

INTERNATIONAL STANDARD



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



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

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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

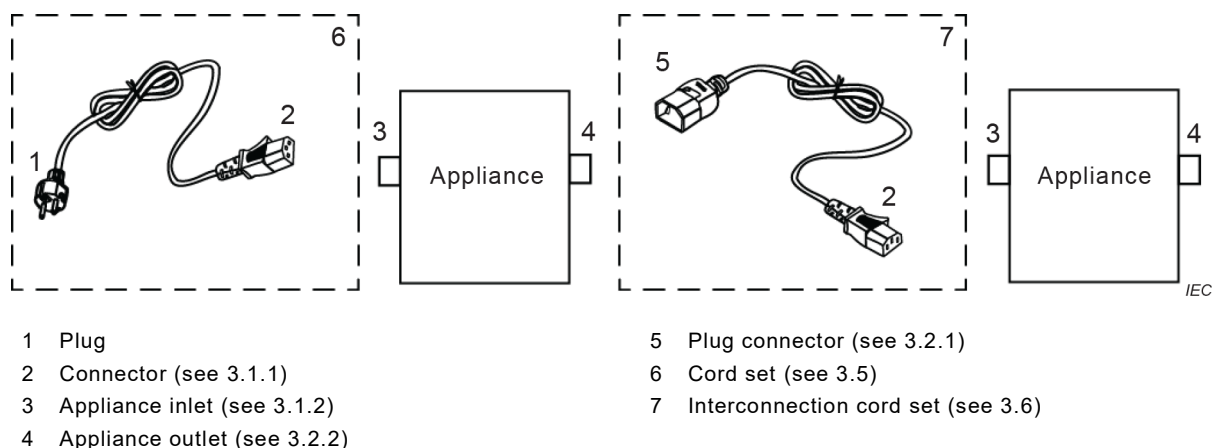


Figure 1 – Intended use of appliance couplers

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~~ 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.

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 h~~ 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 s~~ 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.

Dimensions in millimetres

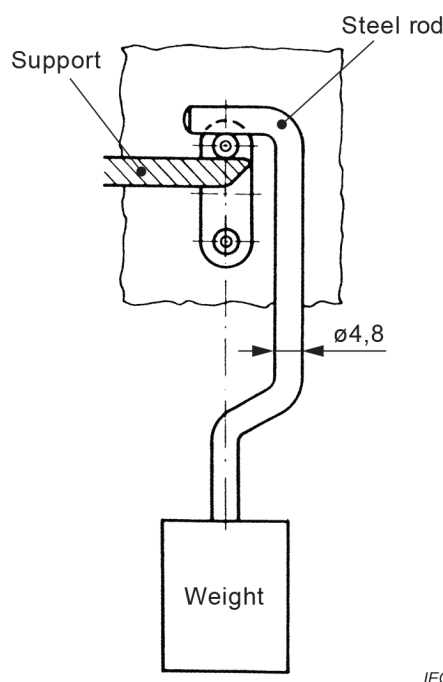


Figure 2 – Device for testing non-solid pins

A force of 100 N is exerted on the pin for ~~1 min~~ 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. **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 $60\text{ s} \pm 5\text{ s}$ 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 $\pm 3\%$.

^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 ~~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.

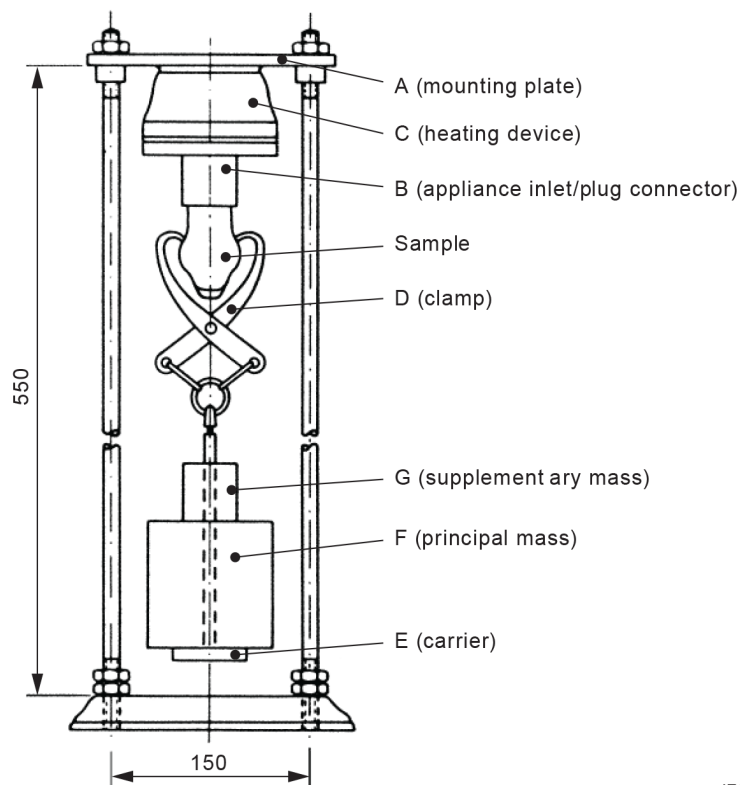
Table 5 – Maximum and minimum withdrawal forces

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 $0,8 \mu\text{m}$ 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.

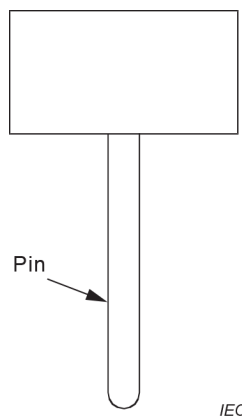
For non-standardized ~~types~~ appliance couplers:

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 °C ± 2 °C for connectors/plug connectors for hot conditions classified in 7.1 b);
- 155 °C ± 2 °C for connectors/plug connectors for very hot conditions classified in 7.1 c).

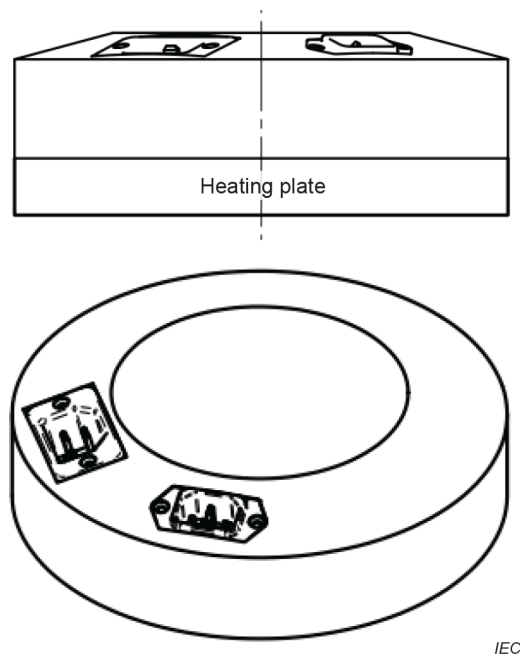


Figure 5 – Example of an apparatus for heating test (see 18.2)

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:

- $120\text{ °C} \pm 2\text{ °C}$ 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 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.

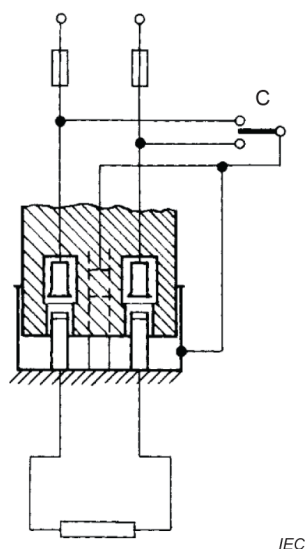
For standardized types, the appliance inlet or plug connector shall have polished, hardened steel pins, and dimensions as specified in the relevant standard sheet. The ends of the pins shall be rounded for rectangular pins and they shall be hemispherical for round pins as shown in the standard sheets.

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

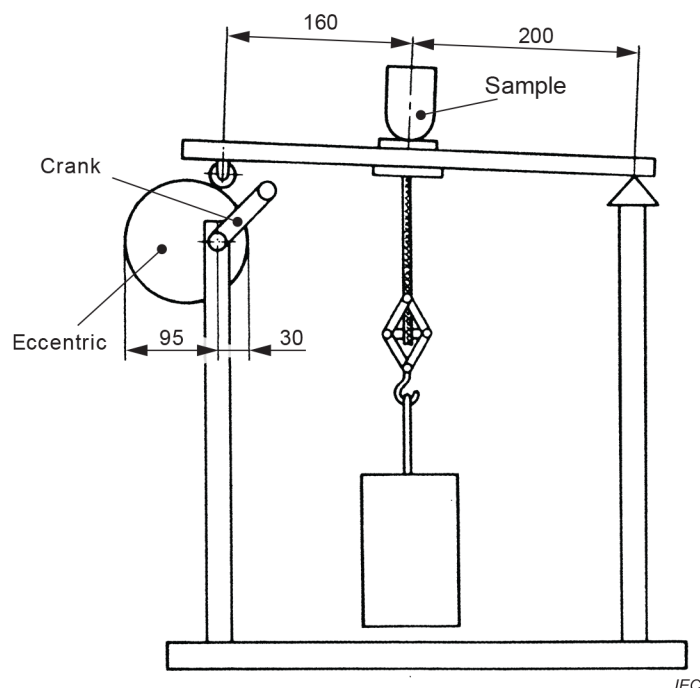


Figure 7 – Apparatus for testing the cord anchorage

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.

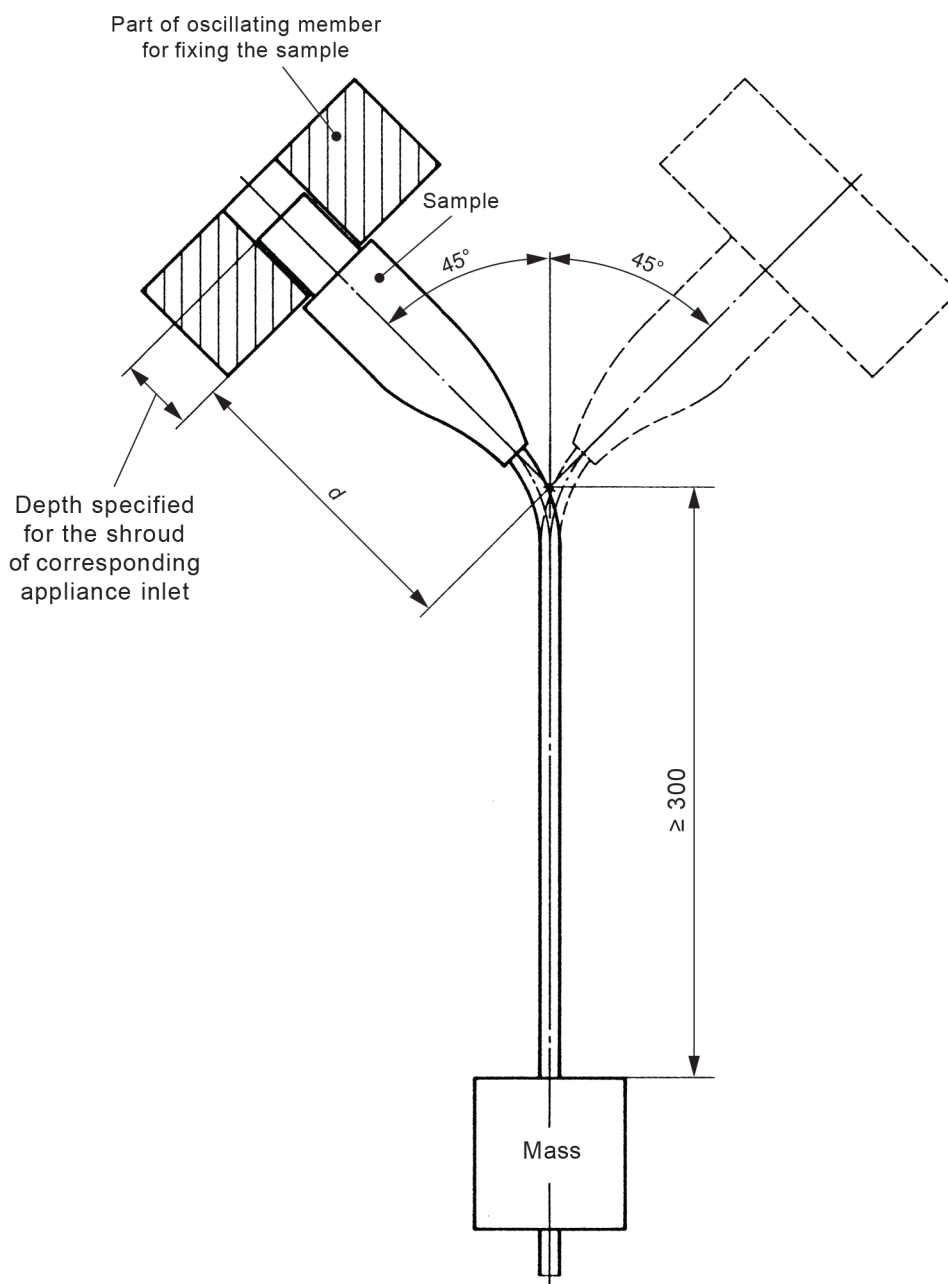
Compliance is checked by inspection and the following test.

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



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~~

- ~~— 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).

Dimensions in millimetres

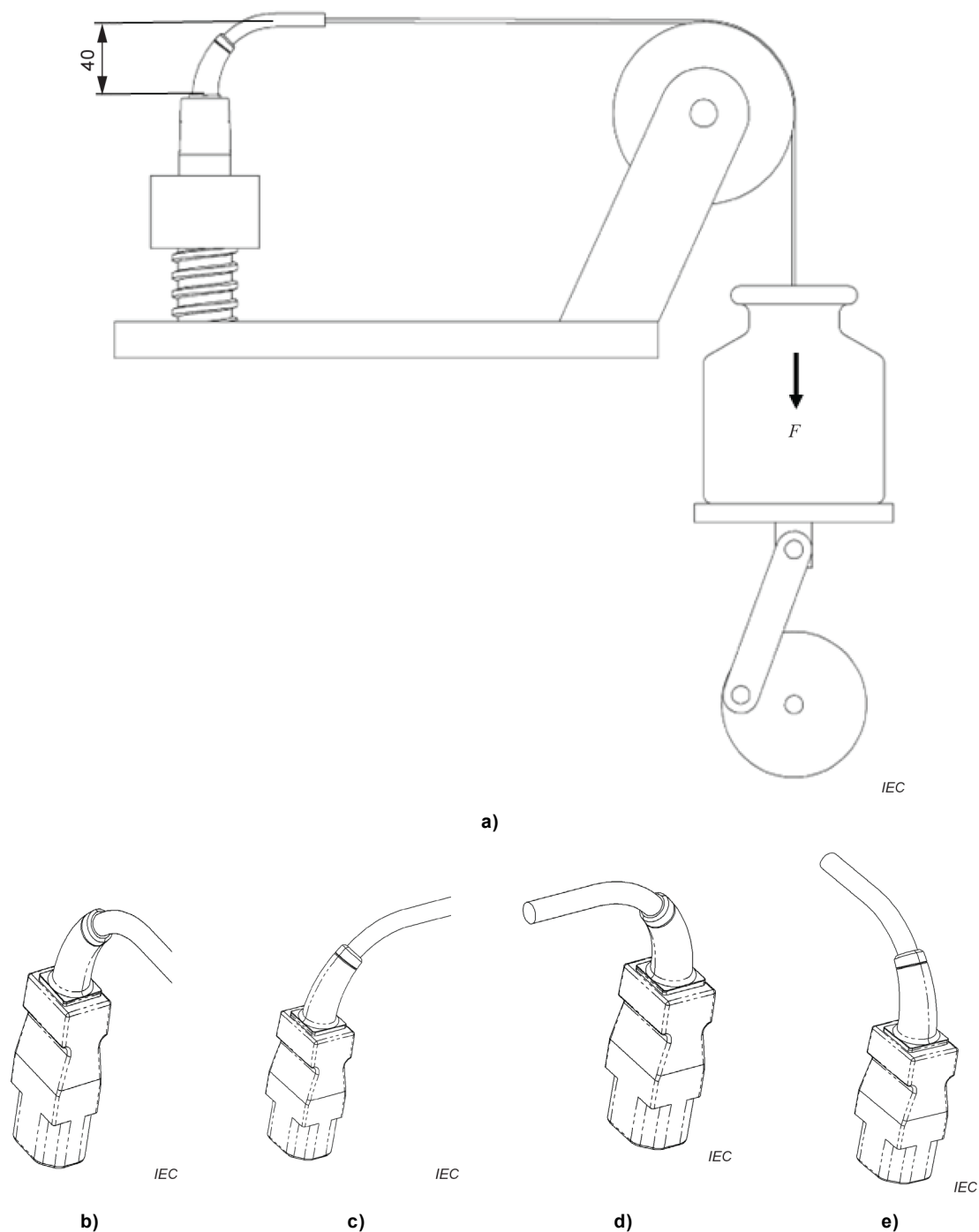


Figure 9 – Example of apparatus for pulling test

~~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.