rated current	0,6 ± 0,05	100
≥ 10	1,1 × rated voltage	1,25 × rated current	0,95 ± 0,05	100

Strokes are applied at a rate of 28 to 30 per minute with continuous movement.

Current flow period: $1,5 \pm 0,5$ s.

A stroke is an engagement or a disengagement of the sample under test into the counterpart.

The test sample is fully inserted into and withdrawn from its counterpart during each cycle.

No current is passed through the earthing circuit, if any.

The selector switch C, connecting the earthing circuit and accessible metal parts to one of the poles of the supply, is operated after half the number of strokes.

During the test, there shall be no flashover between live parts of different polarity or between live parts and parts of the earthing circuit, if any, nor shall there be any sustained arcing.

After the test, the test sample shall show no damage impairing its further use.

20 Normal operation

Appliance couplers shall withstand, without excessive wear or other harmful effects, the mechanical, electrical and thermal stresses occurring in normal use.

Compliance is checked by testing the connectors/appliance outlets in the apparatus described in Clause 19.

Appliance inlets and plug connectors are not tested.

Ratings for the tests are taken from Table 7.

The selector switch C, connecting the earthing circuit and accessible metal parts to one of the poles of the supply, is operated after half the number of strokes at rated current.

Table 7 – Ratings for the tests of Clause 20

Rated current A	Test voltage V	Test current A	Power factor (cos ϕ)	Minimum number of strokes
$\leq 0,2$	–	no current	–	4 000
> 0,2 to < 10	rated voltage	rated current	$0,6 \pm 0,05$	2 000
	–	no current	–	6 000
≥ 10	rated voltage	rated current	$0,95 \pm 0,05$	2 000
	–	no current	–	6 000

Strokes are applied 28 to 30 per minute with continuous movement.

Current flow period: $1,5^{+0,5}_0$ s.

A stroke is an engagement or a disengagement of the sample under test into the counterpart.

The test sample is fully inserted into and withdrawn from its counterpart during each cycle.

After the test, the test samples shall withstand an electric strength test as specified in 15.3. The test voltage is reduced to 50 % of the value of Table 4 without humidity treatment.

The test sample shall not show any:

- wear impairing its further use;
- deterioration of enclosures or barriers;
- damage to the entry holes for the pins that might impair proper working;
- loosening of electrical or mechanical connections;
- seepage of sealing compound.

The electrical safety shall not be impaired.

21 Temperature rise

Contacts and other current-carrying parts shall be so designed as to prevent excessive temperature rise due to the passage of current.

Compliance is checked, for connectors/appliance outlets and plug connectors, by the following test.

Rewirable connectors/plug connectors are fitted with cords according to Table 9 having a length of 1 m and a cross sectional area according to Table 8.

Appliance outlets are fitted with insulated conductors according to Table 8.

The terminal screws, if any, are tightened with two-thirds of the torque specified in the appropriate column of Table 13.

Table 8 – Cords and conductors for the tests of Clause 21

Type of coupler	Rated current A	Conductor mm ²	Test current A
Connectors	≤ 0,2	–	not tested
Non-rewirable connectors/plug connectors	> 0,2 to ≤ 16	with cord as delivered	1,25 × rated current
Rewirable connectors / plug connectors	≤ 10	1,0	1,25 × rated current
	> 10	1,5	
Appliance outlets	> 0,2 to ≤ 6	0,75	1,25 × rated current
	> 6 to ≤ 10	1,0	
	> 10	1,5	

The connector is inserted into an appliance inlet having brass pins with the minimum dimensions specified in the relevant standard sheet, a tolerance of +0,02 mm being allowed, the distance between pin centres having the value specified in the standard sheet.

Appliance outlets are connected to a plug connector.

Plug connectors are inserted into an appliance outlet.

For non-standardized appliance couplers, the counterpart specified by the manufacturer is used.

An alternating current of 1,25 times the rated current is passed through the current-carrying contacts for 1 h.

For connectors/appliance outlets and plug connectors with earthing contact, the current is then passed through one current-carrying contact and the earthing contact for 1 h.

The temperature rise of terminals and contacts shall not exceed 45 K.

After this test, the test samples shall withstand the test of Clause 16.

22 Cords and their connection

22.1 Cords for non-rewirable connectors/plug connectors

Non-rewirable connectors/plug connectors shall be provided with a type of cord complying with the International Standard indicated in Table 9 for the type of connector/plug connector and, in addition, the cord shall have a cross-sectional area not less than that specified in Table 9.

Table 9 – Type and nominal cross-sectional area of cords

Type of connector/plug connector	Type of cord ^a	Nominal cross-sectional area mm ²
0,2 A	60227 IEC 41 ^b	–
2,5 A for class I equipment	60227 IEC 52	0,75
2,5 A for class II equipment	60227 IEC 52	0,75 ^c
6 A	60227 IEC 52	0,75
10 A for cold conditions	60227 IEC 53 or 60245 IEC 53	0,75 ^d
10 A for hot conditions	60245 IEC 53 60245 IEC 89	0,75 ^d
10 A for very hot conditions	60245 IEC 53 60245 IEC 89	0,75 ^d
16 A for cold conditions	60227 IEC 53 or 60245 IEC 53	1,0 ^d
16 A for very hot conditions	60245 IEC 53 60245 IEC 89	1,0 ^d

NOTE For a cross-sectional area using American Wire Gauge (AWG), see Annex D.

^a Other cable or cord with equivalent properties may also be used.

^b In length not exceeding 2 m.

^c If the cord has a length not exceeding 2 m, a nominal cross-sectional area of 0,5 mm² is allowed.

^d If the cord has a length exceeding 2 m, nominal cross-sectional areas shall be minimum:

- 1,0 mm² for 10 A connectors;
- 1,5 mm² for 16 A connectors.

Non-rewirable connectors/plug connectors with earthing contact shall be provided with a three-core cord.

In non-rewirable, non-reversible connectors/plug connectors the cores of the cord shall be connected to the contacts in the following manner:

- green/yellow core to the earthing contact;
- brown core to the line contact;
- light blue core to the neutral contact.

Compliance is checked by inspection and by measurement.

22.2 Cord anchorage

22.2.1 General

Connectors/plug connectors shall be provided with a cord anchorage such that the conductors are relieved from strain, including twisting, where they are connected to the terminals or terminations, and that their outer covering is protected from abrasion.

Cord anchorages of the "labyrinth" type are allowed, provided they withstand the relevant tests.

22.2.2 Additional requirements for rewirable connectors and rewirable plug connectors

Additional requirements for rewirable connectors/plug connectors are:

- it shall be clear how the relief from strain and the prevention of twisting is intended to be effected;
- the cord anchorage, or at least a part of it, shall be integral with or fixed to one of the other component parts of the connector/plug connector;
- makeshift methods, such as tying the cord into a knot or tying the ends with string, shall not be used;
- cord anchorages shall be suitable for the different types of cord which may be connected, and their effectiveness shall not depend upon the assembly of the parts of the body;
- cord anchorages shall be of insulating material or be provided with an insulating lining fixed to the metal parts;
- it shall not be possible for the cord to touch the clamping screws of the cord anchorage if these screws are accessible with the test probe B of IEC 61032 (standard test finger) or are electrically connected to accessible metal parts;
- metal parts of the cord anchorage, including its screws, shall be insulated from the earthing circuit.

22.2.3 Pull test for cable anchorage

Compliance with the requirements of 22.2.1 and 22.2.2 is checked by inspection and by a pull test in an apparatus similar to that shown in Figure 7, followed by a torque test.

Dimensions in millimetres

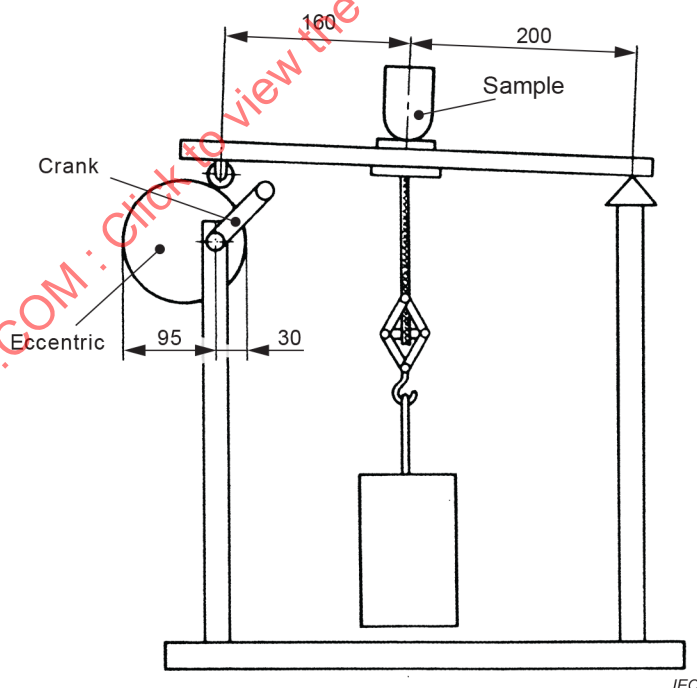


Figure 7 – Apparatus for testing the cord anchorage

Non-rewirable connectors/plug connectors are tested with the cord as delivered; rewirable connectors/plug connectors are tested first with one and then with the other type of cord, as specified in Table 10.

Table 10 – Types of cord for the rewirable connector/plug connector test

Type of connector/plug connector	Type of cord ^a	Cross-sectional area mm ²	
		Pull test according to 22.2.3	Flexing test according to 22.3
10 A for cold conditions	60227 IEC 53 60227 IEC 53	0,75 1,0	1,0
10 A for hot conditions	60245 IEC 53 60245 IEC 53	0,75 1,0	1,0
10 A for very hot conditions	60245 IEC 53 60245 IEC 53	0,75 1,0	1,0
16 A for cold conditions	60227 IEC 53 60227 IEC 53	1,0 1,5	1,5
16 A for very hot conditions	60245 IEC 53 60245 IEC 53	1,0 1,5	1,5
^a Other cable or cord with equivalent properties may also be used.			

Conductors of the cord of rewirable connectors/plug connectors are introduced into the clamping units, and the screws of clamping units, if any, are tightened just sufficiently to prevent the conductors from easily changing their position.

The cord anchorage is used in the normal way, clamping screws being tightened with a torque equal to two-thirds of the torque specified in the appropriate column of Table 13. After assembly of the test sample, the component parts shall fit snugly and it shall not be possible to push the cord into the connector/plug connector to any appreciable extent.

The test sample is fixed in the test apparatus so that the axis of the cord is vertical where it enters the connector/plug connector.

The cord is then subjected 100 times to a pull of 50 N for connectors/plug connectors having a rated current not exceeding 2,5 A and 60 N for other connectors/plug connectors. The pulls are applied without jerks, each time for $1^{+0,5}_0$ s.

Connectors/plug connectors provided with flat twin tinsel cords are not subjected to the torque test.

Immediately afterwards, the cord is subjected for 60^{+5}_0 s to a torque of:

- 0,1 N·m for cords, other than flat twin tinsel cords, having a nominal cross-sectional area not exceeding 0,5 mm²;
- 0,15 N·m for two-core cords having a nominal cross-sectional area of 0,75 mm²;
- 0,25 N·m in all other cases.

During the tests, the cord shall not be damaged.

After the tests, the cord shall not have been displaced by more than 2 mm. For rewirable connectors/plug connectors, the ends of the conductors shall not have moved noticeably in the terminals; for non-rewirable connectors/plug connectors, there shall be no break in the electrical connections.

For the measurement of the longitudinal displacement, a mark is made on the cord before starting the test while subjecting it to a preliminary pull of the value specified; the mark is made at a distance of approximately 2 cm from the end of the connector/plug connector or the cord guard. If, for non-rewirable connectors/plug connectors, there is no definite end to the connector/plug connector or the cord guard, an additional mark is made on the body, from which the distance to the other mark is measured.

After the tests, the displacement of the mark on the cord in relation to the connector/plug connector or the cord guard is measured while the cord is subjected to a pull of the value specified.

22.3 Flexing test

Connectors/plug connectors shall be so designed that the cord cannot be subjected to excessive bending where it enters the connector/plug connector.

Guards provided for this purpose shall be of insulating material and shall be fixed in a reliable manner.

Helical metal springs, whether bare or covered with insulating material, are not allowed as cord guards.

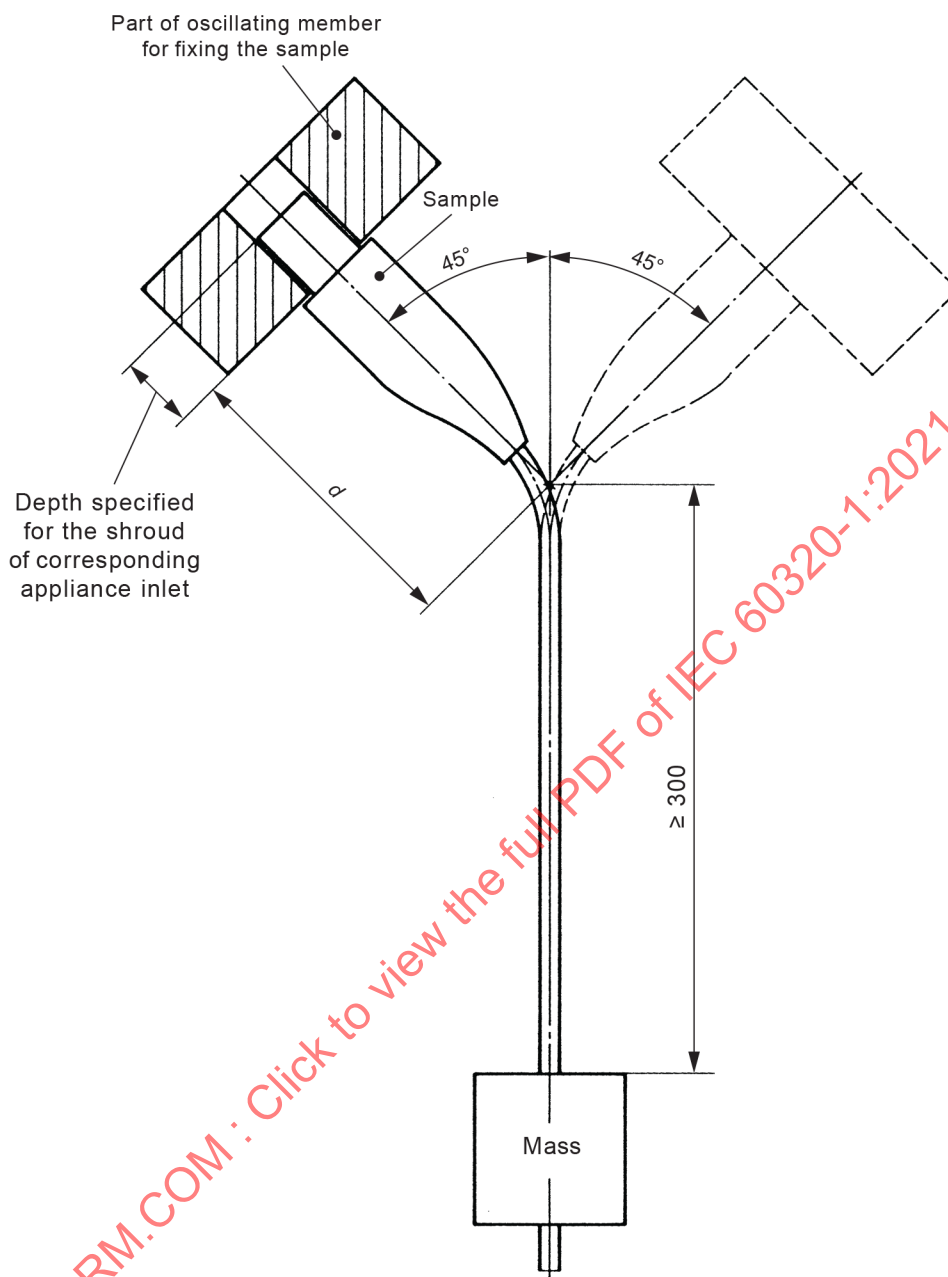
Compliance is checked by inspection and the following test:

For rewirable connectors/plug connectors, before this test is started, the guards are subjected to an accelerated ageing test as specified in:

- 24.2.2, if of elastomeric material;
- 24.2.3, if of thermoplastic material.

Connectors/plug connectors are subjected to a test in an apparatus having an oscillating member similar to that shown in Figure 8.

Dimensions in millimetres



IEC

Figure 8 – Apparatus for the flexing test

Rewirable connectors/plug connectors are fitted with a cord as specified in Table 10, having an appropriate length and strands of the largest diameter allowed for that type of flexible cord. The cord guard, if any, is put in place.

Non-rewirable connectors/plug connectors are tested with the cord as delivered.

The test sample is fixed to the oscillating member of the apparatus so that, when this is at the middle of its travel, the axis of the cord, where it enters the connector/plug connector, is vertical and passes through the axis of oscillation.

The part of the connector/plug connector which, in normal use, is inside the appliance inlet/appliance outlet, is fixed in the test apparatus.

The oscillating member is, by variation of distance d shown in Figure 8, so positioned that the cord makes the minimum lateral movement when the oscillating member of the test apparatus is moved over its full travel.

Test samples with flat cords are mounted so that the major axis of the section is parallel to the axis of oscillation.

The cord is loaded so that the force applied is:

- 20 N for rewirable connectors/plug connectors, and for non-rewirable connectors/plug connectors with cords having a nominal cross-sectional area exceeding 0,75 mm²;
- 10 N for other non-rewirable connectors/plug connectors.

A current equal to the rated current of the connectors/plug connectors is passed through the conductors, the voltage between them being equal to the rated voltage. No current is passed through the earthing conductor, if any.

The oscillating member is moved backwards and forwards through an angle of $90^\circ \pm 3^\circ$ ($45^\circ \pm 3^\circ$ on either side of the vertical), the number of flexings being 10 000 and the rate of flexing being 60 ± 3 per minute.

Test samples with circular-section cords are turned through 90° in the oscillating member after half the required number of flexings; test samples with flat cords are only bent in a direction perpendicular to the plane containing the axes of the cores.

During the test there shall be no interruption of the test current, and no short-circuit between conductors.

After the test, the test sample shall show no damage within the meaning of this document; the guard, if any, shall not have separated from the body and the insulation of the cord shall show no sign of abrasion or wear. Moreover, for non-rewirable connectors/plug connectors, broken strands of the conductors shall not have pierced the insulation so as to become accessible.

NOTE 1 A flexing is one movement, either backwards or forwards.

NOTE 2 The test is carried out on test samples not subjected to any other test.

NOTE 3 A short-circuit between the conductors of the cord is considered to occur if the current attains a value equal to twice the rated current of the connector.

23 Mechanical strength

23.1 General

Appliance couplers shall have adequate mechanical strength.

Compliance is checked in accordance with the subclauses shown in Table 11.

Table 11 – Applicable tests

Test	Appliance outlet	Plug connector	Connector	Appliance inlet
23.2 Free fall test		X	X	
23.3 Lateral pull test for contacts	X		X ^d	
23.4 Impact test	X	X		X ^a
23.5 Deformation test			X ^b	
23.6 Pull tests for connectors/plug connectors with a separate front part		X ^c	X ^{c, d}	
^a For appliance inlets designed for surface-mounting. ^b For connectors according to standard sheet C7 as per IEC 60320-3. ^c For connectors/plug connectors with a separate front part. ^d Connectors with a rating of up to and including 0,2 A are not tested.				

23.2 Free fall test

Rewirable connectors/plug connectors are fitted with the cord, specified in 22.3, having the smallest cross-sectional area 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 the torque specified in the appropriate column of Table 14.

Non-rewirable connectors/plug connectors are tested with the cord as delivered, the cord being cut so that a free length of approximately 100 mm projects from the outer end of the guard.

The test samples shall be subjected one at a time to the free fall test procedure 2 according to IEC 60068-2-31, the number of falls being:

- 500 if the mass of the test sample without cord or cord guard does not exceed 200 g, and
- 100 in all other cases.

After the test, the test samples shall show no damage and no part shall have become detached or loosened which may influence the electrical safety.

Small pieces can be broken off without causing rejection, provided that protection against electric shock is not affected.

Damage to finish and small dents which do not reduce the creepage distances or clearances below the values specified in Clause 26 are neglected.

The approximate 100 mm length can be reduced in order to ensure free fall.

23.3 Lateral pull test for contacts

The purpose of this test is to verify that the contacts of connectors and appliance outlets have sufficient mechanical strength.

For testing connectors, a corresponding appliance inlet is mounted in an appropriate test apparatus with the pins pointing upwards and the connector being inserted.

For testing appliance outlets, they are mounted in the appropriate test apparatus with the contacts pointing upwards and a corresponding plug connector being inserted.

An example of the test apparatus is shown in Figure 9 a).

Dimensions in millimetres

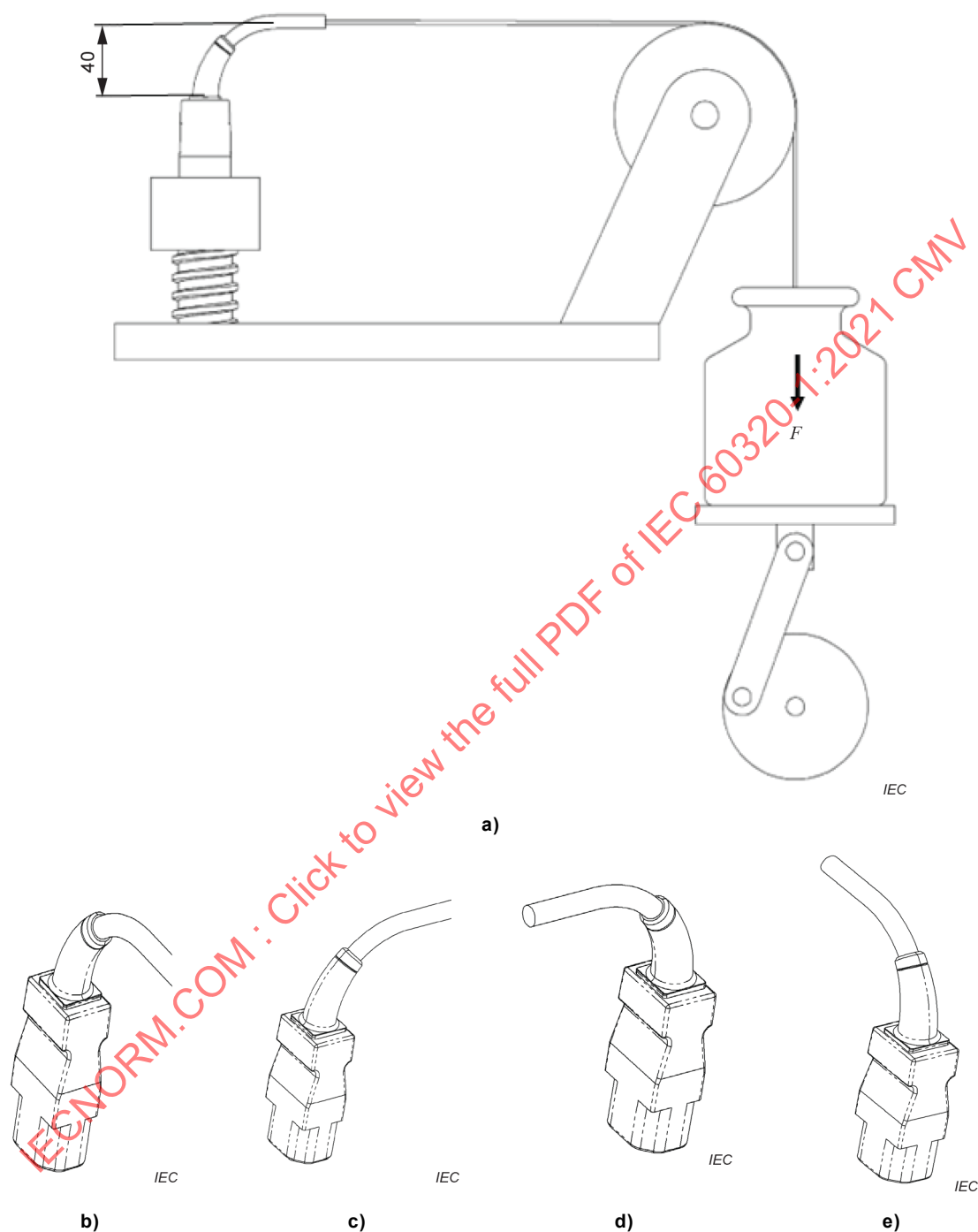


Figure 9 – Example of apparatus for pulling test

A lateral pull force, in parallel with the engagement face, is applied to the cable of the connector/plug connector in four directions in steps of $90^\circ \pm 5^\circ$, as shown in Figure 9 a), b), c), d) and e).

NOTE For angled connectors/plug connectors, the force is not applied in the opposite direction of the cord entry.

A pull force according to Table 12 is applied 50 times in each direction to the cord for $1 \text{ s} \pm 0,5 \text{ s}$.

Table 12 – Values for the lateral pulls applied

Rated current A	Pull force N ($\pm 5\%$)
2,5	6
6	35
10	35
16	50

If necessary, the connector/plug connector is prevented from coming out of the appliance inlet/appliance outlet but shall be free to move inside the appliance inlet/appliance outlet.

After the test, the connector/appliance outlet shall show no damage and the test samples shall comply with 16.3.

23.4 Impact test

The following parts of appliance couplers, of a material other than elastomeric material, are subjected to an impact test by means of a vertical hammer or spring hammer according to IEC 60068-2-75:

- all accessible surfaces covering live parts of appliance outlets;
- shrouds of appliance inlets for surface mounting;
- shrouds of plug connectors.

The hammer head has a hemispherical face with a radius of 10 mm.

The impact energy is $0,5\text{ J} \pm 0,05\text{ J}$.

The hammer head has a hemispherical face of polyamide having a Rockwell hardness of HR 85 to 100.

The test sample is rigidly supported and 12 impacts are applied, three to each of four places chosen so as to include the weakest areas.

After the test, the test sample shall show no damage within the meaning of this document.

23.5 Deformation test

For 2,5 A connectors for class II equipment according to standard sheet C7 of IEC 60320-3, the area where the switch cam(s) can touch the connector shall be sufficiently resistant to deformation.

NOTE This area is indicated by "3)" on standard sheet C7.

Compliance is checked by the following test, which is made by means of an apparatus having a rectangular blade as shown in IEC 60320-3:2014, Figure 9. The test is made with blade A and with blade B successively, which are pressed against the connector body in the area to be checked, with the force as specified in IEC 60320-3:2014, Figure 9.

The apparatus with the test sample in position is kept in a heating cabinet at a temperature of $70\text{ °C} \pm 2\text{ °C}$ for 2 h.

The test sample is then removed from the apparatus and cooled down within 10 s to approximately room temperature by immersion in cold water.

The thickness of the connector body is measured immediately at the point of impression. The difference between the thickness values before and after the test shall be not more than 0,2 mm.

23.6 Pull tests for connectors/plug connectors with a separate front part

23.6.1 General

The external parts of connectors/plug connectors with a separate front part enclosing the contacts shall be reliably fixed to one another.

Compliance is checked for all connectors and plug connectors by the following tests.

Rewirable connectors/plug connectors are fitted with the cord specified in 22.3, having the smallest cross-sectional area.

Non-rewirable connectors/plug connectors are tested with the cord as delivered.

23.6.2 Straight pull test

The front part and the rear part of the connectors/plug connectors are securely fixed to two claws which are so arranged that they can separate from each other in a straight line. A pull force according to Table 13 is applied in the direction of the axes of the pins/contacts without jerks to the claws. The force is maintained for $60^{+0,5}_0$ s.

23.6.3 Lateral pull test

The front part of the connectors/plug connectors is clamped to a test fixture.

A lateral pull force according to Table 13, in parallel with the engagement face, is applied to the cable of the connector/plug connector in four directions in steps of $90^\circ \pm 5^\circ$, as shown in Figure 9 b), c), d) and e).

The force is maintained for $60^{+0,5}_0$ s in each direction.

For angled connectors/plug connectors, the force is not applied in the opposite direction of the cord entry.

After the tests of 23.6.2 and 23.6.3, the two parts of the connectors/plug connectors shall neither have been detached, nor shall parts providing protection against electric shock have been loosened or live parts have become accessible.

Table 13 – Values for pull forces

Rated current A	Straight pull N	Lateral pull N
0,2	50 ± 2	25 ± 2
2,5 Class II	50 ± 2	50 ± 2
2,5 Class I	75 ± 2	75 ± 2
6	75 ± 2	75 ± 2
10	100 ± 2	75 ± 2
16	100 ± 2	100 ± 2

24 Resistance to heat and ageing

24.1 Resistance to heat

Appliance couplers shall be sufficiently resistant to heat.

Compliance is checked with new samples using the ball pressure test according to IEC 60695-10-2 at the following temperatures:

- 155 °C ± 2 °C for parts of appliance couplers classified according to 7.1 c) (very hot conditions) which retain current-carrying parts and parts of the earthing contact in position and the front part of connectors and shrouds of plug connectors;
- 125 °C ± 2 °C for parts of appliance couplers classified according to 7.1 b) (hot conditions) which retain current-carrying parts and parts of the earthing contact in position and the front part of connectors and shrouds of plug connectors;
- 125 °C ± 2 °C for parts of appliance couplers classified according to 7.1 a) (cold conditions) which retain current-carrying parts and parts of the earthing contact in position and shrouds of plug connectors;
- 75 °C ± 2 °C for all other parts of appliance couplers.

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

Compliance is checked by inspection.

The following parts are not subjected to this test:

- parts of the cord anchorage and the cord guard;
- parts of connectors, not immediately surrounding the socket contacts, moulded together with the cord;
- parts of plug connectors, not immediately surrounding the pins, moulded together with the cord;
- connectors with a rated current ≤ 0,2 A;
- parts of ceramic.

NOTE 1 The front part is that part of a connector or a plug connector which can be fully engaged with its counterpart.

NOTE 2 The shroud of a plug connector can be a separate front part.

24.2 Resistance to ageing

24.2.1 General

Appliance couplers of elastomeric or thermoplastic material shall be sufficiently resistant to ageing.

Compliance is checked:

- for appliance couplers of elastomeric material, by the tests of 24.2.2 and 24.2.4;
- for appliance couplers of thermoplastic material, by the tests of 24.2.3 and 24.2.4.

For the tests of 24.2.2 to 24.2.4, one new test sample is used.

For the tests of 24.2.2 and 24.2.3, the use of an electrically heated cabinet is recommended.

NOTE 1 Natural air circulation can be provided by holes in the walls of the cabinet.

NOTE 2 Temperature can be measured by means of thermometers.

24.2.2 Ageing test for elastomeric materials

Appliance couplers of elastomeric material are subjected to an accelerated ageing test made in an atmosphere having the composition and pressure of the ambient air. The test samples are suspended freely in a heating cabinet, ventilated by natural air circulation. They are kept in the cabinet, which is maintained at a temperature of $70\text{ °C} \pm 2\text{ °C}$, for 240 h (10 days).

24.2.3 Ageing test for thermoplastic materials

Appliance couplers of thermoplastic material are subjected to an accelerated ageing test made in an atmosphere having the composition and pressure of the ambient air. The test samples are suspended freely in a heating cabinet, ventilated by natural circulation. They are kept in the cabinet, which is maintained at a temperature of $80\text{ °C} \pm 2\text{ °C}$, for 168 h (7 days).

During the test, the connectors/plug connectors are in engagement with a corresponding appliance inlet/appliance outlet according to the relevant standard sheet.

24.2.4 Ageing test assessment

After the tests of 24.2.2 or 24.2.3, the test samples are allowed to attain approximately ambient temperature and are then examined. They shall show no crack visible to the naked eye, nor shall the material have become sticky or greasy, this being judged as follows.

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

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

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

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

The test sample is placed on one of the pans of a balance and the other pan is loaded with a mass equal to the mass of the test sample plus 500 g. Equilibrium is then restored by pressing the test sample with the forefinger, wrapped in the piece of cloth.

25 Screws, current-carrying parts and connections

25.1 General

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

Screws and nuts for the connection of conductors shall be in engagement with a metal thread.

Screws for mounting parts of appliance couplers shall not be a thread-cutting type.

Screws or nuts for fixing the base of the appliance inlet/appliance outlet on an appliance can be any type. Screws of insulating material shall not be used in cases when the replacement with metal screws could impair the insulation of the appliance coupler.

Compliance is checked by inspection and by the following test.

The screws and nuts are tightened and loosened:

- 10 times for metal screws in engagement with a thread of insulating material and for screws of insulating material;

– 5 times in all other cases.

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 test screwdriver or spanner applying a torque as declared by the manufacturer; if a torque is not declared then the values shown in Table 14 are used.

When testing the terminal screws of connectors/plug connectors, a flexible conductor is placed in the terminal. The conductor is moved each time the screw or nut is loosened.

The nominal cross-sectional area of this conductor is 1 mm² for 10 A connectors/plug connectors and 1,5 mm² for 16 A connectors/plug connectors.

The screws and nuts shall be tightened smoothly.

Table 14 – Torque applied for the tightening and loosening test

Nominal diameter of thread mm	Torque N·m	
	I	II
Up to and including 2,8	0,2	0,4
Over 2,8 up to and including 3,0	0,25	0,5
Over 3,0 up to and including 3,2	0,3	0,6
Over 3,2 up to and including 3,6	0,4	0,8
Over 3,6 up to and including 4,1	0,7	1,2
Over 4,1 up to and including 4,7	0,8	1,8
Over 4,7 up to and including 5,3	0,8	2,0

Torque, Column I applies to screws without heads which, when tightened, do 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.

Torque, Column II applies to other screws and to nuts.

For screws having a hexagonal head with a slot, only the test with the screwdriver is carried out.

During the test, the screwed connection shall not work loose and there shall be no damage, such as breakage of screws or damage to the head slots, threads, washers or stirrups, which will impair the further use of the accessory.

25.2 Electrical connections

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

Compliance is checked by inspection.

NOTE For electrical connections up to 0,2 A the contact pressure can be obtained by insulating material that ensures reliable and permanent contact under all conditions of normal use.

25.3 Securement of connections

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

Connections between terminals and other parts shall be so designed that they will not work loose in normal use.

Compliance is checked by inspection and manual test.

NOTE 1 Spring washers can provide satisfactory locking.

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

25.4 Metallic parts

Current-carrying parts and earthing contacts shall be of a metal having, under conditions occurring in the appliance coupler, adequate mechanical strength and resistance to corrosion.

Parts which may be subjected to mechanical wear shall not be made of steel provided with electroplated coating.

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

Under moist conditions, metals having a great difference of electro-chemical potential with respect to each other shall not be used in contact with each other.

NOTE 1 Examples of suitable metals, when used within the permissible temperature range and under normal conditions of chemical pollution are (this list is not exhaustive):

- copper;
- an alloy containing at least 58 % copper for parts that are worked cold 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 a 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 a 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 a coating of tin according to ISO 2093, the coating having a thickness equal to at least 12 µm (ISO Service Condition No. 2).

NOTE 2 Screws, nuts, washers, clamping plates and similar parts of terminals are not regarded as current-carrying parts.

26 Clearances, creepage distances and solid insulation

26.1 General

Appliance couplers shall be constructed so that the clearances, creepage distances and solid insulation are adequate to withstand the electrical, mechanical and thermal stresses under the environmental influences that may occur during the anticipated life of the appliance couplers and interconnection couplers.

Compliance is checked by inspection and by the tests of 26.2, 26.3 and 26.4.

NOTE The requirements and tests are based on IEC 60664-1.

26.2 Clearances

26.2.1 Dimensioning

The clearances shall be dimensioned to withstand the rated impulse voltage declared by the manufacturer.

For a standard appliance coupler, the minimum rated impulse voltage is 2 500 V. For other rated impulse voltages, see Table 15.

Table 15 – Rated impulse withstand voltage for appliance couplers energized directly from the low voltage mains

Voltage line to neutral derived from nominal voltages AC up to and including V	Rated impulse withstand voltage kV		
	Overvoltage category		
	I	II	III
50	0,33	0,5	0,8
100	0,5	0,8	1,5
150	0,8	1,5	2,5
300	1,5	2,5	4,0

NOTE 1 For more detailed information, see IEC 60664-1. For example, for the overvoltage category, see 4.3 of IEC 60664-1:2020.

Appliance couplers are considered to fall within overvoltage category II. Overvoltage category I is applicable if special precautions against transient overvoltages are taken.

For the measurements, the following provisions apply.

Parts which can be removed without the use of a tool shall be removed and parts which can be assembled in different orientations are placed in the most unfavourable position.

NOTE Movable parts are for example hexagonal nuts, the position of which cannot be controlled throughout an assembly.

Distances through slots or openings in the surfaces of the insulating material are measured to a metal foil in contact with the surface. The foil is pushed into corners and the like by means of test probe 11 according to IEC 61032, but it is not pressed into openings.

A force of 2 N is applied to bare conductors and 30 N for accessible surfaces in order to attempt to reduce clearances when making the measurement.

The force is applied by means of test probe 11 according to IEC 61032.

26.2.2 Minimum values for clearances

The clearance for basic insulation, supplementary insulation and functional insulation shall not be less than the values specified in Table 16.

Except when the dimensions specified in the relevant standard sheet according to the IEC 60320 series lead to smaller distances, the clearances for reinforced insulation shall not be less than the values specified for basic insulation in Table 16, but using the next higher step for the rated impulse withstand voltage.

Compliance is checked by measurement.

Table 16 – Minimum clearances for basic insulation

Rated impulse withstand voltage ^a V	Minimum clearances in air up to 2 000 m above sea-level ^b mm	
	Pollution degree 1	Pollution degree 2
500	0,04	0,2
800	0,10	0,2
1 500	0,5	0,5
2 500	1,5	1,5
4 000 ^c	3	3

^a This voltage is:

- for functional insulation: the maximum impulse voltage expected to occur across the clearance;
- for basic insulation directly exposed to or significantly influenced by transient overvoltage from the low-voltage mains: the rated impulse withstand voltage of the appliance couplers and interconnection couplers;
- for other basic insulation: the highest impulse voltage that can occur in the circuit.

^b Clearances for altitudes higher than 2 000 m above sea-level shall be multiplied by the altitude correction factor in accordance with IEC 60664-1.

^c This voltage is only applicable when determining reinforced insulation for a rated impulse withstand voltage of 2,5 kV.

26.3 Creepage distances

26.3.1 Dimensioning

The creepage distances shall be dimensioned for the voltage which is expected to occur in normal use taking into account pollution degree 2 and the material group. Locally pollution degree 1 may be achieved by encapsulation of the creepage distances.

For the measurements, the following provisions apply.

Parts which can be removed without the use of a tool shall be removed and parts which can be assembled in different orientations are placed in the most unfavourable position.

NOTE 1 Movable parts are for example hexagonal nuts, the position of which cannot be controlled throughout an assembly.

Distances through slots or openings in the surfaces of the insulating material are measured to a metal foil in contact with the surface. The foil is pushed into corners and the like by means of test probe 11 according to IEC 61032, but it is not pressed into openings.

A force of 2 N is applied to bare conductors and 30 N for accessible surfaces in order to attempt to reduce creepage distances when making the measurement.

The force is applied by means of test probe 11 according to IEC 61032.

NOTE 2 A creepage distance cannot be less than the associated clearance.

The material group is determined according to Annex A.

26.3.2 Minimum creepage distances

The creepage distances for basic insulation, supplementary insulation and functional insulation shall not be less than the values specified in Table 17.

Except when the dimensions specified in the relevant standard sheet according to the IEC 60320 series lead to smaller distances, the creepage distances for reinforced insulation shall not be less than double the values specified for basic insulation in Table 17.

Compliance is checked by measurement.

Table 17 – Minimum creepage distances for basic and functional insulation

Voltage RMS ^a V	Pollution degree 1 ^b	Creepage distances mm		
		Pollution degree 2 ^b		
		Material group		
		I	II	III ^c
50	0,18	0,6	0,85	1,2
63	0,2	0,63	0,9	1,25
80	0,22	0,67	0,95	1,3
100	0,25	0,74	1	1,4
125	0,28	0,75	1,05	1,5
160	0,32	0,8	1,1	1,6
200	0,42	1	1,4	2
250	0,56	1,25	1,8	2,5

^a This voltage is the voltage rationalized by Table F.5 of IEC 60664-1:2020.
Interpolation for intermediate values is allowed.

^b Pollution degree 1 – No pollution or only dry, non-conductive pollution occurs. The pollution has no influence.
Pollution degree 2 – Only non-conductive pollution occurs except that occasionally a temporary conductivity caused by condensation is to be expected.

^c Material group III includes IIIa and IIIb.

26.4 Solid insulation

Solid insulation shall be capable of durably withstanding electrical and mechanical stresses as well as thermal and environmental influences which may occur during the anticipated life of the appliance couplers.

Compliance is checked by measurement and during the tests of Clause 15.

The distance through accessible supplementary solid insulation shall have a minimum value of 0,8 mm.

The distance through accessible reinforced solid insulation shall have the following minimum values:

- for rated impulse withstand voltage 1 500 V: 0,8 mm;
- for rated impulse withstand voltage 2 500 V: 1,5 mm.

NOTE No minimum thickness is specified for functional, basic, inaccessible supplementary and inaccessible reinforced solid insulation.

Compliance is checked by inspection and by measurement.

27 Resistance of insulating material to heat, fire and tracking

27.1 Resistance to heat and fire

27.1.1 General

Parts made of insulating material which might be exposed to thermal stresses due to electric effects and whose deterioration might impair safety shall not be unduly affected by heat and fire generated within the accessory.

For accessories with a rated current exceeding 0,2 A, compliance is checked by the glow-wire flammability test method for end-products (GWEPT) according to IEC 60695-2-11.

Appliance inlets/appliance outlets integrated or incorporated in an appliance or equipment are tested in accordance with the relevant appliance standard.

27.1.2 Objective of the test

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 made of insulating material, which might be ignited by the heated test wire under defined conditions, burns for a limited time only and without spreading fire by flame, or burning parts, or drops falling down from the part under test.

27.1.3 General description of the test

The test is made on one test sample only.

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

The test is carried out by applying the glow-wire once only. The test sample shall be positioned during the test in the most unfavourable position of its intended use (with the surface tested in a vertical position).

The tip of the glow-wire shall be applied to the specified surface of the test sample, taking into account the conditions of the intended use under which a hot part may come into contact with the test sample.

If the test cannot be made on the complete test sample, a suitable part may be cut from it.

If the specified tests are carried out at several places on the same test sample, any deterioration caused by previous tests shall not affect the results of the test to be carried out.

Small parts as defined in IEC 60695-2-11:2014, 4.4 are not subjected to this test.

27.1.4 Degree of severity

The following test temperatures are applicable:

- 750 °C for parts made of insulating material intended to retain current-carrying parts and parts of the earthing circuit in position;
- 650 °C for all other parts made of insulating material.

27.1.5 Evaluation of test results

The test specimen is considered to pass the test if:

- 1) there is no ignition, or

- 2) all the following situations apply when ignition has occurred:
- a) if flames or glowing combustion of the test specimen extinguish within 30 s after removal of the glow wire;
 - b) the specified layer placed underneath the test specimen does not ignite.

27.2 Resistance to tracking

Insulating parts supporting, or in contact with, live parts of appliance couplers for hot conditions and of appliance couplers for very hot conditions shall be of material resistant to tracking, with a minimum proof tracking index (PTI) of 175 V.

NOTE An end product standard can require a higher PTI value and/or also values for appliance couplers for cold conditions.

For materials other than ceramic, compliance is checked by the test of Annex A.

28 Resistance to rusting

Ferrous parts shall be adequately protected against rusting.

Compliance is checked by the following test.

The sample is degreased by immersion in white spirit or an equivalent degreasing agent for 10 min. The parts are then immersed for 10 min in a 10 % solution of ammonium chloride at a temperature of $20\text{ °C} \pm 5\text{ °C}$.

Without drying, but after shaking off any drops, the parts are placed for 10 min in a box containing air saturated with moisture at a temperature of $20\text{ °C} \pm 5\text{ °C}$.

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

An alternative test method is as follows.

After degreasing, the sample is submitted to a test according to IEC 60068-2-60 using test method 1 with a test duration of 4 days.

After exposure, the surface shall show no areas of red rust. White rust (zinc oxide) and traces of red rust which are removable by rubbing as well as traces of rust at the surface of cuts, bent edges and welded joints are ignored.

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

29 Electromagnetic compatibility (EMC) requirements

NOTE Requirements for accessories incorporating electronic components are not included as the need has not yet been established.

29.1 Immunity – Accessories not incorporating electronic components

These accessories are not sensitive to normal electromagnetic disturbances and therefore no immunity tests are required.

29.2 Emission – Accessories not incorporating electronic components

These accessories do not generate electromagnetic disturbances; consequently no emission tests are necessary.

NOTE These accessories do not generate electromagnetic disturbances other than those which can occur during occasional operations of insertion and withdrawal of the accessories. The frequency, the level and the consequences of these emissions are considered as part of the normal electromagnetic environment.

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Annex A (normative)

Proof tracking test

The proof tracking test is carried out in accordance with IEC 60112.

NOTE If the surface 15 mm × 15 mm cannot be obtained because of the small dimensions of the appliance couplers, special test samples made with the same manufacturing procedure can be used.

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Annex B (normative)

Routine tests for factory wired appliance couplers related to safety

B.1 General

All factory wired accessories shall be subjected to the following tests as shown in Table B.1.

Table B.1 – Test overview

Type of accessory	Test to be performed according to ...
Two-pole accessories	Clause B.2, B.4.1
Accessories with more than two poles	Clause B.2, Clause B.3, Clause B.4

Failed samples shall be treated in such a way that they cannot fulfil the intended function or be separated from satisfactory products in such a way that they cannot be released for sale.

It shall be possible to identify that appliance couplers released for sale have been subjected to the routine test.

The manufacturer shall maintain a record of the tests carried out which shows:

- type of product;
- date of test;
- place of manufacture (if manufactured in more than one place);
- tested quantity;
- number of failures and actions taken, i.e. destroyed/repaired.

The test equipment shall be checked before and after each period of use and for periods of continuous use, at least every 24 h. During these checks the equipment shall show that it indicates faults when known faulty products are inserted or simulated faults are applied.

Products manufactured prior to a check shall only be released for sale if the check is found satisfactory.

Test apparatus/equipment shall be verified/calibrated at least once a year.

Records shall be kept of all checks and any adjustments found necessary.

B.2 Polarized systems: Line (L) and neutral (N) – Correct connection

For polarized systems the test shall be made by applying a current for a period of not less than 2 s between the remote end of the L and N conductors of the flexible cord independently and the corresponding L and N pin or contact of the appliance coupler.

The period of 2 s may be reduced to not less than 1 s on test equipment with automatic timing.

Polarity shall be correct.

B.3 Earth (PE) continuity

The test shall be made applying a current for a period of not less than 2 s between the remote end of the PE conductor of the flexible cord and the PE pin or contact of the appliance coupler, as appropriate.

The period of 2 s may be reduced to not less than 1 s on test equipment with automatic timing.

Other suitable tests may be used.

Continuity shall be present.

B.4 Short-circuit/wrong connection and reduction in creepage distance and clearance

B.4.1 Accessible surface safety check

For non-rewirable appliance couplers it shall be checked that live parts, for example, loose strands, are not coming through the accessible surface.

If this danger cannot be prevented by the construction and/or suitable manufacturing processes, the following test or a similar one (e.g. impulse voltage test) shall be performed.

The accessible surface of appliance couplers except the engagement face of connectors and plug connectors are scanned by adjusted electrodes with a pressure force of 20 N.

Through the live parts and the surface of the appliance coupler, an AC voltage of $2\,000\text{ V} \pm 200\text{ V}$ shall be applied for at least 1 s.

Neither a flash-over nor a breakdown shall occur.

B.4.2 Short-circuit/wrong connection

The test shall be made between the L and N conductors and the E conductor by applying at the supply end an AC voltage of $2\,000\text{ V} \pm 200\text{ V}$, 50 Hz or 60 Hz for a period of not less than 2 s or by an impulse voltage test using 1,2/50 μs wave form, 4 kV peak value, three impulses for each pole, with intervals of not less than 1 s, the test voltage being applied at the supply end.

The period of 2 s may be reduced to not less than 1 s on test equipment with automatic timing.

The L and N conductors may be connected together for this test.

No flashover shall occur.

Annex C (normative)

Test schedule

See Table C.1.

Table C.1 – Test schedule

Group	Clause/ subclause	Description of the tests	Appliance inlet	Connector	Appliance outlet	Plug connector
1 3 samples	8	Marking	x	x	x	x
	9	Dimensions and compatibility	x	x	x	x
	10	Protection against electric shock	x	x	x	x
	11	Provision for earthing	x	x	x	x
	12	Terminals and terminations	x	x	x	x
	13	Construction	x	x	x	x
	23	Mechanical strength	x	x	x	x
	25	Screws, current-carrying parts and connections	x	x	x	x
	26	Clearances, creepage distances and solid insulation	x	x	x	x
	28	Resistance to rusting	x	x	x	x
2 3 samples^a	14	Moisture resistance	x	x	x	x
	15	Insulation resistance and electrical strength	x	x	x	x
	16	Forces necessary to insert and to withdraw the connector/appliance outlet		x	x	
	19	Breaking capacity		x	x	
	20	Normal operation		x	x	
	21	Temperature rise		x	x	
	17	Operation of contacts	x	x	x	x
3 3 samples^b	22 E.6	Cords and their connections		x		x
4 3 samples^b	22.3	Flexing test		x		x
5 2 samples^a	24.1 E.5.1	Resistance to heat	x	x	x	x
6 2 samples^a	24.2	Resistance to ageing	x	x	x	x
7 2 samples^a	24.2.2 or 24.2.3	Ageing test for appliance couplers made of elastomeric or thermoplastic materials	x	x	x	x
8 2 samples^a	27.1.4	Degree of severity (glow wire test 750 °C (sample 1))	x	x	x	x
	27.1.4	Degree of severity (glow wire test 650 °C (sample 2))	x	x	x	x
9 3 samples^a	27.2, E.5.3	Resistance to tracking	x	x	x	x

Group	Clause/ subclause	Description of the tests	Appliance inlet	Connector	Appliance outlet	Plug connector
10 3 samples^a	18	Resistance to heating of appliance couplers for hot and very hot conditions	x	x	x	x
11 3 samples^a	E.4	Determination of t_a and the rated and derated current in relation to the ambient temperature		x	x	x
12 3 samples^a	E.5.2.2	Ageing test for connectors/appliance outlets		x	x	
	E.5.2.3	Ageing test for appliance inlets/plug connectors	x			x
^a Sample of each different material. ^b Sample of each type of cable, cross-sectional area and manufacturer of the cable.						

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Annex D (informative)

Comparison of typical conductor cross-sectional areas

Table D.1 provides a comparison of the conductor cross-sectional areas of the American Wire Gauge (AWG) with square millimetres, square inches, and circular mils.

Table D.1 – Comparison of conductor sizes

Wire size	Gauge no.	Cross-sectional area		DC resistance of copper at 20 °C	Circular mils
		mm ²	in ²		
mm ²	(AWG)	mm ²	in ²	Ω/km	
0,2		0,196	0,000 304	91,62	387
	24	0,205	0,000 317	87,60	404
0,3		0,283	0,000 438	63,46	558
	22	0,324	0,000 504	55,44	640
0,5		0,500	0,000 775	36,70	987
	20	0,519	0,000 802	34,45	1 020
0,75		0,750	0,001 162	24,80	1 480
	18	0,823	0,001 272	20,95	1 620
1,0		1,000	0,001 550	18,20	1 973
	16	1,31	0,002 026	13,19	2 580
1,5		1,500	0,002 325	12,20	2 960
	14	2,08	0,003 228	8,442	4 110
2,5		2,500	0,003 875	7,56	4 934
	12	3,31	0,005 129	5,315	6 530
4		4,000	0,006 200	4,700	7 894
	10	5,26	0,008 152	3,335	10 380
6		6,000	0,009 300	3,110	11 841
	8	8,37	0,012 967	2,093	16 510
10		10,000	0,001 550	1,840	19 735
	6	13,3	0,020 610	1,320	26 240
16		16,000	0,024 800	1,160	31 576
	4	21,1	0,032 780	0,829 5	41 740
25		25,000	0,038 800	0,734 0	49 338
	2	33,6	0,052 100	0,521 1	66 360
35		35,000	0,054 200	0,529 0	69 073
	1	42,4	0,065 700	0,413 9	83 690
50		47,000	0,072 800	0,391 0	92 756

Annex E

(normative)

Additional tests and requirements for appliance couplers intended to be used in ambient temperatures above +35 °C up to and including +90 °C

E.1 General

As given in the scope, appliance couplers for household and similar purposes complying with the main part of this document are suitable for use at ambient temperatures not normally exceeding +40 °C, but their average over a period of 24 h does not exceed +35 °C with a lower limit of the ambient air temperature of –5 °C.

This Annex E provides a methodology for derating the operating current of an accessory when used in ambient temperatures above +35 °C up to and including +90 °C and includes various tests.

E.2 General requirements on tests

E.2.1 General

Unless otherwise specified, appliance couplers are tested with their counterparts that are in compliance with this document. Corresponding counterparts shall be of identical rating (as per Clause 6) and classification (as per Clause 7).

The additional tests according to Clause E.4 shall be conducted on 3 new specimens.

E.2.2 Test setup

The measurement shall be carried out in an electrically heated cabinet in air as undisturbed as possible. The specimen shall be arranged in the enclosure in a horizontal plane, 50 $^{+10}_0$ mm above the bottom of the enclosure and at least 150 mm below the top and equidistant from the sides. As far as possible, the specimen shall be in free suspension. If this is not possible, a thermal insulating material with a thermal conductivity ≤ 2 W/mK may be used, provided that not more than 20 % of the surface of the specimen is in contact with the insulating material.

Each accessory is wired and connected according to Clause 21 and placed in a heating cabinet.

NOTE A counterpart according to Clause 21 can be a gauge.

In order to reduce external heat dissipation to a minimum, a length of 0,5 $^{+0,1}_0$ m of the connected cable shall be within the measuring enclosure. The L and N terminal of the mating counterpart are connected together with a connection as short as possible.

E.2.3 Conditions of temperature measurement

If temperatures are measured with temperature probes, the probe leads shall pass through the walls of the heating cabinet. Other methods of temperature measurement are permissible.

The measuring point for measuring the ambient temperature shall be located in a horizontal plane passing through the axis of the specimen. It shall be located 50 $^{+5}_0$ mm from the mid-point of the edge of the longest side of the specimen.

Care shall be taken to protect the probe against radiant heat.

The points for measuring the temperature of the specimen shall be on the L and N connection terminals of the mating appliance inlet, appliance outlet or plug connector.

E.2.4 Method of measurement

The specimen shall be arranged in the enclosure as described in E.2.2 and its terminals are connected to a regulated power supply through an ampere meter.

The current shall be maintained for a period of approximately 30 min after thermal stability is achieved at each of the selected current levels. This is defined as when three consecutive values of temperature rise, taken at 5 min intervals, do not differ by more than 2 K of each other.

The average value of the 6 measurements on the 3 specimens shall be taken.

E.3 Markings

Appliance couplers, except standardized appliance inlets, in compliance with the requirements of Annex E shall be marked with t_a as defined in Clause E.4 if the value of t_a is +40 °C or higher. The marked t_a value shall be in increments of 5 °C and rounded down to the lower value, for example, +40 °C, +45 °C, +50 °C, etc.

Example: t_a measured value 47 °C, declared and marked value t_a 45 °C

Example of marking: 10 A 250 V t_a 45

For products declared as suitable for use at a temperature above 35 °C, the manufacturer shall provide information about derated current I_d , at given ambient temperatures t_d .

The ambient temperature(s) can be declared above +35 °C and not exceeding +90 °C in multiples of 5 °C.

For rewirable appliance couplers this information shall be additionally available in the manufacturer's wiring instructions.

Depending on the application, appropriate current limiting devices may be needed to protect the circuit and in this case the information shall be available in the manufacturer's instructions.

Markings are checked by inspection and by the test of 8.8.

E.4 Determination of t_a and the rated and derated current in relation to the ambient temperature

E.4.1 Determination of the maximum ambient temperature (t_a) for operation of the accessory at the rated current

The maximum ambient temperature at rated current (t_a) is determined as follows:

Each appliance coupler is loaded at rated current and the temperature in the heating cabinet is adjusted until the highest temperature measured at the terminals is maintained at +90 °C ± 1 °C for a period of 30 min.

The adjusted value of the heating cabinet required to maintain the highest measured temperature of the terminals at +90 °C ± 1 °C for 30 min is defined as t_a . The t_a should be the mean value of the three tested specimens.

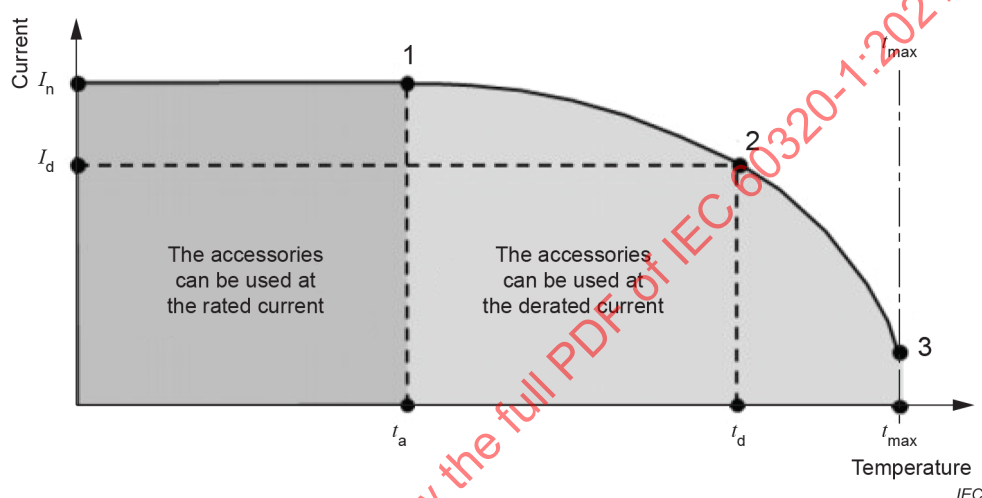
E.4.2 Determination of the derated operating currents for ambient temperatures above t_a

The temperature of the heating cabinet is then increased by steps of maximum 5 °C, the test current being reduced in order to keep the highest measured temperature at the terminals constant at +90 °C ± 1 °C.

For each step, the measured derated operating current (I_d) is recorded. The I_d should be the mean value of the three tested specimens.

This procedure is continued until the highest measured temperature at the terminals and the heating cabinet is maintained at +90 °C ± 1 for a period of 30 min.

An example is shown in Figure E.1.



- 1) Up to the ambient temperature t_a , the appliance couplers can be used at the rated current I_n .
- 2) At an ambient temperature t_d , the appliance couplers can be used up to the derated current I_d .
- 3) t_{max} is the maximum ambient temperature surrounding the appliance coupler.

Figure E.1 – Schematic drawing of a derating curve with an example of a derated current I_d at the operating ambient temperature t_d

NOTE Derated current value I_d at the operating ambient temperature t_d can be given for example by graph shown in Figure E.1, or a table with fixed values in increments of 5 K.

E.5 Test to evaluate the long-term behaviour of the appliance couplers in ambient temperatures above +35 °C up to and including +90 °C

E.5.1 Resistance to heat

Appliance couplers for use in ambient temperatures above +35 °C up to and including +90 °C shall be sufficiently resistant to heat.

Compliance is checked with three new samples using the ball pressure test according to IEC 60695-10-2 at 125 °C ± 2 °C for the following parts of appliance couplers for use in ambient temperatures up to +90 °C:

- parts which retain current-carrying parts;
- parts of the earthing contact in position;
- front part of connectors;
- shrouds of plug connectors for appliance couplers.

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

Compliance is checked by inspection.

The following parts are not subjected to this test:

- parts of the cord anchorage and the cord guard;
- parts of connectors, not immediately surrounding the socket contacts, moulded together with the cord;
- parts of plug connectors, not immediately surrounding the pins, moulded together with the cord;
- parts of ceramic.

NOTE 1 The front part is that part of a connector or a plug connector which can be fully engaged with its counterpart.

NOTE 2 The shroud of a plug connector can be a separate front part.

E.5.2 Resistance to ageing

E.5.2.1 General

Appliance couplers for use in ambient temperatures above +35 °C up to and including +90 °C shall be sufficiently resistant to ageing.

Compliance is checked:

- for connectors and appliance outlets, by the tests of E.5.2.2;
- for appliance inlets/plug connectors, by the tests of E.5.2.3.

For the tests of E.5.2.2 and E.5.2.3, three new test samples are used, which are first subjected to the test of Clause 16.

For the tests of E.5.2.2 and E.5.2.3, the use of an electrically heated cabinet is recommended.

NOTE 1 Natural air circulation can be provided by holes in the walls of the cabinet.

NOTE 2 Temperature can be measured by means of thermometers.

E.5.2.2 Ageing test for connectors/appliance outlets

Connectors/appliance outlets are subjected to an accelerated ageing test carried out in an atmosphere having the composition and pressure of the ambient air.

The test samples are suspended freely in a heating cabinet, ventilated by natural air circulation.

They are kept in the cabinet, which is maintained at a temperature of $100\text{ °C} \pm 2\text{ °C}$, for 336 h (14 days).

During the test, the connectors/appliance outlets are in engagement with a corresponding appliance inlet/plug connector according to the relevant standard sheet.

E.5.2.3 Ageing test for appliance inlets/plug connectors

Appliance inlets/plug connectors are subjected to an accelerated ageing test carried out in an atmosphere having the composition and pressure of the ambient air.

The test samples are suspended freely in a heating cabinet, ventilated by natural circulation. They are kept in the cabinet, which is maintained at a temperature of $100\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$, for 336 h (14 days).

E.5.2.4 Ageing test assessment

After the tests of E.5.2.2 or E.5.2.3, the specimens are taken out of the cabinet and kept at a room temperature in a relative humidity between 45 % and 55 % for at least four days (96 h) and are then examined.

The specimens shall show no crack visible with normal or corrected vision without additional magnification, nor shall the material have become sticky or greasy, this being judged as follows:

- with the forefinger wrapped in a dry piece of rough cloth the specimen is pressed with a force of 5 N;
- no traces of the cloth shall remain on the specimen and the material of the specimen shall not stick to the cloth.

Then an appliance inlet/plug connector with the same rated current as the cord connector/appliance outlet is fully inserted and withdrawn 3 times, any lid is opened and closed each time.

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

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

The test sample is placed on one of the pans of a balance and the other pan is loaded with a mass equal to the mass of the test sample plus 500 g. Equilibrium is then restored by pressing the test sample with the forefinger, wrapped in the piece of cloth.

E.5.3 Resistance to tracking

Insulating parts supporting, or in contact with, live parts of appliance couplers for use in ambient temperatures above $+35\text{ }^{\circ}\text{C}$ up to and including $+90\text{ }^{\circ}\text{C}$ shall be of material resistant to tracking, with a minimum PTI of 175 V.

For materials other than ceramic, compliance is checked by the test of Annex A.

NOTE An end product standard can require a higher PTI value and/or also values for appliance couplers for cold conditions.

E.6 Cords and their connections

The type of cords shall be according to the requirements of Table 9 and Table 10, but shall be of rubber or an equivalent elastomeric type and rated for a maximum conductor insulation temperature of $+90\text{ }^{\circ}\text{C}$ or higher for appliance couplers for use in ambient temperatures up to $+90\text{ }^{\circ}\text{C}$.

NOTE 1 Such a cord is for example: H05BBF rated at $90\text{ }^{\circ}\text{C}$, similar to the cords of IEC 60245 (all parts).

For non-standardized appliance couplers for use in ambient temperatures up to $+90\text{ }^{\circ}\text{C}$, the type of cords shall be of PVC, rubber or an equivalent elastomeric type and rated for a maximum conductor insulation temperature of $+90\text{ }^{\circ}\text{C}$ or higher.

NOTE 2 Such a cord is for example 60227 IEC 57 rated at $90\text{ }^{\circ}\text{C}$.

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² Under preparation. Stage at time of publication: IEC TS PUB 63236-2:2021.

³ Under preparation. Stage at time of publication: IEC TS PUB 63236-3:2021.

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

**CONNECTEURS POUR USAGES DOMESTIQUES
ET USAGES GÉNÉRAUX ANALOGUES –****Partie 1: Exigences générales****AVANT-PROPOS**

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L'IEC 60320-1 a été établie par le sous-comité 23G: Connecteurs, du comité d'études 23 de l'IEC: Petit appareillage. Il s'agit d'une Norme internationale.

Cette quatrième édition annule et remplace la troisième édition parue en 2015 et l'Amendement 1:2018. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

- a) les tolérances nécessaires ont été ajoutées dans l'ensemble du présent document;
- b) l'essai d'échauffement de l'édition 2 a été rétabli en 18.2;
- c) l'échauffement a été ajouté à l'Article 21 pour les fiches mobiles mâles;

- d) le 23.3 a été réorganisé pour des raisons de lisibilité;
- e) l'essai de traction latérale du 23.6 a été mis à jour pour les prises mobiles/fiches mobiles mâles qui comportent des pièces frontales séparées;
- f) le 24.1 qui traite de l'essai à la bille a été revu;
- g) l'Article 27 qui traite de l'essai au fil incandescent a été mis à jour;
- h) l'Annexe C qui traite des séquences d'essais a été revue;
- i) l'Annexe E a été ajoutée afin de définir les essais et exigences supplémentaires pour les connecteurs destinés à être utilisés à des températures ambiantes supérieures à +35 °C.

Le texte de cette Norme internationale est issu des documents suivants:

FDIS	Rapport de vote
23G/464/FDIS	23G/467/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

Une liste de toutes les parties de la série IEC 60320, publiées sous le titre général *Connecteurs pour usages domestiques et usages généraux analogues*, se trouve sur le site web de l'IEC.

Le présent document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/standardsdev/publications.

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- amendé.

CONNECTEURS POUR USAGES DOMESTIQUES ET USAGES GÉNÉRAUX ANALOGUES –

Partie 1: Exigences générales

1 Domaine d'application

La présente partie de la série IEC 60320 établit les exigences générales applicables aux connecteurs bipolaires et bipolaires avec contact de mise à la terre et destinés au raccordement au réseau d'alimentation des dispositifs électriques pour usages domestiques et analogues.

Le présent document s'applique également aux socles de connecteurs/socles femelles de connecteurs intégrés ou incorporés dans des appareils d'utilisation.

La tension assignée ne dépasse pas 250 V (courant alternatif) et le courant assigné ne dépasse pas 16 A.

Les connecteurs conformes au présent document sont prévus pour une utilisation normale à une température ambiante qui ne dépasse généralement pas +40 °C, mais leur moyenne sur une période de 24 h ne dépasse pas +35 °C, avec une limite inférieure de la température ambiante de –5 °C.

L'Annexe E fournit les exigences d'essai pour déclasser le courant de fonctionnement d'un appareil lorsqu'il est utilisé à des températures ambiantes supérieures à +35 °C et inférieures ou égales à +90 °C.

Les connecteurs ne sont pas prévus pour:

- une utilisation en lieu et place des prises de courant selon l'IEC 60884-1;
- une utilisation en lieu et place des dispositifs de connexion pour luminaires (DCL) selon l'IEC 61995 ou des connecteurs soutenus par des luminaires (LSC);
- une utilisation en lieu et place des coupleurs d'installation selon l'IEC 61535.

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60068-2-31, *Essais d'environnement – Partie 2-31: Essais – Essai Ec: Choc lié à des manutentions brutales, essai destiné en premier lieu aux matériels*

IEC 60068-2-60, *Essais d'environnement – Partie 2-60: Essais – Essai Ke: Essai de corrosion dans un flux de mélange de gaz*

IEC 60068-2-75, *Essais d'environnement – Partie 2-75: Essais – Essai Eh: Essais au marteau*

IEC 60112:2020, *Méthode de détermination des indices de résistance et de tenue au cheminement des matériaux isolants solides*

IEC 60227 (toutes les parties), *Conducteurs et câbles isolés au polychlorure de vinyle, de tension nominale au plus égale à 450/750 V*

IEC 60245 (toutes les parties), *Conducteurs et câbles isolés au caoutchouc – Tension assignée au plus égale à 450/750 V*

IEC 60320-3:2014, *Connecteurs pour usages domestiques et usages généraux analogues – Partie 3: Feuilles de norme et calibres*

IEC 60320-3:2014/AMD1:2018

IEC 60417, *Symboles graphiques utilisables sur le matériel* (disponible à l'adresse: <http://www.graphical-symbols.info/equipment>)

IEC 60664-1:2020, *Coordination de l'isolement des matériels dans les réseaux d'énergie électrique à basse tension – Partie 1: Principes, exigences et essais*

IEC 60695-2-11:2014, *Essais relatifs aux risques du feu – Partie 2-11: Essais au fil incandescent/chauffant – Méthode d'essai d'inflammabilité pour produits finis (GWEPT)*

IEC 60695-10-2:2014, *Essais relatifs aux risques du feu – Partie 10-2: Chaleurs anormales – Essai à la bille*

IEC 60730-2-11:2019, *Dispositifs de commande électrique automatiques – Partie 2-11: Exigences particulières pour les régulateurs d'énergie*

IEC 60999-1:1999, *Dispositifs de connexion – Conducteurs électriques en cuivre – Prescriptions de sécurité pour organes de serrage à vis et sans vis – Partie 1: Prescriptions générales et particulières pour les organes de serrage pour les conducteurs de 0,2 mm² à 35 mm² (inclus)*

IEC 61032:1997, *Protection des personnes et des matériels par les enveloppes – Calibres d'essai pour la vérification*

IEC 61058 (toutes les parties), *Interrupteurs pour appareils*

3 Termes et définitions

Pour les besoins du présent document, les termes et définitions suivants s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse <http://www.electropedia.org/>
- ISO Online browsing platform: disponible à l'adresse <http://www.iso.org/obp>

3.1

connecteur

ensemble qui permet la connexion et la déconnexion d'un appareil d'utilisation ou d'un matériel électrique à l'alimentation

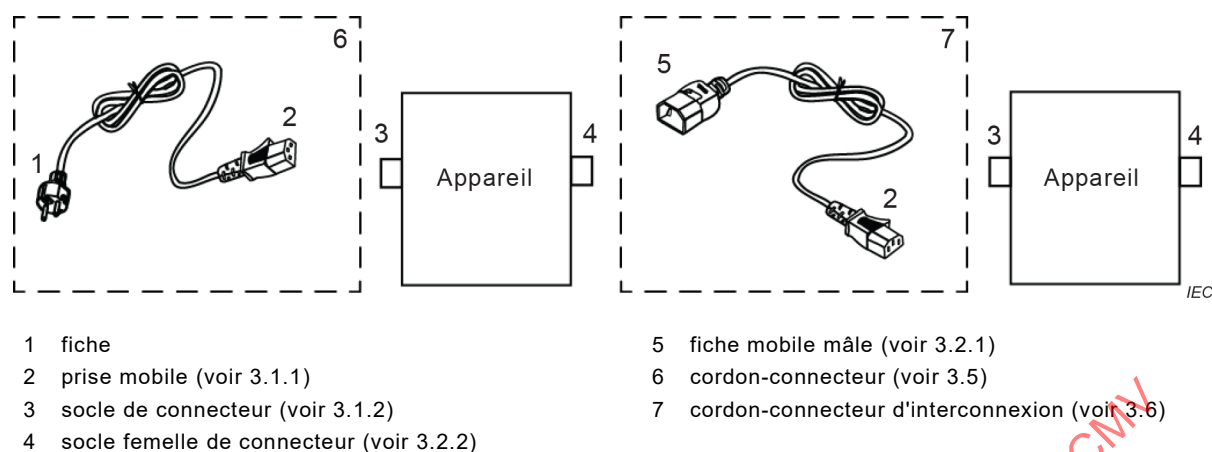


Figure 1 – Utilisation prévue des connecteurs

3.1.1

prise mobile

partie du connecteur d'appareil d'utilisation faisant corps avec un cordon, ou destinée à y être reliée

VOIR: Figure 1.

[SOURCE: IEC 60050-442:1998, 442-07-02, modifié – "le câble souple d'alimentation" a été remplacé par "un cordon" et une référence à la Figure 1 a été ajoutée.]

3.1.2

socle de connecteur

partie du connecteur d'appareil d'utilisation intégrée dans un appareil d'utilisation ou incorporée comme partie séparée dans un appareil d'utilisation ou dans un matériel électrique ou destinée à y être fixée

VOIR: Figure 1.

3.2

connecteur d'interconnexion

connecteur qui permet la connexion et la déconnexion d'un appareil d'utilisation ou d'un matériel électrique à un cordon qui alimente un autre appareil d'utilisation ou un autre matériel électrique

VOIR: Figure 1.

Note 1 à l'article: Un connecteur d'interconnexion est un type de connecteur d'appareil d'utilisation.

3.2.1

fiche mobile mâle

partie du connecteur d'interconnexion faisant corps avec un cordon, ou destinée à y être reliée

VOIR: Figure 1.

[SOURCE: IEC 60050-442:1998, 442-07-09, modifié – "le câble souple d'alimentation" a été remplacé par "un cordon" et une référence à la Figure 1 a été ajoutée.]

3.2.2

socle femelle de connecteur

partie du connecteur d'interconnexion incorporée ou montée dans l'appareil d'utilisation ou dans le matériel électrique ou destinée à y être fixée et à partir duquel l'alimentation est obtenue

VOIR: Figure 1.

[SOURCE: IEC 60050-442:1998, 442-07-08, modifié – Une référence à la Figure 1 a été ajoutée.]

3.3

connecteur démontable

appareil construit de telle façon qu'un câble ou cordon puisse être remplacé

3.4

connecteur non démontable

appareil construit de telle façon qu'il forme une unité complète avec le câble souple d'alimentation ou le cordon, après connexion et assemblage par le constructeur de l'appareil

3.5

cordon-connecteur

ensemble composé d'un câble ou d'un cordon, équipé d'une fiche non démontable et d'une prise mobile non démontable, destiné à relier un appareil d'utilisation ou un matériel électrique à l'alimentation électrique

VOIR: Figure 1.

3.6

cordon-connecteur d'interconnexion

ensemble composé d'un câble ou d'un cordon équipé d'une fiche mobile mâle et d'une prise mobile non démontables, destiné à l'interconnexion entre deux appareils d'utilisation électriques

VOIR: Figure 1

Note 1 à l'article: La définition est fondée sur celle de l'IEC 60050-442:1998, 442-07-06.

3.7

connecteur intégré

connecteur d'appareil d'utilisation constitué par le boîtier ou l'enveloppe de l'appareil d'utilisation ou du matériel électrique et qui ne peut pas être soumis à l'essai séparément

3.8

connecteur normalisé

connecteur dont les dimensions sont conformes aux feuilles de norme de l'IEC 60320-3

3.9

connecteur non normalisé

connecteur dont les dimensions ne sont pas conformes aux feuilles de norme de l'IEC 60320-3

3.10

base d'une broche

partie de la broche, où elle sort de la face d'engagement

3.11

dispositif de retenue

dispositif mécanique ou mécanisme qui maintient de façon convenable la liaison entre une prise mobile et le socle de connecteur correspondant et qui en empêche tout retrait involontaire

3.12**tension assignée** (pour le petit appareillage)

tension fixée par le constructeur pour le fonctionnement spécifié d'un appareil

[SOURCE: IEC 60050-442:1998, 442-01-03]

3.13**courant assigné** (pour le petit appareillage)

courant fixé par le constructeur pour le fonctionnement spécifié d'un appareil

[SOURCE: IEC 60050-442:1998, 442-01-02]

3.14**borne** (pour le petit appareillage)

partie d'un appareil à laquelle un conducteur est fixé pour réaliser une connexion réutilisable

[SOURCE: IEC 60050-442:1998, 442-06-05]

3.15**sortie**

partie d'un appareil à laquelle un conducteur est fixé de manière permanente

[SOURCE: IEC 60050-442:1998, 442-06-06]

3.16**vis autotaraudeuse à découpe**

vis autotaraudeuse ayant un filet non continu qui, par vissage, forme le filetage en enlevant du matériau de la cavité

[SOURCE: IEC 60050-442:1998, 442-06-03]

3.17**essai de type**

essai effectué sur un ou plusieurs dispositifs réalisés selon une conception donnée pour vérifier que cette conception satisfait à certaines exigences

3.18**essai individuel de série**

essai de conformité effectué sur chaque entité en cours ou en fin de fabrication

[SOURCE: IEC 60050-151:2001, 151-16-17]

4 Exigences générales

Les connecteurs doivent être conçus et construits de façon à ce que leur fonctionnement soit sûr en utilisation normale et que l'utilisateur ou l'entourage ne soit pas mis en danger.

Les connecteurs non normalisés doivent satisfaire à l'ensemble des exigences de sécurité du présent document et doivent être soumis à l'essai avec leurs homologues.

La conformité est vérifiée en réalisant la totalité des essais spécifiés.

5 Notes générales sur les essais

5.1 Généralités

Des essais doivent être effectués pour démontrer la conformité aux exigences spécifiées dans le présent document, lorsqu'elles sont applicables.

Ces essais sont tels que:

- 1) les essais de type doivent être effectués sur des échantillons représentatifs de chaque appareil;
- 2) les essais individuels de série doivent être réalisés par le constructeur et effectués sur chaque appareil;
- 3) sauf spécification contraire, les essais sont exécutés dans l'ordre des articles du présent document;
- 4) sauf spécification contraire, les connecteurs sont soumis à l'essai conjointement avec leurs homologues conformes au présent document;
- 5) les connecteurs intégrés et les connecteurs incorporés sont soumis à l'essai dans les conditions d'utilisation des matériels électriques, le nombre d'échantillons étant alors égal au nombre d'échantillons de matériels électriques exigé dans la norme correspondante concernant le matériel;
- 6) les connecteurs sont considérés comme conformes au présent document si pas plus d'un seul échantillon d'un lot donné ne satisfait pas à un essai en raison d'un défaut d'assemblage ou de fabrication. L'essai concerné et ceux qui le précèdent, qui peuvent avoir influencé son résultat, sont recommencés sur un nouveau lot d'échantillons qui doivent alors tous satisfaire aux essais recommencés;
- 7) en général, il est nécessaire de répéter uniquement l'essai qui n'est pas satisfaisant sauf:
 - a) si un défaut se produit sur l'un des trois échantillons, lorsqu'il est soumis à l'essai conformément à l'Article 19, à l'Article 20 ou à l'Article 21, auquel cas les essais sont répétés à partir de l'Article 16; ou
 - b) si un défaut se produit sur l'un des trois échantillons, lorsqu'il est soumis à l'essai conformément à l'Article 22 (à l'exception du 22.3) ou à l'Article 23, auquel cas les essais sont répétés à partir de l'Article 18.

Les essais de type sont décrits en 5.2. Pour le nombre d'échantillons et de séquences d'essais, voir Annexe C.

5.2 Echantillons d'essai

Sauf spécification contraire, les échantillons sont soumis à l'essai en l'état de livraison et dans des conditions normales, assemblés et installés comme en utilisation normale selon les instructions du constructeur, à une température ambiante de $20\text{ °C} \pm 5\text{ °C}$; les essais sont exécutés en courant alternatif à 50 Hz ou 60 Hz. Les essais ne doivent pas être engagés moins de 168 h après fabrication.

Les prises mobiles non démontables et les fiches mobiles mâles non démontables, autres que celles qui font partie d'un cordon-connecteur, doivent être présentées avec un cordon d'au moins 1 m de longueur.

Le demandeur peut soumettre, en même temps que le premier lot d'échantillons, le lot supplémentaire qui peut être nécessaire en cas de défaillance de l'un des échantillons. Le laboratoire soumet alors à l'essai, sans autre avis, les échantillons supplémentaires, le rejet ne survenant qu'à la suite d'une nouvelle défaillance. Si le lot d'échantillons supplémentaire n'est pas soumis au même moment, la défaillance de l'un des échantillons présentés motive le rejet.

5.3 Essais individuels de série

Les essais individuels de série sont spécifiés à l'Annexe B.

6 Valeurs assignées normales

6.1 La tension assignée maximale admise est de 250 V.

6.2 Le courant assigné maximal admis est de 16 A.

Les valeurs préférentielles de courant assigné pour les connecteurs sont 0,2 A, 2,5 A, 6 A, 10 A et 16 A.

NOTE Voir l'IEC 60320-3 pour connaître les valeurs assignées normales.

7 Classification des connecteurs

7.1 En fonction de la température de broche maximale à la base des broches du socle de connecteur correspondant ou des contacts femelles du socle femelle de connecteur correspondant:

- a) connecteurs pour conditions froides (température des broches qui ne dépasse pas 70 °C);
- b) connecteurs pour conditions chaudes (température des broches qui ne dépasse pas 120 °C);
- c) connecteurs pour conditions très chaudes (température des broches qui ne dépasse pas 155 °C).

NOTE Les connecteurs pour conditions chaudes peuvent également être utilisés dans des conditions froides; les connecteurs pour conditions très chaudes peuvent également être utilisés dans des conditions froides ou chaudes.

7.2 En fonction du type de matériel à raccorder:

- a) connecteurs pour matériels de la classe I;
- b) connecteurs pour matériels de la classe II.

NOTE 1 Pour la description des classes, voir l'IEC 61140.

NOTE 2 Les connecteurs 0,2 A sont destinés uniquement au raccordement des petits matériels de la classe II tenus à la main, si la norme applicable à ces matériels le permet.

7.3 Les prises mobiles/fiches mobiles mâles sont classées d'après le mode de raccordement du cordon en:

- a) prises mobiles/fiches mobiles mâles démontables;
- b) prises mobiles/fiches mobiles mâles non démontables.

7.4 En fonction de la température ambiante:

- a) connecteurs pour températures ambiantes inférieures ou égales à +35 °C;
- b) connecteurs pour températures ambiantes inférieures ou égales à +90 °C. Cette classification implique également une classification selon 7.1 b) ou 7.1 c).

8 Marquage

8.1 Généralités

Les connecteurs doivent porter les indications suivantes:

- le nom, la marque de fabrique ou la marque d'identification du constructeur ou du fournisseur responsable;
- la référence du type.

NOTE La référence du type peut être un numéro de catalogue.

8.2 Marquages supplémentaires

Les prises mobiles et fiches mobiles mâles normalisées conformément à l'IEC 60320-3, ainsi que tous les connecteurs non normalisés doivent en outre comporter un marquage qui contient les informations suivantes:

- le courant assigné, en ampères, excepté pour les prises mobiles 0,2 A;
- la tension assignée, en volts;
- le symbole pour la nature du courant;
- le marquage, comme spécifié dans l'IEC 60999-1, pour identifier le type de conducteur approprié aux bornes sans vis.

8.3 Connecteurs pour matériels de la classe II

Les connecteurs pour matériels de la classe II ne doivent pas porter le symbole pour la classe II.

8.4 Symboles ou notations alphanumériques

Lorsque des notations alphanumériques ou des symboles sont utilisés, la présentation doit être la suivante:

ampères	A
volts	V
courant alternatif	AC ou ~
terre de protection	 [IEC 60417-5019 (2006-08)] ou PE
terre	 [IEC 60417-5017 (2006-08)]
borne neutre	N

Pour le marquage de la tension et du courant assignés, des valeurs numériques seules peuvent être utilisées, la valeur du courant assigné étant placée avant ou au-dessus de celle de la tension assignée et séparée de cette dernière par un trait. Le symbole pour la nature du courant doit figurer à côté du marquage de la tension et du courant assignés.

NOTE 1 Exemples pour le marquage du courant, de la tension et de la nature du courant:

$$10 \text{ A } 250 \text{ V } \sim \text{ ou } 10/250 \sim \text{ ou } \frac{10}{250} \sim \text{ ou } \left(\frac{10}{250} \right) \sim$$

NOTE 2 Les lignes dues à la forme de l'outil ne sont pas considérées comme faisant partie du marquage.

8.5 Lisibilité des marquages

Les marquages prévus en 8.1 pour les prises mobiles/fiches mobiles mâles doivent être facilement discernables lorsque la prise mobile/fiche mobile mâle est câblée et prête à l'usage.

NOTE Le terme "prête à l'usage" n'implique pas que la prise mobile est engagée dans un socle de connecteur.

8.6 Marquages des bornes et instructions de câblage

Pour les prises mobiles/fiches mobiles mâles démontables et non réversibles, les bornes doivent être marquées de la manière suivante:

- | | | |
|-----------------------------|---------|---|
| – borne de mise à la terre: | symbole |  ou  ou PE |
| – borne neutre: | lettre | N |

Pour les prises mobiles/fiches mobiles mâles polarisées non démontables, il n'est pas nécessaire de marquer les contacts, mais les conducteurs doivent être connectés, comme spécifié en 22.1.

Pour les socles de connecteurs/socles femelles de connecteurs autres que ceux intégrés ou incorporés dans un appareil d'utilisation ou un matériel électrique et destinés à être utilisés avec des prises mobiles/fiches mobiles mâles conformes aux spécifications de 8.6, les bornes doivent être marquées conformément aux spécifications du 8.6.

Les prises mobiles démontables et les fiches mobiles mâles démontables doivent être fournies avec les instructions suivantes:

- un schéma qui explique la méthode de raccordement des conducteurs, en particulier la longueur supplémentaire du conducteur de terre;
- un schéma qui indique la mise en œuvre du dispositif d'arrêt de traction;
- un schéma qui donne la longueur de gaine et d'isolant à retirer;
- les types et tailles de câbles ou cordons appropriés.

Il n'est pas nécessaire de joindre ces instructions aux prises mobiles/fiches mobiles mâles destinées à l'approvisionnement d'un équipementier, mais elles doivent être mises à disposition de l'équipementier.

8.7 Durabilité

Les marquages exigés dans le cadre du présent document doivent être durables et facilement lisibles. Ils ne doivent pas être placés sur des vis, des rondelles amovibles ou d'autres parties amovibles.

8.8 Essai et examen

La conformité aux exigences spécifiées du 8.1 au 8.7 est vérifiée par examen et par l'essai suivant.

Les marquages sont frottés à la main pendant 15 s avec un chiffon imbibé d'eau, et à nouveau pendant 15 s avec un chiffon imbibé d'essence.

Après cet essai et après tous les essais non destructifs du présent document, les marquages doivent rester lisibles. Il ne doit pas être facile d'enlever les étiquettes et celles-ci ne doivent présenter aucun signe de détachement.

Les marquages réalisés par moulage, estampage ou gravure ne sont pas soumis à cet essai.

9 Dimensions et compatibilité

9.1 Généralités

Les connecteurs doivent être conçus et construits de façon à empêcher tout raccordement involontaire ou incorrect.

La conformité est vérifiée par examen et en cas de doute par les essais décrits du 9.2 au 9.5.

9.2 Connexions unipolaires

Il ne doit pas être possible d'établir des connexions unipolaires entre les prises mobiles/fiches mobiles mâles et les socles de connecteurs/socles femelles de connecteurs.

La conformité est vérifiée par un essai manuel.

9.3 Compatibilité

Il doit être impossible d'engager:

- les prises mobiles destinées au raccordement des matériels de la classe II dans les socles de connecteurs/fiches mobiles mâles prévus pour les matériels de la classe I;
- les fiches mobiles mâles des dispositifs de protection de la classe I dans les prises mobiles/socles femelles de connecteurs de dispositifs de protection de la classe II;
- les prises mobiles pour conditions froides dans les socles de connecteurs pour conditions chaudes ou très chaudes;
- les fiches mobiles mâles pour conditions froides dans les socles femelles de connecteurs pour conditions chaudes ou très chaudes;
- les prises mobiles pour conditions chaudes dans les socles de connecteurs pour conditions très chaudes;
- les fiches mobiles mâles pour conditions chaudes dans les socles femelles de connecteurs pour conditions très chaudes;
- les prises mobiles dans les socles de connecteurs/fiches mobiles mâles dont le courant assigné est supérieur à celui de la prise mobile;
- les fiches mobiles mâles dans les socles femelles de connecteurs dont le courant assigné est inférieur à celui de la fiche mobile mâle.

L'engagement d'une prise mobile ou d'une fiche mobile mâle est réalisé dans n'importe quelle configuration non prévue en exerçant une force de 60 N pendant 60 s au minimum.

Au cours de l'essai, il ne doit y avoir aucun contact des broches.

La conformité est vérifiée par examen, par l'essai manuel du 9.4 et au moyen de tous les composants fournis par le constructeur.

9.4 Dimensions des connecteurs normalisés

Les connecteurs normalisés doivent être conformes aux feuilles de norme applicables conformément à l'IEC 60320-3.

Les dimensions sont vérifiées au moyen de calibres ou par mesurage. En cas de doute, des calibres doivent être utilisés.

9.5 Dimensions des connecteurs non normalisés

Les connecteurs non normalisés dont les dimensions diffèrent de celles spécifiées dans les feuilles de norme conformément à l'IEC 60320-3 sont admis, sous réserve qu'ils ne compromettent pas la fonction et la sécurité des connecteurs conformes aux feuilles de norme, en particulier en ce qui concerne l'interchangeabilité et la non-interchangeabilité.

De faibles écarts par rapport aux dimensions spécifiées dans les feuilles de norme, qui donnent l'impression qu'il s'agit d'un connecteur normalisé et peuvent conduire à le confondre avec un connecteur normalisé, ne sont pas admis.

Aucune modification qui réduit le pouvoir de fermeture des contacts n'est admise.

Il ne doit pas être possible d'engager une partie d'un connecteur non normalisé dans une partie complémentaire d'un connecteur conforme aux feuilles de norme spécifiées dans une partie de l'IEC 60320.

Il ne doit pas être possible d'engager une partie d'un connecteur non normalisé dans une partie complémentaire d'un connecteur normalisé en courant continu.

NOTE Les documents applicables en courant continu, à savoir la série IEC TS 63236, sont en cours d'élaboration.

Il ne doit pas être possible dans un système donné d'établir des connexions autrement que dans la position prévue, ou d'établir des connexions partielles qui provoquent une déformation qui peut compromettre l'usage ultérieur de l'appareil d'utilisation pour:

- une prise mobile et le socle de connecteur associé;
- un socle femelle de connecteur avec la fiche mobile mâle associée.

La conformité est vérifiée par un essai manuel.

10 Protection contre les chocs électriques

10.1 Accessibilité des parties actives

Les connecteurs doivent être conçus de façon à ce que les parties actives ne soient pas accessibles en cas d'engagement partiel ou complet.

Les prises mobiles/socles femelles de connecteur doivent être conçus de façon à ce que les parties actives ne soient pas accessibles lorsque les prises mobiles/socles femelles de connecteur sont convenablement assemblés et câblés comme en utilisation normale.

La conformité est vérifiée par examen et par un essai avec le calibre d'essai normalisé B de l'IEC 61032.

Le calibre d'essai est appliqué dans toutes les positions possibles et les contacts éventuels avec les parties concernées sont mis en évidence par un indicateur électrique. Pour les prises mobiles dont l'enveloppe ou le corps est en élastomère ou en matériau thermoplastique, le doigt d'épreuve normalisé est appliqué pendant 30 s au minimum avec une force de 20 N en chacun des points où une rupture de l'isolant pourrait compromettre la sécurité de la prise mobile.

NOTE Un indicateur électrique, avec une tension comprise entre 24 V et 50 V, est utilisé pour mettre en évidence le contact avec la partie concernée.

10.2 Protection contre les connexions unipolaires

Il ne doit pas être possible d'établir une connexion entre une broche d'un socle de connecteur/d'une fiche mobile mâle et un contact d'une prise mobile/d'un socle femelle de connecteur tant qu'une broche reste accessible.

La conformité est vérifiée par un essai manuel suivi par l'essai du 10.1.

10.3 Protection contre l'accès aux parties actives

Il ne doit pas être possible d'enlever sans l'aide d'un outil les parties qui interdisent l'accès aux parties actives.

Les manchons éventuels prévus aux orifices d'entrée des broches doivent être fixés efficacement et il ne doit pas être possible de les enlever sans démonter la prise mobile/le socle femelle de connecteur.

La conformité est vérifiée par examen et par un essai manuel.

10.4 Parties extérieures

Les parties extérieures des prises mobiles, des socles femelles de connecteurs et des fiches mobiles mâles, à l'exception des vis d'assemblage et organes analogues, doivent être en matériau isolant.

La conformité est vérifiée par examen.

10.5 Jupes

La jupe et la base des socles de connecteurs sans contact de mise à la terre et celles des socles de connecteurs/socles femelles de connecteurs 2,5 A avec contact de mise à la terre doivent être en matériau isolant.

La conformité est vérifiée par examen.

NOTE Les qualités du matériau isolant sont vérifiées lors des essais diélectriques de l'Article 15.

11 Dispositions en vue de la mise à la terre

Les connecteurs avec contact de mise à la terre de protection doivent être construits de sorte que le contact de mise à la terre de protection soit établi en premier et coupé en dernier par rapport à tout autre contact.

La conformité est vérifiée par examen.

12 Bornes et sorties

12.1 Généralités

Pour les bornes et les sorties, les exigences de la Norme internationale IEC pertinente s'appliquent.

Les organes de serrage des bornes ne doivent pas être utilisés pour fixer tout autre composant bien qu'ils puissent maintenir les bornes en place ou les empêcher de tourner.

12.2 Connecteurs démontables

Les connecteurs démontables doivent être équipés d'organes de serrage à vis ou sans vis conformes à l'IEC 60999-1.

La conformité est vérifiée par examen.

12.3 Connecteurs non démontables

Les connecteurs non démontables doivent être équipés de connexions soudées, brasées, serties ou de connexions sans vis aussi efficaces, qui doivent empêcher toute possibilité de déconnexion du conducteur.

La conformité est vérifiée par examen.

13 Construction

13.1 Risque de contact accidentel

Les connecteurs doivent être conçus de façon à éviter tout risque de contact accidentel entre le contact de mise à la terre du socle de connecteur/de la fiche mobile mâle et les contacts qui transportent le courant de la prise mobile/du socle femelle de connecteur.

13.2 Position des contacts

Pour des prises mobiles/fiches mobiles mâles non réversibles, les positions des contacts doivent être établies en observant la face d'engagement des prises mobiles/fiches mobiles mâles, comme indiqué dans les feuilles de norme fournies à l'Article 4 de l'IEC 60320-3:2014 et l'IEC 60320-3:2014/AMD1:2018. Leur position doit être conforme aux spécifications du Tableau 1.

Tableau 1 – Position des contacts

Type de contact	Position des contacts	
	Prises mobiles non réversibles	Fiches mobiles mâles non réversibles
Contact de mise à la terre	Disposition symétrique (de préférence)	Disposition symétrique (de préférence)
Contact de phase	En bas à droite	En bas à gauche
Contact neutre	En bas à gauche	En bas à droite

Pour les connecteurs non réversibles qui ne sont pas conformes aux feuilles de norme fournies à l'Article 4 de l'IEC 60320-3:2014 et l'IEC 60320-3:2014/AMD1:2018, la bonne polarisation doit être vérifiée.

La conformité est vérifiée par examen.

NOTE La conformité aux feuilles de norme assure le respect de cette exigence.

13.3 Parties qui protègent les parties actives

Les parties qui assurent la protection contre les contacts avec les parties actives doivent être protégées efficacement contre les desserrages.

La conformité est vérifiée par examen et par les essais de l'Article 18, l'Article 20 et l'Article 23.

13.4 Construction des broches

13.4.1 Prévention de la rotation

Les broches des socles de connecteurs/fiches mobiles mâles et les contacts des prises mobiles/socles femelles de connecteurs doivent être protégés contre la rotation.

La conformité est vérifiée par examen et par un essai manuel.

NOTE Les vis de serrage peuvent servir à empêcher la rotation des contacts.

13.4.2 Maintien des broches

Les broches des socles de connecteurs/fiches mobiles mâles doivent être solidement maintenues et doivent avoir une résistance mécanique suffisante. Il ne doit pas être possible de les enlever sans l'aide d'un outil et elles doivent être entourées par une jupe. Les broches ne doivent pas faire saillie au-delà du bord de la jupe.

Un léger déplacement des broches est admis.

La sûreté du maintien des broches est vérifiée par examen et, en cas de doute, par l'essai ci-après.

L'échantillon est porté à la température qui correspond à sa classe de température donnée en 7.1 pendant 60^{+5}_0 min et maintenu à cette température pendant la durée de l'essai, y compris la période de 5 min après le retrait de la charge d'essai.

Le socle de connecteur/la fiche mobile mâle est maintenu(e) fermement de telle façon qu'il n'y ait ni distorsion ni compression excessive du corps, et le moyen de fixation ne doit pas aider au maintien des broches dans leur position d'origine.

Chaque broche est soumise à une force de $60 \text{ N} \pm 0,6 \text{ N}$ appliquée sans à-coups dans le sens de l'axe de la broche et maintenue à cette valeur pendant une durée de 60^{+3}_0 s.

Pour toutes les broches, la force est dans un premier temps appliquée vers l'extérieur du socle de connecteur/de la fiche mobile mâle, puis vers l'intérieur du socle de connecteur/de la fiche mobile mâle.

La fixation des broches est jugée satisfaisante s'il n'y a aucun déplacement de plus de 2,5 mm pendant l'essai sur chacune des broches et à condition que dans les 5 min qui suivent le retrait de la force d'essai vers l'intérieur ou vers l'extérieur, toutes les broches restent dans les tolérances spécifiées dans les feuilles de norme applicables ou, pour les connecteurs non normalisés, selon les spécifications du constructeur.

La conformité est vérifiée par examen et par un essai manuel.

13.4.3 Broches non massives

Les broches non massives sont en outre soumises à l'essai suivant après exécution de tous les autres essais.

La jupe est retirée du socle de connecteur/de la fiche mobile mâle et la broche est placée sur un support, comme représenté à la Figure 2.

Dimensions en millimètres

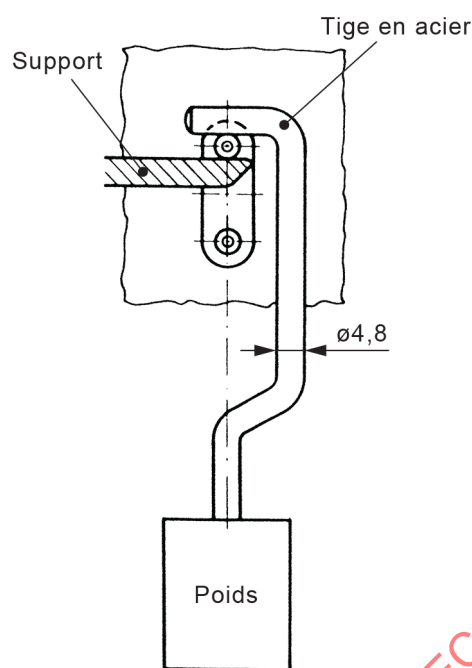


Figure 2 – Dispositif d'essai des broches non massives

Une force de 100 N est exercée sur la broche pendant 60^{+3}_0 s dans une direction perpendiculaire à son axe, au moyen d'une tige en acier de 4,8 mm de diamètre dont l'axe est également perpendiculaire à celui de la broche.

Après l'essai, la forme de la broche ne doit pas avoir été altérée significativement.

13.4.4 Broches de connecteurs pour températures ambiantes élevées (inférieures ou égales à +90 °C)

Les broches des fiches mobiles mâles ou des socles de connecteurs pour températures ambiantes élevées doivent être en matériau solide.

13.5 Pression de contact

Les contacts des prises mobiles/socles femelles de connecteurs doivent s'aligner d'eux-mêmes pour assurer une pression de contact appropriée.

Pour les prises mobiles/socles femelles de connecteurs autres que de type 0,2 A, l'autoalignement des contacts ne doit pas reposer sur l'élasticité du matériau isolant.

La conformité est vérifiée par examen et par les essais des Articles 16 à 21 inclus.

13.6 Enveloppe

13.6.1 Généralités

Les parties du corps des prises mobiles/fiches mobiles mâles doivent être fixées d'une manière sûre les unes aux autres.

La conformité est vérifiée par examen, par un essai manuel et par l'essai du 23.6.

13.6.2 Prises mobiles démontables et fiches mobiles mâles démontables

Il ne doit pas être possible de démonter la prise mobile/fiche mobile mâle sans l'aide d'un outil.

L'enveloppe des prises mobiles/fiches mobiles mâles démontables doit envelopper complètement les bornes et les extrémités du cordon, au moins jusqu'au point où la gaine doit être enlevée.

La construction doit être telle que, depuis le point de séparation des âmes, les conducteurs puissent être raccordés correctement et que, lorsque la prise mobile/fiche mobile mâle est montée et équipée de ses conducteurs comme en utilisation normale, il n'y ait aucun risque que:

- les âmes pressées les unes contre les autres endommagent l'isolant du conducteur, ce qui est susceptible de produire un claquage de l'isolant;
- une âme, dont le conducteur est relié à une borne sous tension, soit susceptible d'être pressée contre des parties métalliques accessibles;
- une âme, dont le conducteur est relié aux bornes de terre, soit susceptible d'être pressée contre des parties actives.

Pour les prises mobiles démontables, il ne doit pas être possible de réaliser un montage dans lequel les bornes sont protégées et les contacts accessibles.

Pour les prises mobiles/fiches mobiles mâles démontables, la fixation et le positionnement d'une partie du corps par rapport à l'autre doivent être assurés par des moyens indépendants dont l'un au moins, par exemple une vis, ne peut être manœuvré qu'avec l'aide d'un outil; les vis autotaraudeuses à découpe ne doivent pas être utilisées à cet effet.

L'élasticité des contacts ne doit pas dépendre de l'assemblage des parties du corps.

Un desserrage partiel des vis de montage ou d'un autre moyen d'assemblage ne doit pas permettre la séparation des parties qui assurent la protection contre les chocs électriques.

La conformité est vérifiée par examen et par un essai manuel.

13.6.3 Prises mobiles non démontables et fiches mobiles mâles non démontables

Les appareils non démontables doivent être tels que:

- le câble souple ou cordon ne peut pas être séparé de l'appareil sans rendre celui-ci inutilisable de façon permanente; et
- l'appareil ne peut pas être ouvert à la main ou à l'aide d'un outil d'usage général.

NOTE Un appareil est considéré comme inutilisable de façon permanente lorsque, pour son remontage, des pièces ou matériels autres que ceux d'origine doivent être utilisés.

La conformité est vérifiée par examen et par un essai manuel.

13.7 Connexion de terre

Pour les prises mobiles/fiches mobiles mâles, le contact/la broche de terre doit être fixé(e) au corps. Si le contact/la broche de terre et la borne de terre ne sont pas d'une seule pièce, les différentes parties doivent être assemblées par rivetage, brasage ou par d'autres procédés qui procurent une fiabilité équivalente.

Les parties métalliques des connecteurs doivent être conçues de sorte que la corrosion n'altère pas la sécurité du point de vue de leurs caractéristiques électriques et mécaniques.

La connexion entre le contact/broche de terre et la borne de terre doit être métallique et résistante à la corrosion.

La conformité est vérifiée par examen.

13.8 Emplacement des bornes et des sorties

13.8.1 Généralités

Les bornes des appareils démontables et les sorties des appareils non démontables doivent être disposées ou protégées de telle sorte que des brins libres d'un conducteur dans l'appareil ne présentent pas de risque de choc électrique.

Les appareils non démontables surmoulés doivent être équipés de dispositifs qui empêchent les brins libres d'un conducteur de réduire les exigences de distance d'isolement minimale entre les brins et toutes les surfaces extérieures accessibles de l'appareil, à l'exception de la face d'engagement du socle de connecteur.

La conformité est vérifiée comme suit:

- pour les appareils démontables, par l'essai du 13.8.2;
- pour les appareils non démontables non surmoulés, par l'essai du 13.8.3;
- pour les appareils non démontables surmoulés, par vérification et examen selon 13.8.4.

13.8.2 Essai de brin libre pour les appareils démontables

L'isolant est retiré sur une longueur de 6 mm à partir de l'extrémité d'un conducteur souple avec une section de 0,75 mm². Un seul brin du conducteur souple est laissé libre et les autres sont introduits complètement et serrés dans la borne, comme pour une utilisation normale.

Le brin libre est plié, sans déchirer l'isolant, dans toutes les directions possibles, mais sans faire de pliages à angle aigu autour des cloisons.

NOTE L'interdiction d'exécuter des pliages à angle aigu autour des cloisons n'implique pas que le brin libre doive être maintenu rectiligne pendant l'essai. En outre, ces pliages à angle aigu sont exécutés s'il est considéré comme probable que de tels pliages puissent se produire au cours de l'assemblage normal de l'appareil, par exemple lorsqu'un couvercle est posé dessus.

Le brin libre d'un conducteur relié à une borne sous tension ne doit pas venir en contact avec une partie métallique accessible ou être susceptible de sortir de l'enveloppe lorsque l'appareil a été assemblé.

Le brin libre d'un conducteur relié à une borne de terre ne doit pas venir en contact avec une partie active.

Si nécessaire, l'essai est répété avec le brin libre dans une autre position.

13.8.3 Essai de brin libre pour les appareils non démontables non surmoulés

Une longueur d'isolant qui correspond à la longueur maximale prévue de dénudage déclarée par le constructeur augmentée de 2 mm est enlevée de l'extrémité d'un conducteur souple qui a la même section que le conducteur d'origine. Un seul brin du conducteur souple est laissé libre dans la position la plus défavorable et les autres sont connectés d'une manière semblable à celle utilisée dans la conception de l'appareil.

Le brin libre est plié, sans déchirer l'isolant, dans toutes les directions possibles, mais sans faire de pliages à angle aigu autour des cloisons.

NOTE L'interdiction d'exécuter des pliages à angle aigu autour des cloisons n'implique pas que le brin libre doive être maintenu rectiligne pendant l'essai. En outre, ces pliages à angle aigu peuvent être exécutés s'il est considéré comme probable que de tels pliages puissent se produire au cours de l'assemblage normal de l'appareil, par exemple lorsqu'un couvercle est posé dessus.

Le brin libre d'un conducteur relié à une sortie sous tension ne doit pas venir en contact avec une partie métallique accessible ni réduire les lignes de fuite et les distances d'isolement à travers tout orifice de conception jusqu'à la surface extérieure au-dessous de 1,5 mm.

Le brin libre d'un conducteur relié à une sortie de terre ne doit pas venir en contact avec une partie active.

13.8.4 Vérification du brin libre pour les appareils non démontables surmoulés

Les appareils non démontables surmoulés doivent être examinés pour vérifier qu'ils sont équipés de dispositifs qui empêchent les brins libres du conducteur et/ou les parties actives de réduire la distance minimale à travers l'isolation jusqu'à la surface extérieure accessible (à l'exception de la face d'engagement des socles de connecteurs) au-dessous de 1,5 mm.

NOTE La vérification des moyens peut exiger la vérification de la conception du produit ou de la méthode d'assemblage.

13.9 Prises mobiles/fiches mobiles mâles sans contact de mise à la terre

Les prises mobiles/fiches mobiles mâles sans contact de mise à la terre et les prises mobiles/fiches mobiles mâles 2,5 A avec contact de mise à la terre doivent faire partie d'un cordon-connecteur ou d'un cordon-connecteur d'interconnexion.

La conformité est vérifiée par examen.

13.10 Fusibles, relais, thermostats, déclencheurs thermiques et interrupteurs

Les fusibles, les relais, les thermostats et les déclencheurs thermiques ne doivent pas être incorporés à des prises mobiles ou à des fiches mobiles mâles conformes aux feuilles de norme de l'IEC 60320-3.

Les fusibles, les relais, les thermostats et les déclencheurs thermiques incorporés à des socles de connecteurs et à des socles femelles de connecteurs doivent être conformes aux Normes internationales IEC applicables.

Les interrupteurs incorporés à des connecteurs doivent être conformes à l'IEC 61058 (toutes les parties).

Les régulateurs d'énergie incorporés à des connecteurs doivent être conformes à l'IEC 60730-2-11.

La conformité est vérifiée par examen et en soumettant à l'essai les interrupteurs, les fusibles, les relais, les thermostats, les déclencheurs thermiques et les régulateurs d'énergie conformément aux spécifications de la Norme internationale IEC applicable.

14 Résistance à l'humidité

Les connecteurs doivent être capables de résister aux conditions d'humidité qui peuvent survenir en utilisation normale.

Si de tels connecteurs sont utilisés avec des matériels qui sont sujets, en utilisation normale, à des débordements de liquide, la protection contre l'humidité doit alors être assurée par le matériel.

La conformité est vérifiée par l'épreuve hygroscopique décrite à l'Article 14, suivie immédiatement des essais de l'Article 15.

Les prises mobiles/fiches mobiles mâles et les socles de connecteurs/socles femelles de connecteurs ne sont pas engagés lorsqu'ils sont soumis à l'épreuve hygroscopique; les prises mobiles/fiches mobiles mâles démontables ne sont pas équipées d'un cordon.

L'épreuve hygroscopique est effectuée dans une enceinte humide, où l'humidité relative de l'air est maintenue entre 91 % et 95 %. La température de l'air, en tout endroit où peuvent être placés les échantillons, est maintenue, à ± 1 °C, à une valeur t °C adéquate comprise entre 20 °C et 30 °C.

Avant d'être placés dans l'enceinte humide, les échantillons sont portés à une température comprise entre t °C et $(t + 4)$ °C.

Les échantillons sont maintenus dans l'enceinte pendant:

- 168 h (7 j) dans le cas des connecteurs avec contact de mise à la terre lorsqu'ils sont présentés comme des appareils individuels, non incorporés dans d'autres matériels électriques;
- 48 h (2 j) dans tous les autres cas.

NOTE 1 Dans la plupart des cas, les échantillons peuvent être portés à la température spécifiée en les maintenant à cette température pendant 4 h au minimum avant l'épreuve hygroscopique.

NOTE 2 Une humidité relative comprise entre 91 % et 95 % peut être obtenue en plaçant dans l'enceinte humide une solution saturée de sulfate de sodium (Na_2SO_4) ou de nitrate de potassium (KNO_3) dans de l'eau qui présente une surface de contact suffisamment importante avec l'air.

Après cette épreuve, l'échantillon ne doit présenter aucun dommage au sens du présent document.

15 Résistance d'isolement et rigidité diélectrique

15.1 Généralités

La résistance d'isolement et la rigidité diélectrique des connecteurs doivent avoir une valeur appropriée.

La conformité est vérifiée par les essais du 15.2 et du 15.3, ces essais étant exécutés immédiatement après l'épreuve hygroscopique de l'Article 14.

Les indicateurs tels que les lampes au néon, qui peuvent être endommagés lors des essais du 15.2 et du 15.3, doivent avoir un pôle déconnecté avant l'essai.

La résistance d'isolement est mesurée en tenant compte des conditions suivantes:

- a) pour les socles de connecteurs, avec une prise mobile insérée entre les contacts qui transportent le courant reliés ensemble et le corps;
- b) pour les socles de connecteurs, avec une prise mobile insérée tour à tour entre chaque broche et les autres broches reliées ensemble;
- c) pour les socles femelles de connecteurs, avec une fiche mobile mâle insérée entre les contacts qui transportent le courant reliés ensemble et le corps;
- d) pour les socles femelles de connecteurs, sans une fiche mobile mâle insérée entre les contacts qui transportent le courant reliés ensemble et le corps;
- e) pour les socles femelles de connecteurs, avec une fiche mobile mâle insérée tour à tour entre chaque broche et les autres broches reliées ensemble;

- f) pour les prises mobiles, entre les contacts qui transportent le courant reliés ensemble et le corps;
- g) pour les prises mobiles, tour à tour entre chaque contact et les autres contacts reliés ensemble;
- h) pour les fiches mobiles mâles, entre les contacts qui transportent le courant reliés ensemble et le corps;
- i) pour les fiches mobiles mâles, tour à tour entre chaque contact et les autres contacts reliés ensemble.

Essai additionnel pour les prises mobiles démontables et les fiches mobiles mâles démontables:

- j) pour les prises mobiles démontables, entre toute partie métallique du dispositif d'arrêt de traction et de torsion, y compris les vis de serrage, et le contact de mise à la terre ou la borne de terre;
- k) pour les prises mobiles démontables, entre toute partie métallique du dispositif d'arrêt de traction et de torsion, à l'exception des vis de serrage, et une tige métallique du diamètre maximal du cordon spécifié dans le Tableau 2, montée à sa place;
- l) pour les fiches mobiles mâles démontables, entre toute partie métallique du dispositif d'arrêt de traction et de torsion, y compris les vis de serrage, et le contact de mise à la terre ou la borne de terre;
- m) pour les fiches mobiles mâles démontables, entre toute partie métallique du dispositif d'arrêt de traction et de torsion, à l'exception des vis de serrage, et une tige métallique du diamètre maximal du cordon spécifié dans le Tableau 2, montée à sa place.

Aux points a), c), d), f) et h) ci-dessus, le terme "corps" fait référence à toutes les parties métalliques accessibles, les vis de fixation, les vis d'assemblage extérieures ou analogues et une feuille métallique appliquée sur la surface extérieure des parties externes en matériau isolant. Aux points d), f) et h), le terme "corps" fait référence la face d'engagement des prises mobiles ou des socles femelles de connecteurs, mais pas à la face d'engagement des fiches mobiles mâles.

La feuille métallique est plaquée contre la surface extérieure des parties externes en matériau isolant, mais elle n'est pas introduite dans les ouvertures.

Tableau 2 – Diamètres maximaux des cordons

Type de cordon	Nombre de conducteurs et section nominale	Diamètre maximal
	mm ²	mm
60227 IEC 53	3 × 0,75	7,6
	3 × 1	8,0
	3 × 1,5	9,4
60245 IEC 53	3 × 0,75	8,1
	3 × 1	8,5
	3 × 1,5	10,4

La tension d'essai selon 15.2 et 15.3 est appliquée comme suit, selon le cas:

- isolation fonctionnelle: entre les différents pôles du connecteur;
- isolation principale: entre toutes les parties actives reliées ensemble et une feuille métallique appliquée sur la surface extérieure de l'isolation principale et/ou les parties conductrices accessibles;

- isolation supplémentaire: entre deux feuilles métalliques appliquées séparément sur la surface intérieure généralement inaccessible de l'isolation supplémentaire et sa surface accessible;
- isolation renforcée: entre toutes les parties actives reliées ensemble et une feuille métallique appliquée sur la surface accessible de l'isolation renforcée.

Les distances d'isolement et les lignes de fuite doivent être maintenues lors de la préparation de l'échantillon pour cet essai.

Lorsque l'isolation principale et l'isolation supplémentaire ne peuvent pas être soumises à l'essai séparément, l'isolation fournie est soumise aux tensions d'essai spécifiées pour l'isolation renforcée.

15.2 Résistance d'isolement

La résistance d'isolement de l'échantillon est mesurée avec application d'une tension continue de 500^{+50}_0 V, le mesurage étant réalisé dans un délai de $60\text{ s} \pm 5\text{ s}$ après application de la tension. La résistance d'isolement ne doit pas être inférieure à la valeur spécifiée dans le Tableau 3.

Tableau 3 – Résistance d'isolement minimale

Isolation à soumettre à l'essai	Résistance d'isolement
	MΩ
Fonctionnelle	2
Principale	2
Supplémentaire	5
Renforcée	7

NOTE Les matériaux tels que la céramique émaillée ou la porcelaine sont considérés comme ayant une résistance d'isolement satisfaisante et ne sont donc pas soumis aux essais de résistance d'isolement.

15.3 Rigidité diélectrique

L'échantillon d'essai est soumis à une tension quasiment sinusoïdale de fréquence nominale 50 Hz ou 60 Hz. La tension est appliquée pendant $60\text{ s} \pm 5\text{ s}$ à travers l'isolation, comme spécifié dans le Tableau 4.

Au début de l'essai, la tension appliquée ne dépasse pas la moitié de la valeur spécifiée; elle est ensuite rapidement amenée à la pleine valeur. Il ne doit se produire ni contournement ni claquage. Les décharges lumineuses qui ne coïncident pas avec une chute de tension ne sont pas retenues.

Tableau 4 – Rigidité diélectrique

Isolation ou déconnexion à soumettre à l'essai ^b	Tension d'essai (valeur efficace) ^a		
	Tension assignée inférieure ou égale à 50 V	Tension assignée supérieure à 50 V et inférieure ou égale à 130 V	Tension assignée supérieure à 130 V et inférieure ou égale à 250 V
	V	V	V
Isolation fonctionnelle ^c	500	1 300	1 500
Isolation principale ^d	500	1 300	1 500
Isolation supplémentaire ^d	500	1 300	1 500
Isolation renforcée ^{d,e}	500	2 600	3 000

NOTE 1 Tension assignée inférieure ou égale à 50 V: non destinée à être raccordée directement au réseau ni soumise à des surtensions temporaires, comme défini dans l'IEC 60364-4-44.

NOTE 2 Tension supérieure à 50 V: les valeurs reposent sur l'IEC 60364-4-44. Pour l'isolation fonctionnelle, l'isolation principale et l'isolation supplémentaire, les valeurs sont calculées selon la formule $U_0 + 1\,200\text{ V}$ et arrondies. Dans le présent document, la tension maximale phase-terre retenue est $U_0 = 300\text{ V}$.

^a Le transformateur haute tension utilisé pour l'essai doit être conçu de façon à ce que, lorsque les bornes de sortie sont court-circuitées lorsque la tension de sortie a été réglée à la tension d'essai adéquate, le courant de sortie soit d'au moins 200 mA. Le relais à maximum de courant ne doit pas se déclencher lorsque le courant de sortie est inférieur à 100 mA. Des dispositions sont prises pour mesurer les valeurs efficaces de la tension d'essai à $\pm 3\%$.

^b Les composants spéciaux qui peuvent empêcher de réaliser l'essai (lampes à décharge, bobines, enroulements ou condensateurs, par exemple) sont déconnectés à un pôle ou pontés, selon le cas, par rapport à l'isolation à l'essai.

^c Un exemple est l'isolation entre pôles.

^d Pour l'essai, toutes les parties actives sont reliées ensemble et des dispositions sont prises pour s'assurer que toutes les parties mobiles sont dans la position la plus défavorable.

^e Pour les connecteurs qui incorporent une isolation renforcée et une double isolation, des dispositions sont prises pour s'assurer que la tension appliquée à l'isolation renforcée n'impose pas de contrainte excessive sur les parties principales ou supplémentaires de la double isolation.

16 Forces nécessaires pour insérer et retirer la prise mobile/le socle femelle de connecteur

16.1 Généralités

La construction des connecteurs doit permettre une insertion et un retrait faciles de la prise mobile/du socle femelle de connecteur et empêcher la prise mobile/le socle femelle de connecteur de se séparer du socle de connecteur/de la fiche mobile mâle en utilisation normale.

Pour les prises mobiles/socles femelles de connecteurs, la conformité est vérifiée par les essais suivants:

- selon l'essai décrit en 16.2, pour s'assurer que la force maximale nécessaire au retrait de la prise mobile/du socle femelle de connecteur du socle de connecteur/de la fiche mobile mâle n'est pas supérieure à la force maximale spécifiée dans le Tableau 5. Pour les besoins de l'essai, l'homologue correspondant de la prise mobile/du socle femelle de connecteur doit être utilisé (calibre multibroche);
- selon l'essai décrit en 16.3, pour s'assurer que la force minimale nécessaire au retrait d'un calibre à broche unique du contact individuel n'est pas inférieure à la force minimale spécifiée dans le Tableau 5.