IEC 60884-2-6

Edition 2.0 2025-02
EXTENDED VERSION

INTERNATIONAL STANDARD

This full version of IEC 60884-2-6:2025 includes the content of the references made to IEC 60884-1:2022

Plugs and socket-outlets for household and similar purposes – Part 2-6: Particular requirements for switched socket-outlets with interlock for fixed electrical installations

IEC 60884-2-6:2025-02 EXV(en)

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PLUGS AND SOCKET-OUTLETS FOR HOUSEHOLD AND SIMILAR PURPOSES –

Part 2-6: Particular requirements for switched socket-outlets with interlock for fixed electrical installations

FOREWORD

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This extended version (EXV) of the official IEC Standard provides the user with the full content of the Standard.

IEC 60884-2-6:2025 EXV includes the content of IEC 60884-2-6:2025, and the references made to IEC 60884-1:2022.

The specific content of IEC 60884-2-6:2025 is displayed on a blue background.

IEC 60884-2-6 has been prepared by subcommittee 23B: Plugs, socket-outlets and switches, of IEC technical committee 23: Electrical accessories. It is an International Standard.

This second edition cancels and replaces the first edition published in 1997. This edition constitutes a technical revision.

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

a) alignment to IEC 60884-1, fourth edition.

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

Draft	Report on voting
23B/1547/FDIS	23B/1561/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.

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/publications.

This document is to be used in conjunction with IEC 60884-1:2022.

This document supplements or modifies the corresponding clauses in IEC 60884-1:2022, so as to convert that publication into the IEC standard: Particular requirements for switched socket-outlets without interlock for fixed installations.

When a particular subclause of IEC 60884-1:2022 is mentioned in this document, that subclause applies as far as reasonable. Where this document states "addition", "modification" or "replacement", the relevant text of IEC 60884-1:2022 is to be adapted accordingly.

In this document the following print types are used:

– requirements proper: in roman type;
– *test specifications: in italic type;*
– Explanatory matter: in smaller roman type.

Subclauses, notes, figures and tables or figures which are additional to those in IEC 60884-1:2022 are numbered starting from 101.

A list of all the parts in the IEC 60884 series, under the general title *Plugs and socket-outlets for household and similar purposes*, can be found on the IEC website.

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, or
- revised.

PLUGS AND SOCKET-OUTLETS FOR HOUSEHOLD AND SIMILAR PURPOSES –

Part 2-6: Particular requirements for switched socket-outlets with interlock for fixed electrical installations

1 Scope

This part of IEC 60884 applies to switched socket-outlets with interlock for AC only, for fixed electrical installations, with or without earthing contact, with rated voltage above 50 V but not exceeding 440 V and a rated current not exceeding 32 A, intended for household and similar purposes, either indoors or outdoors.

Switched socket-outlets with interlock according to this document consist of a combination of socket-outlets according to IEC 60884-1, interlocked with a switch according to IEC 60669-1 and/or IEC 60669-2-1 supplied as a complete accessory.

The rated current is limited to 16 A maximum for fixed accessories provided with screwless terminals.

This document does not cover requirements for flush mounting boxes.

However, it covers those requirements for surface-type mounting boxes which are necessary for the tests on socket-outlets.

NOTE 1 General requirements for mounting boxes are covered by IEC 60670.

NOTE 2 Interlocked socket-outlets incorporating devices according to IEC 60898, IEC 61008 and IEC 61009 are not covered by this document. This document can be used as a guide for the requirements and tests of these accessories where relevant.

This document does not apply to

– interlocked socket-outlets for industrial purposes;
– interlocked socket-outlets for EV;
– interlocked socket-outlets for SELV.

Plugs and socket-outlets complying with this document are suitable for use at ambient temperatures not normally exceeding +40 °C, but their average temperature over a period of 24 h does not exceed +35 °C, with a lower limit of the ambient air temperature of −5 °C.

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 60068-2-30, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 + 12 h cycle)*

IEC 60068-2-31, *Environmental testing – Part 2-31: Tests – Test Ec: Rough handling shocks, primarily for equipment-type specimens*

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

IEC 60112, *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 60417, *Graphical symbols for use on equipment* (available at http://www.graphical-symbols.info/equipment)

IEC 60423:2007, *Conduit systems for cable management – Outside diameters of conduits for electrical installations and threads for conduits and fittings*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*
IEC 60529:1989/AMD1:1999
IEC 60529:1989/AMD2:2013

IEC 60669 (all parts), *Switches for household and similar fixed-electrical installations*

IEC 60669-1:2017, *Switches for household and similar fixed electrical installations – Part 1: General requirements*

IEC 60669-2-1:2021, *Switches for household and similar fixed electrical installations – Part 2-1: Particular requirements – Electronic control devices*

IEC 60695-2-10:2021, *Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure*

IEC 60695-2-11:2021, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end products (GWEPT)*

IEC 60884-1:2022, *Plugs and socket-outlets for household and similar purposes – Part 1: General requirements*

IEC 60884-2-1, *Plugs and socket-outlets for household and similar purposes – Part 2-1: Particular requirements for fused plugs*

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

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

IEC 61545, *Connecting devices – Devices for the connection of aluminium conductors in clamping units of any material and copper conductors in aluminium bodied clamping units*

ISO/IEC Guide 51, *Safety aspects – Guidelines for their inclusion in standards*

ISO 1456:2009, *Metallic and other inorganic coatings – Electrodeposited coatings of nickel, nickel plus chromium, copper plus nickel and of copper plus nickel plus chromium*

ISO 2081:2018, *Metallic and other inorganic coatings – Electroplated coatings of zinc with supplementary treatments on iron or steel*

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

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:

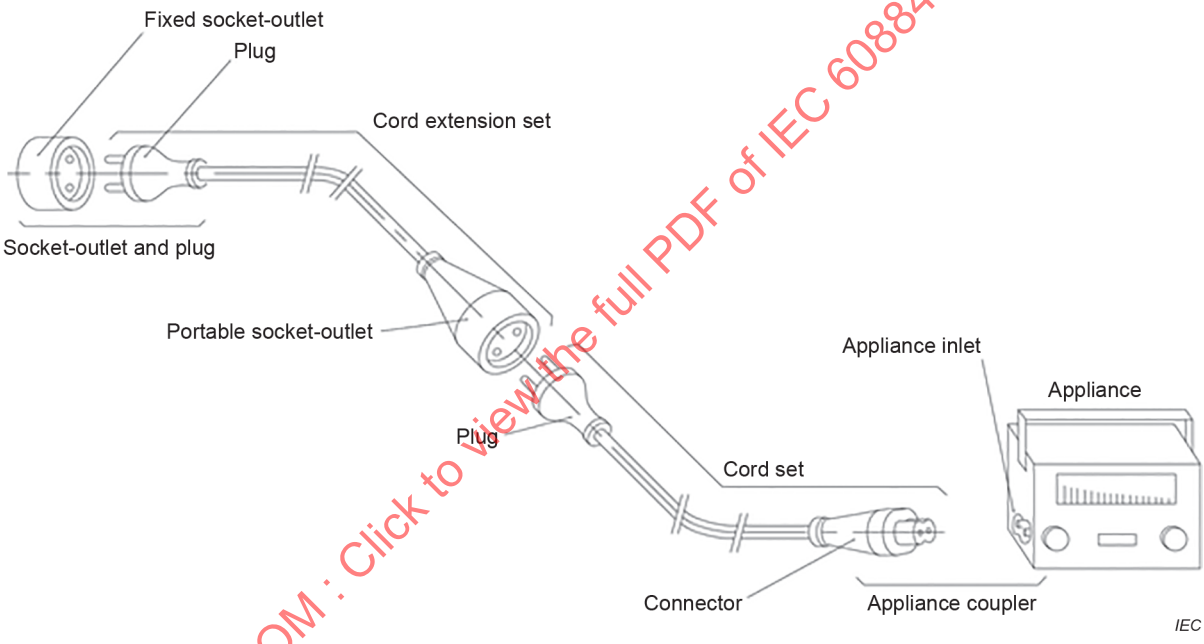
- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

NOTE 1 Where the terms "voltage" and "current" are used, they imply RMS values, unless otherwise specified.

NOTE 2 Throughout this document the word "earthing" is used for "protective earthing" unless otherwise stated.

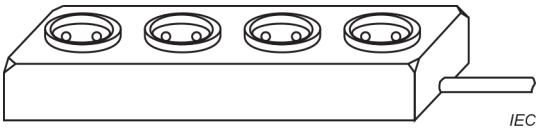
NOTE 3 The term "accessory" is used as a general term covering plugs and socket-outlets; the term "portable accessory" covers plugs and portable socket-outlets. Examples of the use of accessories are shown in Figure 1 a).

NOTE 4 Throughout this document the term "socket-outlet" covers both fixed and portable socket-outlets, except where the reference is specific to one type or the other.



a) Diagram showing various accessories and their use

NOTE Appliance, appliance inlet and appliance coupler are used in this figure only for illustration purposes and they are not covered by this document.



b) Example of a multiple socket-outlet

Figure 1 – Examples of accessories

3.1
plug
accessory having pins designed to engage with the contacts of a socket-outlet

Note 1 to entry: A plug allows the manual connection and disconnection of an electrical load to an electrical supply by an ordinary person.

Note 2 to entry: The plug can be connected to a cable or integrated into an accessory.

Note 3 to entry: In adaptors, the plug can be integral or detachable, see IEC 60884-2-5.

Note 4 to entry: For special purposes such as lighting chains (see also IEC 60598-2-20), two or three single-core cables can be connected within the plug.

3.2
socket-outlet
accessory having socket-contacts designed to engage with the pins of a plug

Note 1 to entry: The socket-outlet can be connected to a cable or integrated into an accessory.

Note 2 to entry: In adaptors, the socket-outlet can be integral or detachable, see IEC 60884-2-5.

3.3
fixed socket-outlet
socket-outlet intended to be installed at a fixed location and be connected to fixed wiring

3.4
portable socket-outlet
socket-outlet intended to be connected to or integral with one flexible cable and which can easily be moved from one place to another while connected to the supply

3.5
multiple socket-outlets
combination of two or more socket-outlets

Note 1 to entry: An example is shown in Figure 1 b).

3.6
rewirable plug
plug so constructed that the flexible cable can be replaced

3.7
non-rewirable plug
assembly of the plug and the flexible cable so constructed that the flexible cable cannot be replaced

3.8
rewirable portable socket-outlet
socket-outlet so constructed that the flexible cable can be replaced

3.9
non-rewirable portable socket-outlet
assembly of the socket-outlet and the flexible cable so constructed that the flexible cable cannot be replaced

3.10
moulded-on accessory
non-rewirable portable accessory the manufacture of which is completed by insulating material moulded around pre-assembled component parts and the terminations for the flexible cable

[SOURCE: IEC 60050-442:1998, 442-01-14, modified – "portable" has been added to the definition and "or cord" has been omitted.]

3.11
mounting box
box intended for mounting in or on a wall, floor or ceiling, etc., for flush or surface application, intended for use with fixed socket-outlet(s)

3.12
cord set
assembly consisting of a flexible cable or cord fitted with a non-rewirable plug and a non-rewirable connector, intended for the connection of an electrical appliance to the electrical supply

[SOURCE: IEC 60050-442:1998, 442-07-04, and IEC 60050-442:2008, 461-06-16]

3.13
cord extension set
assembly consisting of one flexible cable fitted with one plug and one single or multiple portable socket-outlets

3.14
terminal
insulated or non-insulated connecting device intended for reusable electrical connection of the external conductors

3.15
termination
insulated or non-insulated connecting device intended for non-reusable electrical connection of the external conductors

3.16
clamping unit
part(s) of the terminal necessary for the mechanical clamping and the electrical connection of the conductor(s), including the parts which are necessary to ensure correct contact pressure

[SOURCE: IEC 60050-442:1998, 442-06-12]

3.17
screw-type terminal
terminal for the connection and subsequent disconnection of one conductor or the interconnection and subsequent disconnection of two or more conductors, the connection being made, directly or indirectly, by means of screws or nuts of any kind

Note 1 to entry: Term entries 3.18 to 3.23 are examples of screw-type terminals.

3.18
pillar terminal
screw-type terminal in which the conductor is inserted into a hole or cavity, where it is clamped under the end of the screw or screws

Note 1 to entry: The clamping pressure may be applied directly by the end of the screw or through an intermediate clamping member to which pressure is applied by the end of the screw.

Note 2 to entry: Examples of pillar terminals are shown in Figure 9.

3.19
stirrup terminal
pillar terminal where the clamping pressure may be applied indirectly by an intermediate clamping member when the screw is tightened

Note 1 to entry: Examples of stirrup terminals are shown in Figure 9.

3.20
screw head terminal
screw-type terminal in which the conductor is clamped under the head of the screw

Note 1 to entry: The clamping pressure may be applied directly to the head of a screw or through an intermediate part, such as a washer, clamping plate or anti-spread device.

Note 2 to entry: Examples of screw head terminals are shown in Figure 10.

3.21
stud terminal
screw-type terminal in which the conductor is clamped under a nut

Note 1 to entry: The clamping pressure may be applied directly by a suitably shaped nut or through an intermediate part, such as a washer, clamping plate or anti-spread device.

Note 2 to entry: Examples of stud terminals are shown in Figure 10.

3.22
saddle terminal
screw-type terminal in which the conductor is clamped under a saddle by means of two or more screws or nuts

Note 1 to entry: Examples of saddle terminals are shown in Figure 11.

3.23
mantle terminal
screw-type terminal in which the conductor is clamped against the base of a slot in a threaded stud by means of a nut

Note 1 to entry: The conductor is clamped against the base of the slot by a suitably shaped washer under the nut, by a central peg if the nut is a cap nut, or by equally effective means for transmitting the pressure from the nut to the conductor within the slot.

Note 2 to entry: Examples of mantle terminals are shown in Figure 12.

3.24
screwless-type terminal
connecting device for the connection and subsequent disconnection of a rigid (solid or stranded) or flexible conductor or the interconnection of two or more conductors, capable of being dismantled, the connection being made, directly or indirectly, by means of springs, parts of angled, eccentric or conical form, etc., without special preparation of the conductor concerned, other than removal of insulation

3.25
thread-forming screw
screw having an uninterrupted thread, which by screwing in, forms a thread by displacing material

Note 1 to entry: An example of a thread-forming screw is shown in Figure 2.

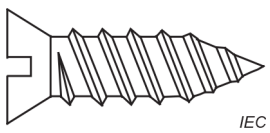


Figure 2 – Example of thread-forming screw

3.26
thread-cutting screw
screw having an interrupted thread, which by screwing in, forms a thread by removing material

Note 1 to entry: An example of a thread-cutting screw is shown in Figure 3.

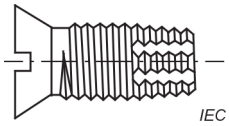


Figure 3 – Example of thread-cutting screw

3.27
rated voltage
voltage assigned by the manufacturer for a specified operating condition of an accessory

[SOURCE: IEC 60050-442:1998, 442-01-03, modified – The domain "(for accessories)" has been omitted.]

3.28
rated current
current assigned by the manufacturer for specified operating condition of an accessory

Note 1 to entry: Examples of the operating conditions are ambient condition, characteristics of the power supply, duty cycle or duty type.

[SOURCE: IEC 60050-442:1998, 442-01-02, modified – The domain "(for accessories)" has been omitted and the note to entry added.]

3.29
shutter
movable part incorporated into a socket-outlet arranged to shield at least the live socket-contacts automatically when the plug is withdrawn

3.30
type test
test of one or more devices made to a certain design to show that the design meets certain specifications

3.31
routine test
test to which each individual device is subjected during and/or after manufacture to ascertain whether it complies with certain criteria

3.32
base
part of the socket-outlet supporting the socket-contacts

3.33
live part
conductor or conductive part intended to be energized in normal use, including a neutral conductor, but by convention not a PEN conductor

Note 1 to entry: Live parts according to this document are always considered as hazardous with the exception of SELV circuits.

[SOURCE: IEC 60050-826:2004, 826-12-08, modified – "operation" has been replaced with "use"; "or PEM conductor or PEL conductor" and the note to entry omitted.]

3.34
cable anchorage
part of an accessory which has the ability to limit the displacement of a fitted flexible cable against pull, push and turning forces

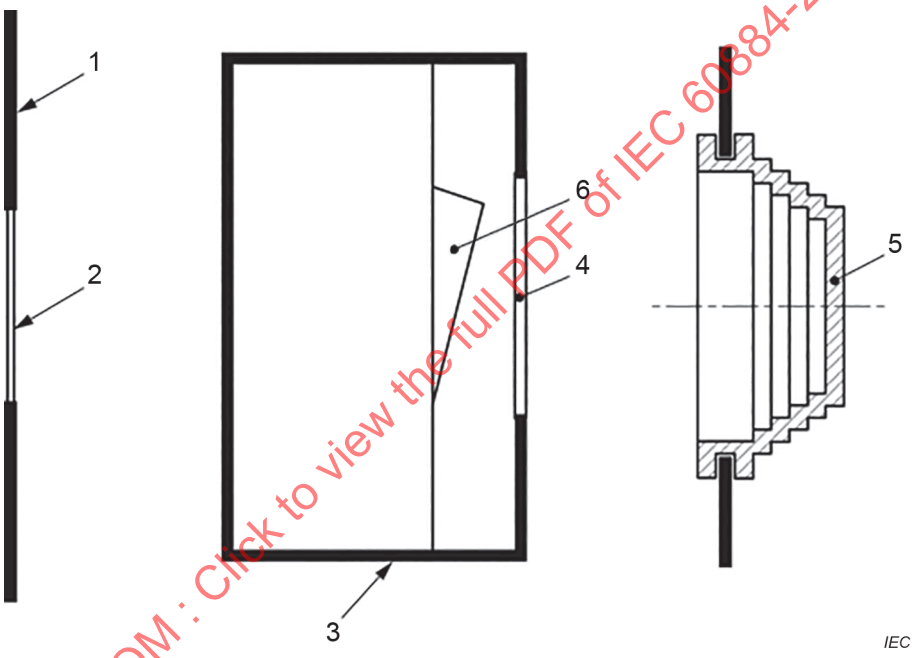
3.35
main part
assembly consisting of the base and other parts

Note 1 to entry: This assembly is not intended to be dismantled at any time after manufacture.

3.36
grommet
component used to support and protect the cable or conduit at the point of entry

Note 1 to entry: A grommet may also prevent the ingress of moisture or contaminants.

Note 2 to entry: Examples of membranes and grommets are shown in Figure 4.



Key

1 Box
2 Entry membrane
3 Envelope
4 Protective membrane
5 Grommet
6 Switch

Figure 4 – Examples of membranes and grommets

3.37
entry membrane
component or integral part of the accessory used to protect the cable which may be used to support the cable or conduit at the point of entry

Note 1 to entry: An entry membrane may also prevent the ingress of moisture or contaminants and may be part of a grommet.

Note 2 to entry: Examples of membranes and grommets are shown in Figure 4.

3.38
protective membrane
component or integral part of the accessory that is not intended to be penetrated in normal use and is intended to provide protection against ingress of water or solid objects and/or to allow the operation of an accessory

Note 1 to entry: Examples of membranes and grommets are shown in Figure 4.

3.39
normal load
load typically associated with household appliances

Note 1 to entry: Examples of normal loads:

– washing machines,
– refrigerators,
– clothes irons,
– vacuum cleaners,
– multimedia equipment.

3.40
high load
HL
load that applies long and repetitive cycles up to the rated current to the accessories exceeding normal load conditions

Note 1 to entry: Examples of applications having HLs are electric vehicle chargers and large terrace heaters.

3.41
crimped connection
permanent connection made by the application of pressure inducing the deformation or reshaping of the barrel around the conductor of a cable

Note 1 to entry: In some cases the deformation or reshaping of the barrel may affect the form of the conductor.

Note 2 to entry: Examples of crimped connections are shown in IEC 60352-2.

[SOURCE: IEC 60050-461:2008, 461-19-01, modified – Note 2 to entry has been added.]

3.42
pilot light
device incorporating a light source either integral or designed to be installed with the accessory and intended to give for example an indication of the accessory state or to indicate the accessory location

3.43
protective earthing
protective grounding, (US)
earthing for purposes of electrical safety

[SOURCE: IEC 60050-195:2021, 195-01-11]

3.44
functional earthing
earthing for purposes other than electrical safety

[SOURCE: IEC 60050-195:2021, 195-01-13, modified – The term "functional grounding" has been omitted.]

3.45
stroke
insertion or withdrawal of the plug

3.101
interlock
device, either electrical or electronic or mechanical or a combination of these, which prevents the pins/contacts of a plug from becoming live before the plug is in proper engagement with a socket-outlet and which either prevents the plug from being withdrawn while its pin/contacts are live or makes the contacts of the socket-outlet dead before the plug is withdrawn

3.102
switched socket-outlet with interlock
factory assembled accessory consisting of a socket-outlet with an integral switching device controlling the socket-outlet, which is provided with an interlock

3.103
retaining device
mechanical arrangement which holds a plug in position when it is in proper engagement, and prevents its unintentional withdrawal

4 General requirements

Accessories and boxes of surface mounting accessories shall be so designed and constructed that, in normal use, their performance is reliable and safety is achieved by reducing risk to a tolerable level, as defined in ISO/IEC Guide 51.

NOTE In the following country, a load connected by plugs and socket-outlets for household and similar purposes shall not exceed an energy quantity of Emax = 7 360 VAh in 3 h: AT, DE.

Compliance is checked by meeting all the relevant requirements and tests specified.

5 General remarks on tests

5.1 General

Tests shall be carried out to prove compliance with the requirements laid down in this document, where applicable.

Tests are carried out as follows:

– *type tests shall be carried out on representative specimens of each accessory;*
– *routine tests shall be carried out on the accessory or on parts of the accessory according to the requirements given in this document.*

Subclauses 5.2 to 5.5 are applicable to type tests and 5.6 to routine tests.

5.2 Products arrangement during test

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

The neutral, if any, is treated as a pole.

Accessories having provision for pilot lights shall be tested with pilot lights fitted, unless otherwise stated. The results of the tests shall be considered to apply to socket-outlets of the same type which do not have this facility.

Non-rewirable accessories are tested with the type and size of flexible cable as delivered. Non-rewirable accessories not incorporated in a cord set or a cord extension set, or which are not a component of equipment, shall be provided, for testing, with at least 1 m of flexible cable.

Non-rewirable multiple portable socket-outlets are tested with flexible cables as delivered.

Flush-type and semi-flush-type socket-outlets shall be tested, if appropriate, when installed in a box complying with the applicable standard sheet(s), if any. If the socket-outlet is manufactured for a specific box, the tests shall be conducted when the socket-outlet is installed in the corresponding box as specified by the manufacturer.

Socket-outlets which require a box to complete their enclosure are tested with their boxes.

The fixing screws of terminals, covers and cover-plates shall be tightened with a torque equal to two-thirds of the values specified in Table 7 unless otherwise specified.

5.3 Ambient test condition

Unless otherwise specified, the tests are carried out in the order of the clauses (see Table 1), at an ambient temperature between 15 °C and 35 °C.

It is recommended that the tests are carried out at an ambient temperature of (20 ± 5) °C.

5.4 Additional samples

A set of three specimens is subjected to all the relevant tests.

For the tests of Clauses 10, 12, 13, 20, 21, 23 and 24 additional specimens may be necessary.

For the test of Clause 15, it is possible that three additional specimens are necessary.

The number of specimens needed for the tests are given in Table 1.

Table 1 – Survey of specimens needed for tests

Clauses and subclauses		Number of specimens		
		Fixed socket-outlets	Portable socket-outlets	Plugs
6	Ratings	A	A	A
7	Classification	A	A	A
8	Marking	A	A	A
9	Checking of dimensions	ABC	ABC	ABC
10	Protection against electric shock[a]	ABC	ABC	ABC
11	Provision for earthing	ABC	ABC	ABC
12	Terminals	ABC[b, c]	ABC	ABC
13	Construction of fixed socket-outlets	ABC[d, e]	–	–
14	Construction of plugs and portable socket-outlets	–	ABC[d, e]	ABC[d, e]
15	Interlocked socket-outlets	ABC	ABC	–
16	Resistance to ageing, to harmful ingress of water and to humidity	ABC[f]	ABC	ABC
17	Insulation resistance and electric strength	ABC[g]	ABC[g]	ABC
18	Operation of earthing contacts	ABC	ABC	ABC

19	Temperature rise	ABC	ABC	ABC
20	Breaking capacity	ABC	ABC	ABC
21	Normal operation	ABC	ABC	ABC
22	Force necessary to withdraw the plug	ABC	ABC	–
23	Flexible cables and their connection	–	ABC[h]	ABC[h]
24	Mechanical strength	ABC[i k]	ABC[i]	ABC[j]
25	Resistance to heat[l]	ABC	ABC	ABC
26	Screws, current-carrying parts and connections	ABC	ABC	ABC
27	Creepage distances, clearances and distances through sealing compound	ABC	ABC	ABC
29	Resistance to rusting	ABC	ABC	ABC
28.1	Resistance to abnormal heat and to fire	DEF	DEF	DEF
28.2	Resistance to tracking[m]	DEF	DEF	DEF
30	Additional tests on pins provided with insulating sleeves	–	–	GHI[n]
	TOTAL	6	6	9

[a] One extra set of specimens is needed for the test of 10.6.

[b] One extra set of specimens is needed for each type of conductor for 12.2.6.

[c] One extra set of specimens may be required for the test of 12.3.10. Five extra screwless-type terminals are used for the test of 12.3.11 and one extra set of specimens is used for the test of 12.3.12.

[d] One extra set of membranes is needed for each of the tests of 13.22 and 13.23.

[e] One extra set of specimens may be needed to verify that the mechanical strength of the pin does not depend on the plastic material.

[f] One extra set of specimens is needed for 16.1.

[g] One extra set of specimens of socket-outlets fitted with pilot lamps may be used for the tests of Clause 17.

[h] One extra set of specimens is needed for 23.2 and 23.4 for non-rewirable accessories for each type of cable and cross-sectional area.

[i] One extra set of specimens is needed for 24.9 for shuttered socket-outlets.

[j] One extra set of specimens is needed for 24.11 for plugs.

[k] One extra set of specimens is needed for 24.13.2 and 24.13.3.

[l] One extra set of aged specimens may be used for the tests of 25.3 and 25.4.

[m] One extra set of specimens may be used.

[n] One extra set of specimens is needed for 30.2 and 30.3 for plugs with pins with insulating sleeves.

5.5 Compliance general requirement

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

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

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

5.6 Routine tests

Routine tests for factory-wired portable accessories (protection against electric shock and correct polarity) are specified in Annex A.

NOTE Annex E provides routine tests that can be applied during the production of crimped connections in accessories.

6 Ratings

Accessories should preferably be of a type and preferably have a voltage and current rating as shown in Table 2.

Table 2 – Preferred combinations of types and ratings

Type		Rated voltage	Rated current
General, with P = pole	**Implementation**	V	A
2P (non-rewirable portable accessories)	L1 + L2 or L1 + N	130 or 250	2,5
2P	L1 + L2 or L1 + N	130 or 250	6
2P + ⏚	L1 + L2 + ⏚ or L1 + N + ⏚	130 or 250	6
2P	L1 + L2 or L1 + N	130 or 250	10 13 16 20 25 32
2P + ⏚	L1 + L2 + ⏚ or L1 + N + ⏚		
2P + ⏚	L1 + L2 + ⏚	400 or 440	10 13 16 20 25 32
3P + ⏚	L1 + L2 + L3 + ⏚		
3P + N + ⏚	L1 + L2 + L3 + N + ⏚		
NOTE 1 Standardized values and configurations of existing systems are reported in IEC/TR 60083. NOTE 2 L1 + L2 and L1 + N are examples, any combination of the 3 phases are possible. The phase contacts L1, L2, L3 and the neutral contact N, if any, are treated as pole and considered to be live. In some tables or tests, ⏚ is treated as a pole.			

NOTE 1 In the following countries fixed 2P socket-outlets are not allowed: AT, BR, DE, IT, GB, TR.

NOTE 2 In the following country, fixed 2P socket-outlets are allowed only under certain conditions as specified in the wiring code: BE, ZA (SANS 10142-1).

7 Classification

7.1 Accessories classification

7.1.1 Accessories are classified according to the degree of protection against access to hazardous parts and against harmful effects due to the ingress of solid foreign objects as described in IEC 60529.

7.1.2 Accessories are classified according to the degree of protection against harmful effects due to the ingress of water as described in IEC 60529.

7.1.3 Classification according to the provision for earthing:

7.1.3.1 Accessories without earthing contact;

7.1.3.2 Accessories with earthing contact.

7.1.4 Classification according to the method of connecting the cable:

7.1.4.1 Rewirable accessories;

7.1.4.2 Non-rewirable accessories.

7.1.5 Classification according to the type of terminals:

7.1.5.1 Accessories with screw type terminals;

7.1.5.2 Accessories with screwless-type terminals;

7.1.5.3 Accessories with insulation piercing terminals (see Annex F).

NOTE In the following country accessories with screwless-type terminals for rigid conductors only are not allowed: ES, IT.

7.1.6 Classification according to the type of conductors to be connected:

7.1.6.1 For fixed socket-outlets with rigid (both solid and stranded) conductors only;

7.1.6.2 For fixed socket-outlets with rigid (both solid and stranded) and flexible conductors;

7.1.6.3 For portable accessories with flexible conductors only.

7.2 Socket-outlet classification

7.2.1 Classification according to the degree of protection against electric shock when mounted as for normal use:

7.2.1.1 with normal protection (see 10.2);

7.2.1.2 with increased protection (see 10.7).

7.2.2 Classification according to the existence of shutters:

7.2.2.1 without shutters;

7.2.2.2 with shutters (see 10.5).

NOTE In the following countries, socket-outlets without shutters are not allowed: FR, IT, ZA.

7.2.3 Classification according to the method of application/mounting type of the socket-outlet:

7.2.3.1 surface or

7.2.3.2 flush, or

7.2.3.3 semi-flush, or

7.2.3.4 void

7.2.3.5 architrave, or

7.2.3.6 portable, or

7.2.3.7 furniture, or

7.2.3.8 floor recessed, or

7.2.3.9 appliance.

7.2.4 Classification according to the method of installation, as a consequence of the design:

7.2.4.1 fixed socket-outlets where the cover or cover-plate can be removed without displacement of the conductors (design A), or

7.2.4.2 fixed socket-outlets where the cover or cover-plate cannot be removed without displacement of the conductors (design B).

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

7.2.5 Classification according to the intended use:

7.2.5.1 Socket-outlets for circuits where a single earthing circuit provides protective earthing for connected equipment and exposed conductive parts of the socket-outlet, if any;

7.2.5.2 Socket-outlets for circuits where electrical noise immunity is desired for the earthing circuit of connected equipment. The equipment earthing circuit is electrically separated from the protective earthing circuit provided for the exposed conductive parts of the socket-outlet, if any.

7.2.101 Switched socket-outlets with interlock are classified:

7.2.101.1 According to the method of actuating the switch:

– rotary;
– tumbler;
– rocker;
– push-button;
– touch;
– proximity;
– optical;
– acoustic;
– other external influences.

7.2.101.2 According to the number of poles of the switch:

– single-pole;
– double-pole;
– three-pole;
– three-pole with neutral.

7.2.101.3 According to the type of interlock:

– mechanical;
– electrical;
– electronic;
– a combination of any of these.

7.2.101.4 According to the retaining device:

– without device;
– with device.

7.3 Plug classification according to the class of equipment to which they are intended to be connected

7.3.1 for equipment of class I;

7.3.2 for equipment of class II.

NOTE For the description of the classes of equipment, see IEC 61140.

8 Marking

8.1 General

Accessories shall be marked as follows:

– rated current in amperes;
– rated voltage in volts;
– symbol for nature of supply;
– the name, trademark or identification mark of the manufacturer or responsible vendor;
– type reference which may be a catalogue number;

NOTE 1 The type reference can be the series reference only.

– first characteristic numeral for the degree of protection against access to hazardous parts and against harmful effects due to ingress of solid foreign objects, if declared to be higher than 2, and for fixed socket-outlets higher than 4, in which case the second characteristic numeral shall also be marked;
– second characteristic numeral for the degree of protection against harmful effects due to ingress of water, if declared to be higher than 0, and for fixed socket-outlets higher than 2, in which case the first characteristic numeral shall also be marked.
– symbol of mini-gap construction, if applicable;
– symbol of micro-gap construction, if applicable;
– symbol for semiconductor switching device, if applicable.

NOTE 2 The degrees of protection are based on IEC 60529.

In addition, socket-outlets with screwless-type terminals shall be marked with the following:

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

– an indication of the suitability to accept rigid conductors only, for those socket-outlets having this restriction.

8.2 Symbols

When symbols are used, they shall be as follows:

Amperes ..... A

Volts V

Alternating current ..... ~ or AC

Neutral ..... N

Protective earth ..... 

(IEC 60417-5019 (2006-08))

Degree of protection, when relevant ..... IPXX

Degree of protection for fixed accessories also able to be installed on rough surfaces

(test wall of Figure 18 b) and Figure 18 c)) ..... IPXX 

(IEC 60417-6345 (2015-07))

For screwless-type terminals: suitability to accept rigid conductors only ..... r

Mini-gap construction ..... m

Micro-gap construction ..... μ

Semiconductor switching device ..... ε

"OFF" position ..... O

"ON" position I

NOTE 1 Details of construction of symbols are given in IEC 60417.

NOTE 2 In the IP code the letter "X" is replaced by the relevant number.

NOTE 3 Lines formed by the construction of the tool are not considered as part of the marking.

For the marking with rated current and rated voltage the values may be used alone. These values shall be placed on one line separated by an oblique line or the value for rated current shall be placed above the value for rated voltage, separated by a horizontal line.

The marking for the nature of supply shall be placed next to the marking for rated current and rated voltage.

NOTE 4 The marking for current, voltage and nature of supply can be, for example, as follows:

$$16\ \text{A}\ 440\ \text{V AC or } 16/440\ \text{AC or } \frac{16}{440}\sim$$

8.3 Particular requirements for fixed socket-outlets

For fixed socket-outlets the following marking shall be placed on the main part:

– rated current, rated voltage and nature of supply;

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

– length of insulation to be removed before the insertion of the conductor into the screwless-type terminal;

– an indication of the suitability to accept rigid conductors only for screwless-type terminals for those socket-outlets having this restriction;

– the type reference, which may be a catalogue number.

NOTE 1 The type reference can be the series reference only.

Parts such as cover plates, which are necessary for safety purposes and are intended to be sold separately, shall be marked with the manufacturer's or responsible vendor's name, trademark or identification mark and type reference.

NOTE 2 Additional type references can be marked on the main part, or on the outside of the associated enclosure.

The IP code, if applicable, shall be marked so as to be easily discernible when the socket-outlet is mounted and wired as for normal use.

Fixed socket-outlets classified according to 7.2.5.2 shall be identified by a triangle which shall be visible after installation unless the socket-outlets have an interface configuration which is different from that used in normal circuits.

NOTE 3 In the following countries an orange triangle is required by the national installation rules: CA, MX, US.

8.4 Particular requirements for portable accessories

For plugs and portable socket-outlets the marking specified in 8.1, other than the type reference, shall be easily discernible when the accessory is wired and assembled.

Plugs and portable socket-outlets for equipment of class II shall not be marked with the symbol for class II construction.

NOTE The type reference of rewirable portable accessories can be marked on the inside of the enclosure or cover.

8.5 Particular requirements for markings on terminals other than phase terminals

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

Earthing terminals for the connection of the protective conductor shall be indicated by the symbol  .

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

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

Terminations in non-rewirable accessories need not be marked.

Terminals provided for the connection of conductors not forming part of the main function of the socket-outlets shall be clearly identified unless their purpose is self-evident, or indicated in a wiring diagram which shall be fixed to the accessory.

The indication of such terminals may be achieved by:

– their being marked with graphical symbols according to IEC 60417 or with colours and/or an alphanumeric system, or

– their being marked with their physical dimensions or relative location.

Leads of pilot lights are not considered to be conductors in the context of this subclause.

8.6 IP code marking for surface-type mounting boxes forming an integral part of socket-outlets

For surface-type mounting boxes forming an integral part of socket-outlets having an IP code higher than IP4X, or higher than IPX2, the IP code shall be marked on the outside of their associated enclosure so as to be easily discernible when the socket-outlet is mounted and wired as in normal use.

8.7 Additional requirement for marking

It shall be indicated either by marking or in a manufacturer's catalogue or instruction sheet which position or with which special provisions (for example, box, type of mounting surface, plug, etc.) the declared degree of protection of fixed socket-outlets having an IP code higher than IPX0 is ensured, unless this is self-evident.

Compliance is checked by inspection.

8.8 Durability

Marking shall be easily legible, durable and indelible.

Laser marking directly on the product and marking made by moulding, pressing or engraving are not subjected to this test.

Compliance is checked by inspection, using normal or corrected vision, without additional magnification and, if necessary, by the following test.

The test is done by rubbing the marking for 15 s with a piece of cotton cloth soaked with water and again for 15 s with a piece of cotton cloth soaked with n-hexane 95 % (Chemical Abstracts Service Registry Number, CAS RN, 110-54-3).

NOTE n-hexane 95 % (Chemical Abstracts Service Registry Number, CAS RN, 110-54-3) is available from a variety of chemical suppliers as a high pressure liquid chromatography (HPLC) solvent.

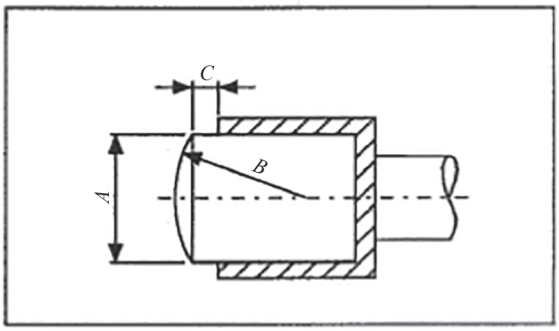
When using the liquid specified for the test, precautions as stated in the relative material safety datasheet provided by the chemical supplier shall be taken to safeguard the laboratory technicians.

The marking surface to be tested shall be dried after the test with water.

Rubbing shall commence immediately after soaking the piece of cotton, applying a compression force of (5 ± 1) N at a rate of about one cycle per second (a cycle comprising a forward and backward movement along the length of the marking). For markings longer than 20 mm, rubbing can be limited to a part of the marking, over a path of at least 20 mm length.

The compression force is applied by means of a test piston which is wrapped with cotton comprising cotton wool covered by a piece of cotton medical gauze.

The test piston shall have the dimensions specified in Figure 5 and shall be made of an elastic material which is inert against the test liquids and has a Shore-A hardness of 47 ± 5 (for example synthetic rubber).



Dimensions mm			
°	**A**	**B**	**C**
Dimensions	20	20	2
Tolerance	+2, −0	±0,5	+1, −0

Figure 5 – Test piston dimensions

When it is not possible to carry out the test on the specimens due to the shape/size of the product or the marking is not accessible with the test piston:

– *a suitable piece having the same characteristics as the product can be submitted to the test*

or

– *another test piston with different shape can be used on the condition that radius B is kept.*

8.101 Identification of line terminals

Terminals of switched socket-outlets with interlock intended for the connection of the phase conductors shall be identified, unless the method of connection is of no importance or is self-evident or is indicated in a wiring diagram. Such identification may take the form of a letter L or in the case of more than one terminal, the letters L_1, L_2, L_3, etc., which may be accompanied by an arrow pointing to the relevant terminal(s).

Alternatively, the surface of such terminals shall be bare brass or copper, other terminals being covered with a metallic layer of another colour.

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

8.102 Indication of the actual switch position

Switched socket-outlets with interlock shall be so marked that the direction of movement of the actuating member to its different positions or the actual switch position, is clearly indicated.

These indications shall be clearly visible on switched socket-outlets with interlock fitted with their cover or cover plate as for normal use. If these indications are placed on the cover or cover plate, it shall not be possible to fix the cover or cover plate in a position such that the indications are incorrect.

For indicating the direction of movement of the operating means, the symbols "O" and " I " may be used.

The short, straight line indicating the "ON" position shall be radial for rotary switches, perpendicular to the axis of rotation of the dolly for tumbler switches and rocker switches, and vertical for push-button switches when mounted vertically in its intended position.

9 Checking of dimensions

9.1 General

Accessories and surface-type mounting boxes shall comply with the appropriate standard sheets and corresponding gauges for plugs and socket-outlets systems, if any.

Insertion of plugs into fixed or portable socket-outlets shall be ensured by their compliance with the relevant standard sheets.

Compliance is checked as follows.

Socket-outlets are first subjected to 10 insertions and 10 withdrawals of a plug complying with the corresponding standard sheet having the maximum dimensions for the pins following which dimensions are checked by measurement and/or by means of gauges.

The manufacturing tolerances of these gauges shall be as shown in Table 3 if not otherwise specified. The most unfavourable dimensions of the standard sheet shall be used for the design of the gauges.

NOTE In some cases (for example, distances between centres), it can be necessary to check both the extreme dimensions.

Moreover, for shuttered socket-outlets, to ascertain the easy insertion of a plug in the corresponding socket-outlet the test as described in 22.4 shall be carried out on the same samples after the 10 insertions and withdrawals have been performed.

Table 3 – Gauge tolerances

Gauge for checking	Gauge tolerance mm
Pin diameter or pin thickness	$^{0}_{-0,01}$
Dimension of entry holes corresponding to pin diameter and to distance between contact surfaces	$^{+0,01}_{0}$
Pin length and width	$^{0}_{-0,1}$
Pin spacing	$^{0}_{-0,02}$ or $^{+0,02}_{0}$ (according to the case)
Distance from the engagement face to point of first electrical contact (for socket-outlet)	$^{0}_{-0,05}$ or $^{+0,05}_{0}$ (according to the case)
Guiding elements	±0,03

9.2 Dangerous compatibility

It shall not be possible, within a given system, to engage a plug with:

– a socket-outlet having a higher voltage rating or a lower current rating;

– a socket-outlet with a different number of live poles; exceptions may be admitted for socket-outlets which are specially constructed for the purpose of allowing engagement with plugs of a lower number of poles, provided that no dangerous situation can arise, for example a connection between a live pole and an earthing contact or the interruption of the earthing circuit;

– a socket-outlet with earthing contact, if the existing plug of the relevant national system is a plug for class 0 equipment.

It shall not be possible to engage existing plugs on the relevant national system for equipment of class 0 or of class I with a socket-outlet exclusively designed to accept plugs for class II equipment.

Compliance is checked by inspection or by manual test using gauges, the manufacturing tolerances of which shall be as specified in Table 3.

In case of doubt, the impossibility of insertion is checked by applying the appropriate gauge for 1 min with a force of 150 N for accessories with a rated current not exceeding 16 A, or 250 N for other accessories.

Where the use of elastomeric or thermoplastic material is likely to influence the result of the test, it is carried out at an ambient temperature of (35 ± 2) °C, both the accessories and the gauges being at this temperature.

NOTE For accessories of rigid material, such as thermosetting resins, ceramic material and the like, conformity to the relevant standard sheets ensures compliance with the requirement.

9.3 Permitted deviations

Deviations from the dimensions specified in the standard sheets may be made, but only if they provide a technical advantage and do not adversely affect the purpose and safety of accessories complying with the standard sheet, especially with regard to interchangeability and non-interchangeability.

Accessories with such deviations shall, however, comply with all applicable requirements.

10 Protection against electric shock

10.1 General

Accessories shall ensure protection against electric shock.

For the purposes of this Clause 10, lacquer, enamel and sprayed insulating coatings are not considered as insulating material.

10.2 Accessibility of live parts during normal use

Fixed socket-outlets, plugs when engaged and portable socket-outlets shall be so designed and constructed that when they are mounted and/or wired as for normal use, live parts are not accessible, even after removal of parts which can be removed without the use of a tool.

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

NOTE In the following countries this requirement does not apply when the plug is partially engaged: CA, CN, DK, JP, US.

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

The test is carried out on the specimen mounted as for normal use and fitted with conductors of the smallest nominal cross-sectional area, the test being then repeated using conductors of the largest nominal cross-sectional area, specified in Table 4 for screw-type terminals and Table 8 for screwless-type terminals.

The standard test finger, test probe B of IEC 61032, is applied in every possible position, an electrical indicator with a voltage between 40 V and 50 V being used to show contact with the relevant parts.

For plugs, the test finger is applied when the plug is in partial and complete engagement with a socket-outlet.

For accessories where the use of thermoplastic or elastomeric material is likely to influence the requirements, one additional test is made but at an ambient temperature of (35 ± 2) °C, the accessories being at this temperature.

During this additional test the accessories are subjected for 1 min to a force of 75 N, applied through the tip of a straight unjointed test finger, test probe 11 of IEC 61032. This finger with an electrical indicator as described above is applied to all places where yielding of insulating material could impair the safety of the accessory but is not applied to membranes or the like. The finger as described is applied to thin-walled knock-outs but with a force of 10 N.

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

Each specimen of plug or portable socket-outlet is then pressed between two flat surfaces with a force of 150 N for 5 min, as shown in Figure 6. The specimen is checked 15 min after removal from the test apparatus, and shall not show such deformation as would result in undue alteration of those dimensions shown in the relevant standard sheets which ensure safety.

Dimensions in millimetres

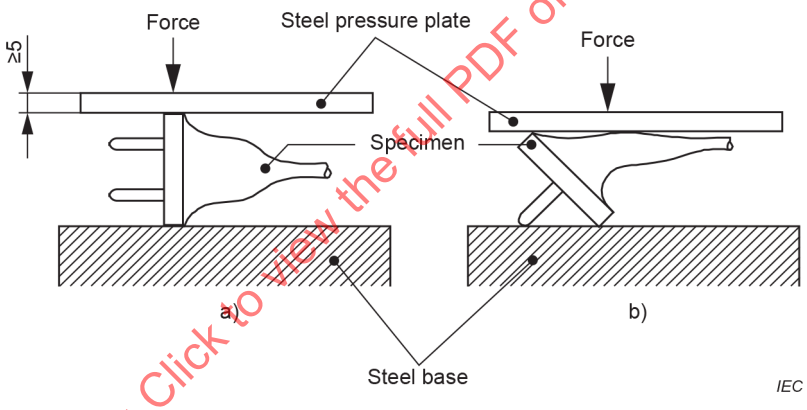


Figure 6 – Arrangement for compression test

10.3 Requirements for accessible parts of accessory during normal use

10.3.1 Accessible parts of the accessory when wired and/or mounted as in normal use shall be made of insulating material with the exception of the following:

– small screws and the like which are isolated from live parts and which are used for the fixing of the main part and of covers, cover plates or other parts of the enclosure of socket-outlets;

– the covers, cover plates and other parts of the enclosure of fixed socket-outlets and accessible parts of portable socket-outlets and plugs made of metal which comply with the requirements of 10.3.2 or 10.3.3;

– earthing pins and earthing straps of accessories;

– current-carrying pins and metal shoulders around pins of plugs when not inserted in a socket-outlet.

Compliance is checked by inspection.

10.3.2 Covers, cover plates or other parts of the enclosure of metal shall be protected by additional insulation made by insulating linings or insulating barriers. The insulating linings or insulating barriers shall either:

– be fixed to covers, cover plates, other parts of the enclosure or the body of the accessory in such a way that they cannot be removed without being permanently damaged, or
– be so designed that:
  - they cannot be replaced in an incorrect position;
  - if they are omitted, the accessories are rendered inoperable or manifestly incomplete;
  - there is no risk of accidental contact between live parts and metal covers, cover plates or other parts of the enclosure, for example through their fixing screws, even if a conductor should come away from its terminal;
  - precautions are taken in order to prevent creepage distances or clearances becoming less than the values specified in Table 26.

In the case of single-pole insertion, the requirement given in 10.4 applies.

Compliance is checked by inspection.

The above linings or barriers shall comply with the tests of Clause 17 and Clause 27.

10.3.3 The earthing of metal covers or cover plates can be made with fixing screws or other integral means, the resulting connection shall be of low resistance.

The creepage distances and the clearances between the live pins of a plug when fully inserted and the earthed metal cover of a socket-outlet shall comply with items 2 and 7 of Table 26, respectively; in addition, in the case of single-pole insertion, the requirement given in 10.4 applies.

NOTE In the following countries 10.3.3 is not allowed: DK (only IPX0 equipment).

Compliance is checked by inspection and by the tests of 11.5.

10.4 Single-pole insertion

It shall not be possible for a pin of a plug to come into contact with a live socket-contact of a socket-outlet while any other pin is accessible.

Compliance is checked by manual test and by means of gauges based on the most unfavourable dimensions of the standard sheet; the tolerances of the gauges shall be as specified in Table 3.

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

For socket-outlets with enclosures or bodies of rubber or polyvinyl chloride, the gauge is applied with a force of 75 N for 1 min.

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

Single-pole insertion may be prevented by the use of at least one of the following means:

– *a sufficiently large cover or cover-plate;*
– *other means (for example, shutters).*

NOTE In the following countries the use of a shutter as the only means to prevent single-pole insertion is not allowed: AT, AU, BE, CA, CZ, DE, ES, FI, NL, PT, GB, US, TR.

10.5 Shuttered socket-outlets

Shuttered socket-outlets shall, in addition, be so constructed that live parts are not accessible without a plug in engagement, with the gauges shown in Figure 7 and Figure 8.

The gauges shall be applied to the entry holes corresponding to the live contacts only and shall not touch live parts.

To ensure this degree of protection, socket-outlets shall be so constructed that live contacts are automatically screened when the plug is withdrawn.

Shutters shall be so designed that a plug is inserted with the same movement in a socket-outlet with shutters as in a socket-outlet without shutters.

The means for achieving this shall be such that such means cannot easily be operated by anything other than a plug and shall not depend upon parts which are liable to be lost.

An electrical indicator with a voltage between 40 V and 50 V included is used to show contact with the relevant part.

Compliance is checked by inspection and for socket-outlets with a plug completely withdrawn by applying the above gauges as follows.

The gauge according to Figure 7 is applied to the entry holes corresponding to the live contacts with a force of 20 N.

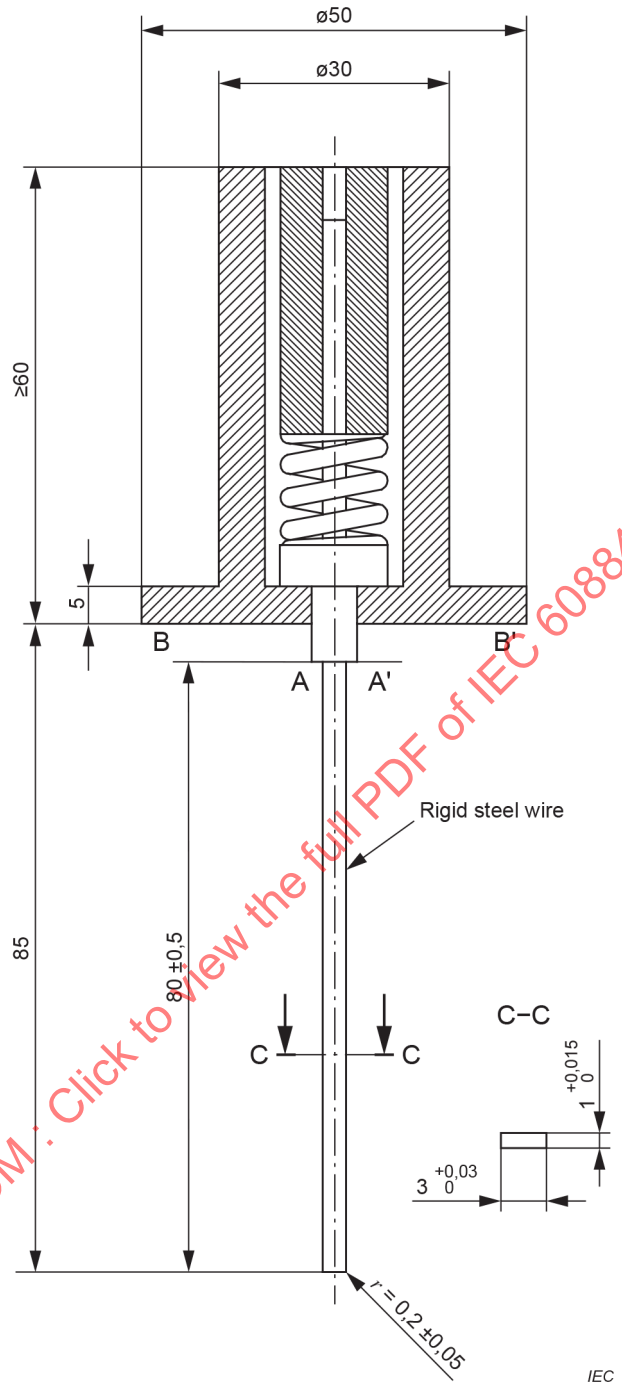
The gauge is applied to the shutters in the most unfavourable position, successively in three directions, to the same place for approximately 5 s in each of the three directions.

During each application the gauge shall not be rotated and it shall be applied in such a way that the 20 N force is maintained. When moving the gauge from one direction to the next, no force is applied but the gauge shall not be withdrawn.

A steel gauge, according to Figure 8, is then applied with a force of 1 N and in three directions, for approximately 5 s in each direction, with independent movements, withdrawing the gauge after each movement.

For socket-outlets with enclosures or bodies of thermoplastic material, the test is carried out at an ambient temperature of (35 ± 2) °C, both the socket-outlets and the gauge being at this temperature.

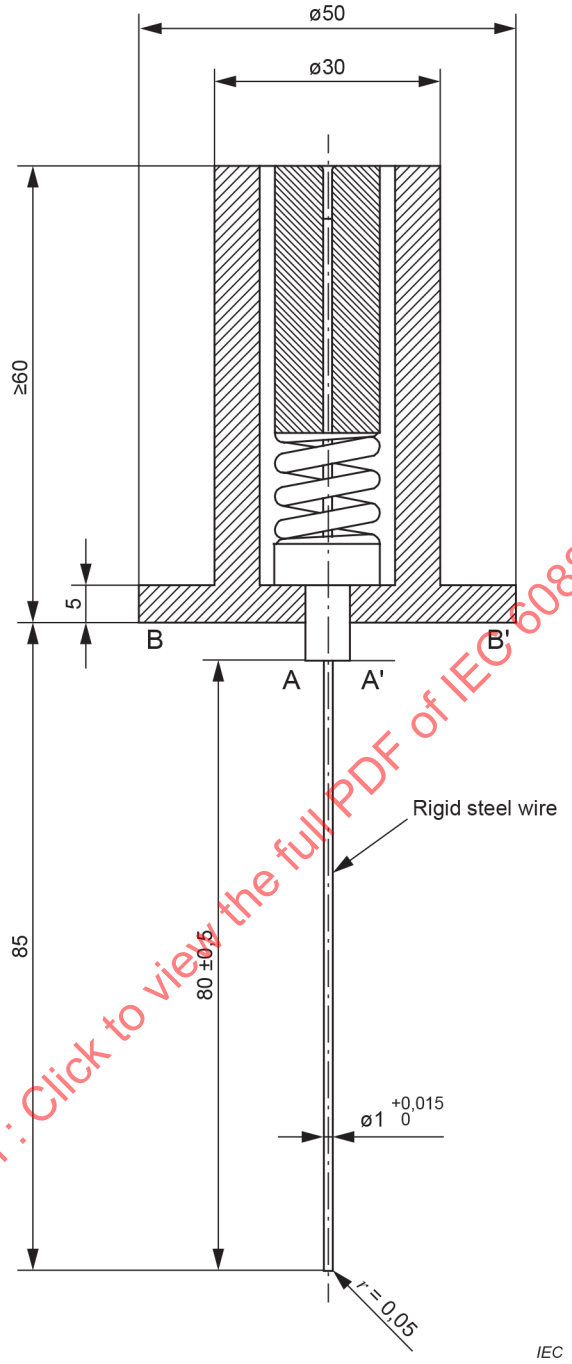
Dimensions in millimetres



To calibrate the gauge, a push force of 20 N is applied on the steel rigid wire in the direction of its axis: the characteristics of the gauge internal spring shall be such that the surface A – A′ is brought practically to the same level as the surface B – B′ when this force is applied.

Figure 7 – Gauge for checking non-accessibility of live parts, through shutters

Dimensions in millimetres



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

Figure 8 – Gauge for checking non-accessibility of live parts, through shutters, and of live parts of socket-outlets with increased protection

10.6 Deformation of earthing contacts

Earthing contacts, if any, of a socket-outlet shall be so designed that they cannot be deformed by the insertion of a plug to such an extent that safety is impaired.

Compliance is checked by the following test, carried out on a new set of specimens.

The socket-outlet is placed in such a position that the socket-contacts are in a vertical position.

A test plug, having the dimensions of the corresponding standard sheet, is inserted into the socket-outlet with a force of 150 N which is applied for 1 min.

In addition, in the case of a socket-outlet with an earth pin, a force of 150 N is applied axially to the earth pin for 1 min.

After this test, the socket-outlet shall still comply with the requirements of Clause 9.

10.7 Socket-outlets with increased protection

Socket-outlets with or without lid, classified according to 7.2.1.2, shall be so constructed that, when mounted and wired as in normal use, live parts shall not be accessible with a test wire of 1 mm in diameter (see Figure 8).

NOTE In the following countries the increased protection is considered fulfilled when the lid (spring loaded) is closed: AT, DE.

Compliance is checked by applying with a test wire of 1,0 mm in diameter (see Figure 8) a force of 1 N on all accessible surfaces in the most unfavourable conditions without a plug inserted and with the lid, if any, open.

For socket-outlets with enclosures or bodies of thermoplastic material, the test is carried out at an ambient temperature of (35 ± 2) °C, both the socket-outlets and the gauge being at this temperature.

During this test, it shall not be possible to touch live parts with the gauge.

An electrical indicator as described in 10.2 shall be used.

10.101 Requirements for operating parts

Knobs, operating levers, push-buttons, rockers and the like, for operating switches in switched socket-outlets with interlock shall be of insulating material, unless their accessible metal parts are separated from the metal parts of the mechanism by double insulation or reinforced insulation, or in the case of switched socket-outlets with interlock with earthing terminals, they are reliably connected to earth.

Compliance is checked by inspection and by the tests of Clause 17 and Clause 21.

10.102 Requirements for accessible metal parts (protrusion from enclosure)

Metal parts of the switch mechanism, such as the spindle or the pivot of the dolly or rocker, that are not insulated from live parts, shall not protrude from the enclosure.

Compliance is checked by inspection. If necessary, the actuating member may be removed or broken.

If the actuating member has to be broken, compliance is checked after the test of Clause 28.

10.103 Requirements for accessible metal parts (accessibility)

Metal parts of the switch mechanism, such as the spindle or the pivot of the dolly or rocker, shall not be accessible when the switched socket-outlet with interlock is mounted as for normal use.

In addition, these metal parts shall be insulated from accessible metal parts, including metal frames supporting the base of flush-type switched socket-outlets with interlock, liable to be mounted in a metal box, and also from screws used for fixing the base to its support.

This additional requirement does not apply if the metal parts of the mechanism are separated from live parts in such a way that the creepage distances and clearances have at least twice the values specified in 27.1, or as an alternative for switched socket-outlets with interlock provided with earthing terminals, if they are reliably connected to earth.

Compliance is checked by inspection. If necessary, measurement and the tests of Clause 17 and Clause 20 may be used.

11 Provision for earthing

11.1 General

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

When withdrawing the plug, the current-carrying pins shall separate before the earth connection is broken.

Socket-outlets are tested using a test plug having the dimensions of the corresponding standard sheets.

When inserting the test plug, the earth contact of the plug shall make connection with the earth contact of the socket-outlet before the current-carrying contacts of the plug become live.

When withdrawing the test plug, the current-carrying pins of the plug shall separate before the earth connection is broken.

The insertion and withdrawal of the test plug shall be in a direction perpendicular to the engagement face of the socket-outlet. An electrical indicator supplied with a voltage between 40 V and 50 V is used to check that the earth contact makes first and breaks last.

11.2 Earthing terminals

Earthing terminals of rewirable accessories shall comply with the appropriate requirements of Clause 12.

Earthing terminals of rewirable accessories shall be of the same size as the corresponding terminals for the supply conductors.

Earthing terminals of rewirable accessories with earthing contact shall be internal.

Fixed socket-outlets can have an additional external earthing terminal.

Earthing terminals of fixed socket-outlets shall be fixed to the base or to a part reliably fixed to the base.

Earthing contacts of fixed socket-outlets shall be fixed to the base or to the cover, but, if fixed to the cover, they shall be automatically and reliably connected to the earthing terminal when the cover is put in place, the contact pieces being silver-plated or having a protection no less resistant to corrosion and abrasion.

This connection shall be ensured under all conditions which may occur in normal use, including loosening of cover-fixing screws, careless mounting of the cover, etc.

Except as mentioned above, parts of the earthing circuit shall be in one piece or shall be reliably connected together by riveting, welding, or the like.

NOTE 1 The requirement regarding the connection between an earthing contact fixed to a cover and an earthing terminal can be met by the use of a solid pin and a resilient socket-contact.

NOTE 2 For the purpose of the requirements of this Subclause 11.2, screws are not considered as parts of contact pieces.

NOTE 3 When considering the reliability of the connection between parts of the earthing circuit, the effect of possible corrosion is taken into account.

11.3 Accessible metal parts

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

This requirement does not apply to the accessible metal parts mentioned in 10.3.2.

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

11.4 Requirements for socket-outlets having an IP code higher than IPX0

Socket-outlets, having an IP code higher than IPX0, with an enclosure of insulating material, having more than one cable inlet, shall be provided with an internal fixed earthing terminal or adequate space for a floating terminal allowing the connection of an incoming and an outgoing conductor for the continuity of the earthing circuit unless the earthing terminal of the socket-outlet itself is so designed that it allows the connection of an incoming and an outgoing earthing conductor.

Floating terminals are not subject to the requirements of Clause 12.

Compliance with 11.2 to 11.4 is checked by inspection and by the tests of Clause 12.

Compliance with requirements to ensure adequate space for floating terminals is checked by performing a test connection using the type of terminal specified by the manufacturer.

11.5 Internal connection with the earthing terminal

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

Compliance is checked by the following test.

A current derived from an AC or DC source having a no-load voltage not exceeding 12 V and equal to 1,5 times the rated current or 25 A, whichever is the greater, is passed between the earthing terminal and each of the accessible metal parts in turn.

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

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

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

11.6 Particular requirements for socket-outlets according to 7.2.5.2

Socket-outlets according to 7.2.5.2, for use on circuits where electrical noise immunity is desired for connected equipment, shall have the earthing socket-contact and its terminal electrically separated from any metal mounting means or other exposed conductive parts which may be connected to the protective earthing circuit of the installation.

Compliance is checked by inspection.

12 Terminals and terminations

12.1 General

All the tests on terminals, with the exception of the tests of 12.3.11 and 12.3.12 shall be carried out after the tests of 16.1.

Rewirable accessories shall be provided with terminals having screw clamping or with screwless-type terminals.

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

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

Non-rewirable accessories shall be provided with soldered, welded, crimped or equally effective permanent connections (termination); screwed or snap-on connections shall not be used.

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

Compliance is checked by inspection and by the tests of 12.2 or 12.3, as applicable.

12.2 Terminals with screw clamping for external copper conductors

12.2.1 Terminals with screw clamping may be of the type suitable for rigid copper conductors only or of the type suitable for both rigid and flexible copper conductors having cross-sectional areas as shown in Table 4.

Terminals with screw clamping for rewirable portable accessories shall be of the type suitable for flexible copper conductors having cross-sectional areas as shown in Table 4.

Table 4 – Relationship between rated current and connectable nominal cross-sectional areas of copper conductors

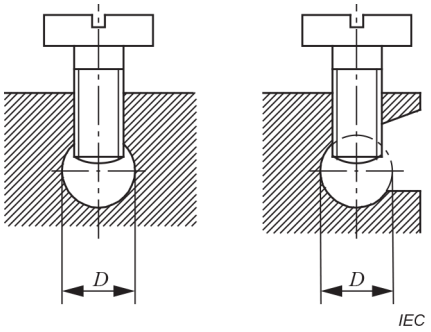
Current and type of accessory	Rigid (solid or stranded) copper conductors		Flexible copper conductors	
	Nominal cross-sectional area	Diameter of the largest conductor	Nominal cross-sectional area	Diameter of the largest conductor
	mm^2	mm	mm^2	mm
6 A	–	–	From 0,75 up to 1,5 inclusive	1,73

Current and type of accessory	Rigid (solid or stranded) copper conductors		Flexible copper conductors	
	Nominal cross-sectional area	Diameter of the largest conductor	Nominal cross-sectional area	Diameter of the largest conductor
	mm^2	mm	mm^2	mm
10 A 3P + N + ⏚ (fixed accessory)	From 1 up to 2,5 inclusive [a]	2,13	From 1 up to 2,5 inclusive [a]	2,21
10 A 3P + N + ⏚ (portable accessory)	–	–	From 0,75 up to 1,5 inclusive	1,73
10 A and 13 A 2P and 2P + ⏚ (fixed accessory)	From 1 up to 2,5 inclusive [a] [b]	2,13	From 1 up to 2,5 inclusive [a] [b]	2,21
10 A and 13 A 2P and 2P + ⏚ (portable accessory)	–	–	From 0,75 up to 1,5 inclusive	1,73
13 A 2P and 2P + ⏚ (fixed accessory) (Socket-outlets for fused plugs)	From 1,5 up to 3 × 2,5 [b] From 1,5 up to 2 × 4 [b]	2,72	From 1,5 up to 3 × 2,5 [b] From 1,5 up to 2 × 4 [b]	2,9
13 A 2P and 2P + ⏚ (portable accessory) (fused plugs)	–	–	From 0,5 up to 1,5	1,73
16 A 2P and 2P + ⏚ (fixed accessory)	From 1,5 up to 2 × 2,5 inclusive	2,13	From 1,5 up to 2 × 2,5 inclusive	2,21
16 A 2P and 2P + ⏚ (plugs)	–	–	From 0,75 up to 1,5 inclusive	1,73
16 A 2P and 2P + ⏚ (portable socket-outlets)	–	–	From 1 up to 1,5 inclusive	1,73
16 A other than 2P and 2P + ⏚ (fixed accessory)	From 1,5 up to 4 inclusive	2,72	From 1,5 up to 4 inclusive	2,9
16 A other than 2P and 2P + ⏚ (portable accessory)	-	-	From 1 up to 2,5 inclusive	2,21
20 A (fixed accessory)	From 2,5 up to 4 inclusive	2,72	From 2,5 up to 4 inclusive	2,9
20 A (portable accessory)	-	-	From 2,5 up to 4 inclusive	2,9
25A 2P + ⏚ (fixed accessory)	From 2,5 up to 6 inclusive	3,47	From 2,5 up to 6 inclusive	3,87

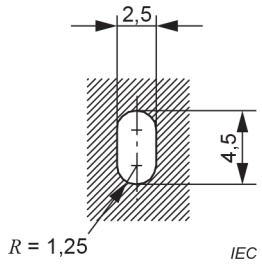
Current and type of accessory	Rigid (solid or stranded) copper conductors		Flexible copper conductors	
	Nominal cross-sectional area	Diameter of the largest conductor	Nominal cross-sectional area	Diameter of the largest conductor
	mm^2	mm	mm^2	mm
25A 2P + ⏚ (portable accessory)	-	-	From 2,5 up to 4 inclusive	2,9
32 A (fixed accessory)	From 4,0 up to 10 inclusive	4,32	From 4,0 up to 10 inclusive	5,1
32 A (portable accessory)	-	-	From 2,5 up to 6 inclusive	3,87
[a] The terminal shall allow the connection of two 1,5 mm^2 conductors which have a diameter of 1,45 mm. [b] Some countries require the looping-in of three conductors of 2,5 mm^2, or two conductors of 4 mm^2.				

The conductor space shall be at least that specified in Figure 9, Figure 10, Figure 11 or Figure 12.

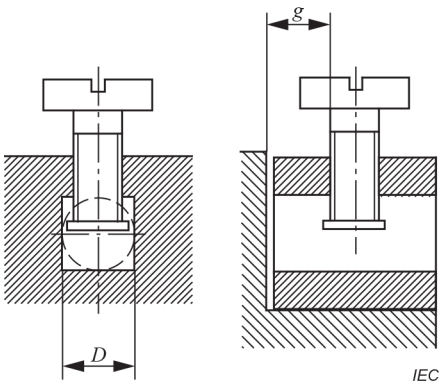
Dimensions in millimetres



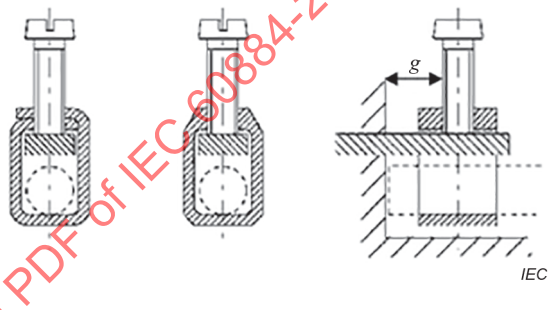
a) Terminal without pressure plate



b) Elongated hole terminal



c) Terminal with pressure plate



d) Stirrup terminal

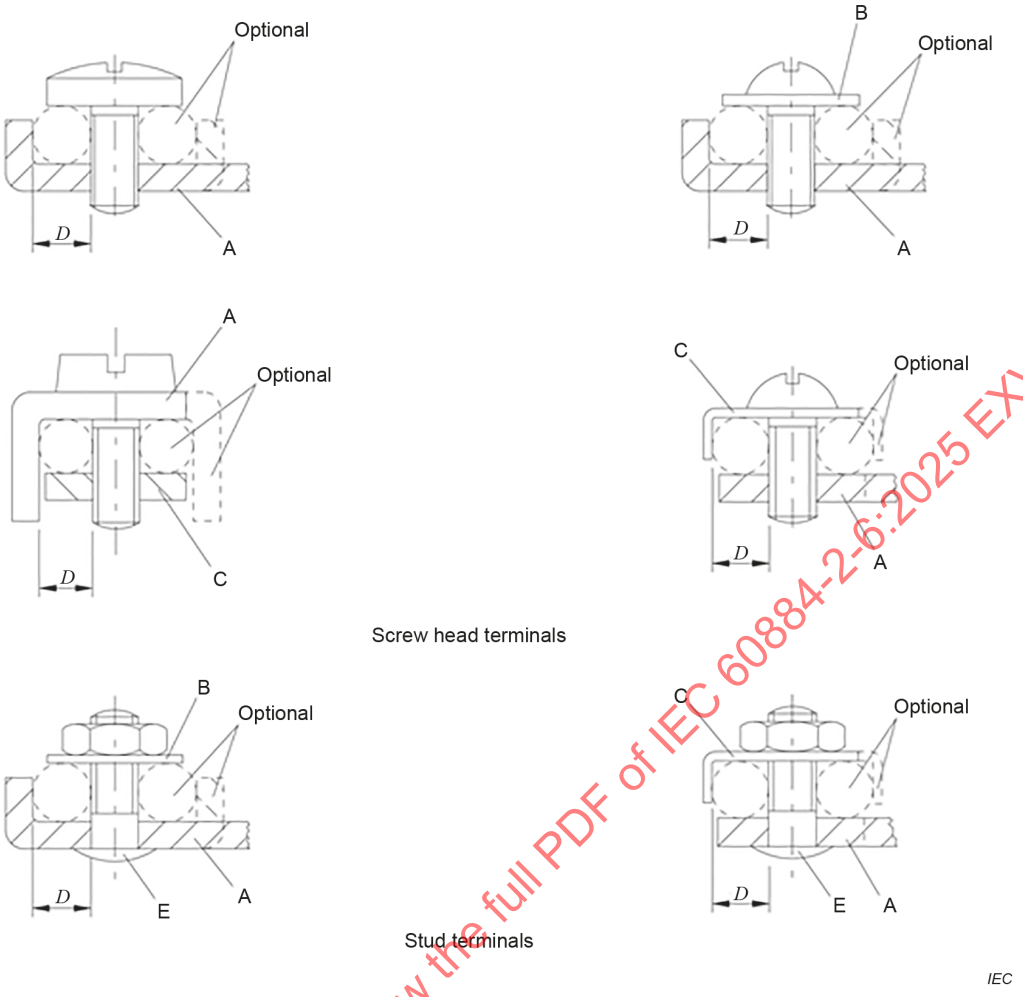
Cross-section of conductor accepted by the terminal	Minimum diameter *D* (or minimum dimensions) of conductor space	Minimum distance *g* between clamping screw and end of conductor when fully inserted		Torque					
mm^2	mm	mm		Nm					
		One screw	Two screws	1 [a]		2 [a]		3 [a]	
				One screw	Two screws	One screw	Two screws	One screw	Two screws
Up to 1,5	2,5	1,5	1,5	0,2	0,2	0,4	0,4	0,4	0,4
2,5 (circular hole)	3,0	1,5	1,5	0,25	0,2	0,5	0,4	0,5	0,4
2,5 (elongated hole)	2,5 × 4,5	1,5	1,5	0,25	0,2	0,5	0,4	0,5	0,4
4	3,6	1,8	1,5	0,4	0,2	0,8	0,4	0,8	0,4
6	4,0	1,8	1,5	0,4	0,25	0,8	0,5	0,8	0,5
10	4,5	2,0	1,5	0,7	0,25	1,2	0,5	1,2	0,5

[a] The values specified apply to screws covered by the corresponding columns in Table 7.

The part of the terminal containing the threaded hole and the part of the terminal against which the conductor is clamped by the screw may be two separate parts, as in the case of terminals provided with a stirrup.

The shape of the conductor space may differ from those shown, provided that a circle with a diameter equal to the minimum specified for *D* or the minimum outline specified for the elongated hole accepting cross-sections of conductors up to 2,5 mm^2 can be inscribed.

Figure 9 – Pillar terminals



Key

A Fixed part
B Washer or clamping plate
C Anti-spread device
D Conductor space
E Stud

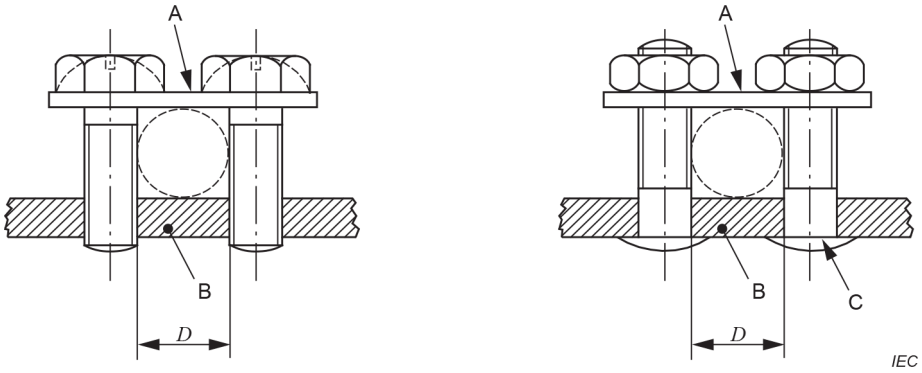
Cross-section of conductor accepted by the terminal	Minimum diameter *D* of conductor space	Torque	
mm^2	mm	Nm	
		3[a]	
		One screw or stud	Two screws or studs
Up to 1,5	1,7	0,5	–
Up to 2,5	2,0	0,8	–
Up to 4	2,7	1,2	0,5
Up to 6	3,6	2,0	1,2
Up to 10	4,3	2,0	1,2

[a] The values specified apply to the screws covered by the corresponding columns in Table 7.

The part which retains the conductor in position may be of insulating material provided the pressure necessary to clamp the conductor is not transmitted through the insulating material.

The second optional space for the terminal accepting cross-section of conductors up to 2,5 mm^2 may be used for the connection of the second conductor when it is required to connect two 2,5 mm^2 conductors.

Figure 10 – Screw head terminals and stud terminals



Key

A Saddle

B Fixed part

C Stud

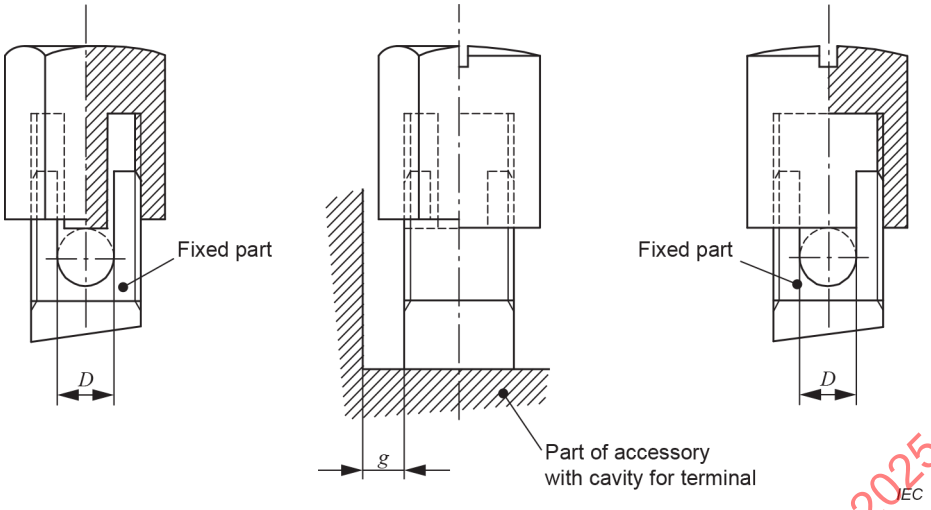
D Conductor space

Cross-section of conductor accepted by the terminal mm^2	Minimum diameter *D* of conductor space mm	Torque Nm
Up to 4	3,0	0,5
Up to 6	4,0	0,8
Up to 10	4,5	1,2

The shape of the conductor space may differ from that shown in this Figure 11, provided that a circle with a diameter equal to the minimum value specified for *D* can be inscribed.

The shape of the upper and lower faces of the saddle may have a different shape to accommodate conductors of either small or large cross-sectional areas by inverting the saddle.

Figure 11 – Saddle terminals



Cross-section of conductor accepted by the terminal mm²	Minimum diameter *D* of conductor space [a] mm	Minimum distance *g* between fixed part and end of conductor when fully inserted mm
Up to 1,5	1,7	1,5
Up to 2,5	2,0	1,5
Up to 4	2,7	1,8
Up to 6	3,6	1,8
Up to 10	4,3	2,0

[a] The bottom of the conductor space shall be slightly rounded in order to obtain a reliable connection.

The value of the torque to be applied is that specified in column 2 or 3 of Table 7 as appropriate.

Figure 12 – Mantle terminals

Compliance is checked by inspection, by measurement and by fitting conductors of the smallest and largest nominal cross-sectional areas specified.

12.2.2 Terminals with screw clamping shall allow the conductor to be connected without special preparation.

Compliance is checked by inspection.

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

12.2.3 Terminals with screw clamping shall have adequate mechanical strength.

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

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

Compliance is checked by inspection and by the tests of 12.2.6 and 12.2.8.

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

12.2.4 Terminals with screw clamping shall be resistant to corrosion.

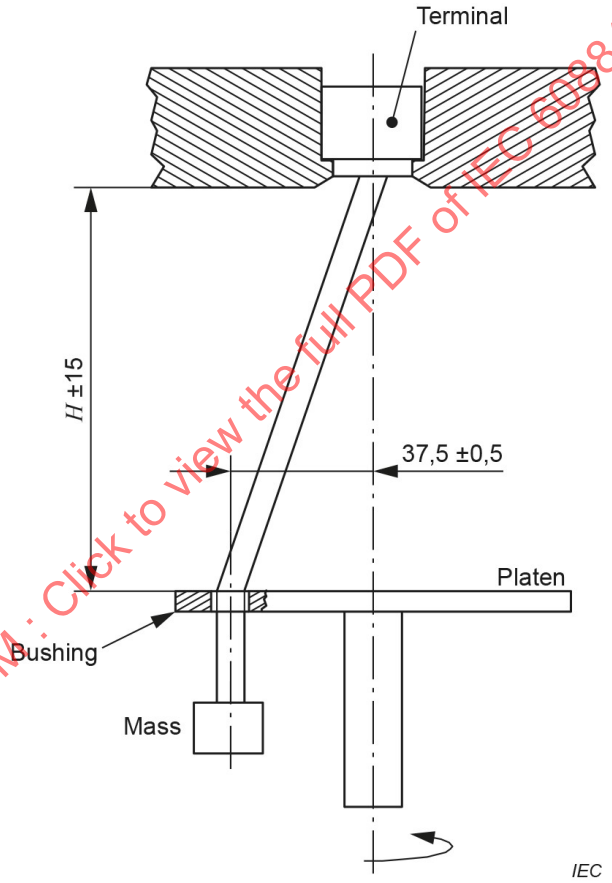
Terminals, the body of which is made of copper or copper alloy as specified in 26.5, are considered as complying with this requirement.

12.2.5 Terminals with screw clamping shall be so designed and constructed that they clamp the conductor(s) without undue damage to the conductor(s).

Compliance is checked by the following test.

The terminal is placed in the test apparatus according to Figure 13 and fitted with rigid solid, rigid stranded and/or flexible conductor(s), according to Table 4 first with the smallest and then with the largest nominal cross-sectional area, the clamping screw(s) or nut(s) being tightened with the torque according to Table 7.

Dimensions in millimetres



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

Figure 13 – Arrangement for checking damage to conductors

Terminals suitable for rigid and flexible conductors according to Table 4 are checked with rigid solid or rigid stranded conductors and on a new set of specimens with flexible conductors.

Terminals suitable for flexible conductors only (rewirable portable accessories) are checked with flexible conductors

The length of the test conductor shall be 75 mm longer than the height (H) specified in Table 10.

The end of the conductor is passed through an appropriate bushing in a plate positioned at a height (H) below the equipment, as given in Table 10. The bushing is positioned in a horizontal plane such that its centre line describes a circle of 75 mm diameter, concentric with the centre of the clamping unit in the horizontal plane; the platen is then rotated at a rate of (10 ± 2) revolutions per minute.

The distance between the mouth of the clamping unit and the upper surface of the bushing shall be within ±15 mm of the height specified in Table 10. The bushing may be lubricated to prevent binding, twisting, or rotation of the insulated conductor.

A mass as specified in Table 10 is suspended from the end of the conductor. The duration of the test is approximately 15 min.

During the test, the conductor shall neither slip out of the clamping unit nor break near the clamping unit, nor shall the conductor be damaged in such a way as to render it unfit for further use.

In the case of the flexible conductor, the breakage of a few wires shall not be taken into account provided it does not exceed 15 % of the original number of wires.

12.2.6 Terminals with screw clamping shall be so designed that they clamp the conductor reliably between metal surfaces.

Compliance is checked by inspection and by the following test.

Terminals suitable for rigid and flexible conductors according to Table 4 are checked with rigid solid or rigid stranded conductors and on a new set of specimens with flexible conductors.

Terminals suitable for flexible conductors only (rewirable portable accessories) are checked with flexible conductors.

The terminals are fitted first with conductors of the smallest and then with conductors of the largest cross-sectional area specified in Table 4, the terminal screws being tightened with a torque equal to two-thirds of the torque shown in the appropriate column of Table 7.

If the screw has a hexagonal head with a slot, the torque applied is equal to two-thirds of the torque shown in column 3 of Table 7.

Each conductor is then subjected to a pull as specified in Table 5, applied without jerks, for 1 min, in the direction of the axis of the conductor space.

Table 5 – Values for pull test for screw-type terminals

Nominal cross-sectional area of conductors accepted by the terminal mm²	Pull N
Above 0,75 up to 1,5 inclusive	40
Above 1,5 up to 4 inclusive	50
Above 4 up to 6 inclusive	60
Above 6 up to 10 inclusive	80

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

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

12.2.7 Terminals with screw clamping shall be so designed or placed that neither a rigid solid conductor nor a wire of a stranded conductor can slip out while the clamping screws or nuts are tightened.

Compliance is checked by the following test.

The terminals are fitted with conductors having the largest nominal cross-sectional area specified in Table 4.

Terminals suitable for rigid and flexible conductors according to Table 4 are checked with rigid solid or rigid stranded conductors and on a new set of specimens with flexible conductors.

Terminals suitable for flexible conductors only (rewirable portable accessories) are checked with flexible conductors.

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

The terminals are fitted with conductors having the composition shown in Table 6.

Table 6 – Composition of conductors

Nominal cross-sectional area mm²	Number of wires (*n*) and nominal diameter of conductors *n* × mm		
	Flexible conductor	Rigid solid conductor	Rigid stranded conductor
0,75	24 × 0,20	–	–
1,0	32 × 0,20	1 × 1,13	7 × 0,42
1,5	30 × 0,25	1 × 1,38	7 × 0,52
2,5	50 × 0,25	1 × 1,78	7 × 0,67
4,0	56 × 0,30	1 × 2,25	7 × 0,86
6,0	84 × 0,30	1 × 2,76	7 × 1,05
10,0	–	1 × 3,57	7 × 1,35

Before insertion into the clamping means of the terminal, wires of rigid (solid or stranded) conductors are straightened; rigid stranded conductors may, in addition, be twisted to restore them approximately to their original shape and flexible conductors are twisted in one direction so that there is a uniform twist of one complete turn in a length of approximately 20 mm.

The conductor is inserted into the clamping means of the terminal for the minimum distance specified, or where no distance is specified, until the conductor just projects from the far side of the terminal and in the position most likely to allow the wire to escape.

The clamping screw is then tightened with a torque equal to two-thirds of the torque shown in the appropriate column of Table 7.

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

After the test, no wire of the conductors shall have escaped from the clamping unit thus reducing creepage distances and clearances to values lower than those indicated in Table 26.

12.2.8 Terminals with screw clamping shall be so fixed or located within the accessory that, when the clamping screws or nuts are tightened or loosened, the terminals shall not work loose from their fixing to accessories.

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

The use of sealing compound or resin is considered to be sufficient for preventing a terminal from working loose, provided that:

– the sealing compound or resin is not subject to stress during normal use, and
– the effectiveness of the sealing compound or resin is not impaired by temperatures attained by the terminal under the most unfavourable conditions specified in this document.

Compliance is checked by inspection and by the following test.

A rigid solid copper conductor or a rigid stranded conductor of the largest nominal cross-sectional area specified in Table 4 is placed in the terminal.

Where rigid solid conductors do not exist, the test may be done with rigid stranded conductors.

Before insertion into the clamping means of the terminal, wires of rigid (solid or stranded) are straightened; rigid stranded conductors may, in addition, be twisted to restore them approximately to their original shape.

The conductor is inserted into the clamping means of the terminal for the minimum distance specified, or where no distance is specified, until the conductor just projects from the far side of the terminal and in the position most likely to allow the wire to escape.

Screws and nuts are tightened and loosened five times by means of a suitable test screwdriver or spanner, the torque applied when tightening being equal to the torque shown in the appropriate column of Table 7 or in the table of the appropriate Figure 9, Figure 10 or Figure 11, whichever is the greater.

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

Where a screw has a hexagonal head with a slot, only the test with the screwdriver is performed with the torque values given in column 3 of Table 7.

Table 7 – Tightening torques for the verification of the mechanical strength of screw-type terminals

Nominal diameter of thread mm	Torque Nm		
	1 [a]	2 [b]	3 [c]
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	1,2
Over 4,1 up to and including 4,7	0,8	1,8	1,2
Over 4,7 up to and including 5,3	0,8	2,0	1,4

[a] Column 1 applies to screws without a head if the screw, when tightened, does not protrude from the hole and to other screws which cannot be tightened by means of a screwdriver with a blade wider than the diameter of the screw.

[b] Column 2 applies to other screws which are tightened by means of a screwdriver and to screws and nuts which are tightened by means other than a screwdriver.

[c] Column 3 applies to nuts of mantle terminals which are tightened by means of a screwdriver.

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

For mantle terminals the specified nominal diameter is that of the slotted stud.

The shape of the blade of the test screwdriver should suit the head of the screw to be tested.

The screws and nuts should not be tightened in jerks.

12.2.9 Clamping screws or nuts of earthing terminals with screw clamping shall be adequately locked against accidental loosening and it shall not be possible to loosen them without the aid of a tool.

Compliance is checked by manual test.

NOTE In general, the design of terminals shown in Figure 9, Figure 10, Figure 11 and Figure 12 provide sufficient resiliency to comply with this requirement; for other designs, special provisions, such as the use of an adequate resilient part which is not likely to be removed inadvertently, can be necessary.

12.2.10 Earthing terminals with screw clamping shall be such that there is no risk of corrosion resulting from contact between these parts and the copper of the earthing conductor, or any other metal that is in contact with these parts.

The body of the earthing terminal shall be of brass or other metal no less resistant to corrosion, unless it is a part of the metal frame or enclosure, in which case the screw or nut shall be of brass or other metal no less resistant to corrosion.

NOTE In the following country, the use of any type of zinc alloy for earthing terminal is not allowed: BR, ZA.

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

Compliance is checked by inspection.

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

12.2.11 For pillar terminals, the distance between the clamping screw and the end of the conductor, when fully inserted, shall be at least that specified in Figure 9.

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

For mantle terminals, the distance between the fixed part and the end of the conductor, when fully inserted, shall be at least that specified in Figure 12.

Compliance is checked by measurement, after a solid conductor of the largest nominal cross-sectional area specified in Table 4, has been fully inserted and fully clamped.

12.3 Screwless-type terminals for external copper conductors

12.3.1 Screwless-type terminals may be of the type suitable for rigid copper conductors only or of the type suitable for both rigid and flexible copper conductors.

For the latter type the tests are carried out with rigid conductors first and then repeated with flexible conductors.

Screwless-type terminals for rewirable portable accessories shall be of the type suitable for flexible copper conductors.

12.3.2 Screwless-type terminals shall be provided with two clamping units each allowing the proper connection of rigid or of rigid and flexible copper conductors having nominal cross-sectional areas as shown in Table 8.

Table 8 – Relationship between rated current and connectable cross-sectional areas of copper conductors for screwless-type terminals

Rated current	Conductors		
	Nominal cross-sectional areas	Diameter of largest rigid conductor	Diameter of largest flexible conductor
A	mm^2	mm	mm
From 10 up to and including 16	From 1,5 up to 2,5 inclusive	2,13	2,21

When two conductors have to be connected, each conductor shall be introduced in a separate independent clamping unit (not necessarily in separate holes).

Compliance is checked by inspection and by fitting conductors of the smallest and largest nominal cross-sectional areas specified.

12.3.3 Screwless-type terminals shall allow the conductor to be connected without special preparation.

Compliance is checked by inspection.

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

12.3.4 Parts of screwless-type terminals mainly intended to carry current shall be of materials as specified in 26.5.

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

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

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

The conductor shall be clamped between metal surfaces.

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

Compliance is checked by inspection and by the tests of 12.3.10.

12.3.6 It shall be clear how the connection and disconnection of the conductors is to be made.

The intended disconnection of a conductor shall require an operation, other than a pull on the conductor, so that it can be done manually with or without the help of a general purpose tool.

It shall not be possible to confuse the opening intended for the use of a tool to assist the connection or disconnection with the opening intended for the conductor.

Compliance is checked by inspection and by the tests of 12.3.10.

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

– the clamping of one of the conductors is independent of the clamping of the other conductor(s);
– during the connection or disconnection the conductors can be connected or disconnected either at the same time or separately;
– each conductor shall be introduced in a separate clamping unit (not necessarily in separate holes);
– it shall be possible to clamp securely any number of conductors up to the maximum as designed.

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

12.3.8 Screwless-type terminals of fixed socket-outlets shall be designed so that adequate insertion of the conductor is obvious and over-insertion is prevented if further insertion is liable to reduce the creepage distances and/or clearances required in Table 26, or to influence the operation of the socket-outlet.

Compliance is checked by inspection.

12.3.9 Screwless-type terminals shall be properly fixed to the socket-outlet.

They shall not work loose when the conductors are connected or when the conductors are disconnected during installation.

Compliance is checked by inspection and by the tests of 12.3.10.

Covering with sealing compound without other means of locking is not sufficient. Self-hardening resins may, however, be used to fix terminals which are not subject to mechanical stress in normal use.

12.3.10 Screwless-type terminals shall withstand the mechanical stresses occurring in normal use.

Compliance is checked by the following tests which are carried out with uninsulated conductors on one screwless-type terminal of each specimen, using a new specimen for each test.

The test is carried out with solid rigid copper conductors, first with conductors having the largest nominal cross-sectional area, and then with conductors having the smallest nominal cross-sectional area specified in Table 8.

Conductors are connected and disconnected five times, new conductors being used each time, except for the fifth time, when the conductors used for the fourth connection are clamped at the same place. For each connection, the conductors are either pushed as far as possible into the terminal or are inserted so that adequate connection is obvious.

After each connection, the conductor is subjected to a pull of the value shown in Table 9; the pull is applied without jerks, for 1 min, in the direction of the longitudinal axis of the conductor space.

Table 9 – Value for pull test for screwless-type-type terminals

Rated current A	Pull N
From 10 up to and including 16	30

During the application of the pull, the conductor shall not come out of the screwless-type terminal.

The test is then repeated with rigid stranded copper conductors having the largest and smallest nominal cross-sectional areas specified in 12.3.2; these conductors are, however, connected and disconnected only once.

Screwless-type terminals intended for both rigid and flexible conductors shall also be tested with flexible conductors, making five connections and disconnections.

For fixed socket-outlets with screwless-type terminals, each conductor is subjected for 15 min to a circular motion with (10 ± 2) revolutions per minute using an apparatus, as shown in Figure 13. During this test, a mass as specified in Table 10 is suspended from the end of the conductor.

Table 10 – Values for flexing under mechanical load test for copper conductors

Nominal cross-sectional area of conductor [a] mm^2	Diameter of bushing hole [b] mm	Height H mm	Mass for conductor kg
0,5	6,5	260	0,3
0,75	6,5	260	0,4
1,0	6,5	260	0,4
1,5	6,5	260	0,4
2,5	9,5	280	0,7
4,0	9,5	280	0,9
6,0	9,5	280	1,4
10,0	9,5	280	2,0

[a] Approximate relationship between mm^2 and AWG sizes can be found in Annex D.

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

During the test, the conductors shall not move noticeably in the clamping unit.

After these tests, neither the terminals nor the clamping means shall have worked loose and the conductors shall show no deterioration impairing their further use.

In the case of the flexible conductor, the breakage of a few wires shall not be taken into account provided it does not exceed 15 % of the original number of wires.

12.3.11 Screwless-type terminals shall withstand the electrical and thermal stresses occurring in normal use.

Compliance is checked by the following tests a) and b), which are carried out on five screwless-type terminals of socket-outlets which have not been used for any other test.

Both tests are carried out with new copper conductors.

a) *The test is carried out loading the screwless-type terminals for 1 h with an AC or DC current as specified in Table 11 and connecting rigid solid conductors 1 m long having the nominal cross-sectional area as specified in Table 11.*

The test is carried out on each clamping unit.

Table 11 – Test current for the verification of electrical and thermal stresses in normal use for screwless-type terminals

Rated current A	Test current A	Nominal cross-sectional area of the conductor mm^2
10 and 13	17,5	1,5
16	22	2,5
NOTE For socket-outlets having rated currents lower than 10 A, the test current is proportionally determined and the cross-sectional area of the conductors is 1,5 mm^2.		

During the test the current is not passed through the socket-outlet, but only through the terminals.

Immediately after this period of 1 h, the voltage drop across each screwless-type terminal is measured with rated current flowing.

In no case shall the voltage drop exceed 15 mV.

The measurements are made across each screwless-type terminal and as near as possible to the place of contact.

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

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

a) The screwless-type terminals already subjected to the determination of the voltage drop specified in the previous test a) are tested as follows.

During the test, a current equal to the test current value given in Table 11 is passed only through the terminals.

The whole test arrangement, including the conductors, shall not be moved until the measurements of the voltage drop have been completed.

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

- *the current flows for approximately 30 min;*
- *for a further period of approximately 30 min no current flows.*

The voltage drop in each screwless-type terminal is determined as specified for the test of a) and is done at the following moments:

- *after the first 24 temperature cycles and after the 192nd temperature cycle;*
- *additional measurements shall be carried out after any 3 of the following temperature cycles: after the 48th, 72nd, 96th, 120th, 144th or 168th temperature cycles.*

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

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

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

12.3.12 Screwless-type terminals shall be so designed that the connected rigid solid conductor remains clamped, even when it has been deflected during normal installation, for example, during mounting in a box, and the deflecting stress is transferred to the clamping unit.

Compliance is checked by the following test which is carried out on three socket-outlet specimens which have not been used for any other test.

The test apparatus, the principle of which is shown in Figure 14 a), shall be so constructed that:

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

NOTE A reference direction need not be specified.

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

The deflecting device shall be so designed that:

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

Provisions shall be made so that the voltage drop across the clamping unit under test can be measured when the conductor is connected, as shown for example in Figure 14 b).

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

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

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

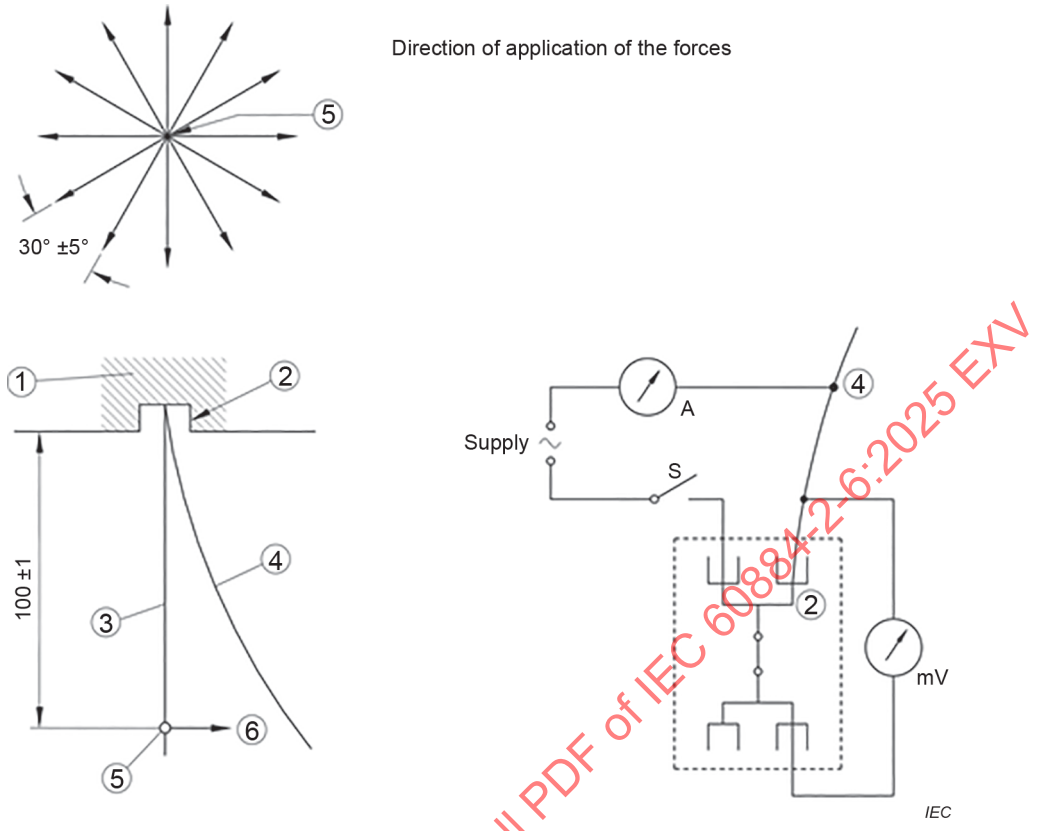
To avoid oxidation, the insulation shall be removed from the conductor immediately before starting the test.

A clamping unit is fitted as for normal use with a rigid solid copper conductor having the smallest nominal cross-sectional area specified in Table 12 and is submitted to a first test sequence; the same clamping unit is submitted to a second test sequence using the conductor having the largest nominal cross-sectional area, unless the first test sequence has failed.

The force for deflecting the conductor is specified in Table 13, the distance of 100 mm being measured from the extremity of the terminal, including the guidance, if any, for the conductor, to the point of application of the force to the conductor.

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

Dimensions in millimetres



a) Principle of the test apparatus for deflection on screwless-type terminals

b) Example of test arrangement to measure the voltage drop during deflection test on screwless-type terminals

Key

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

Figure 14 – Information for deflection test

Table 12 – Nominal cross-sectional areas of rigid copper conductors for deflection test of screwless-type terminals

Rated current of the socket-outlet A	Nominal cross-sectional area of the test conductor mm^2	
	First test sequence	Second test sequence
From 10 up to and including 16	1,5	2,5

Table 13 – Deflection test forces for screwless-type terminals

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

A test current equal to the rated current of the socket-outlet is passed through the clamping unit under test. A force according to Table 13 is applied to the test conductor inserted in the clamping unit under test in one of the 12 directions shown in Figure 14 a) and the voltage drop across this clamping unit is measured. The force is then removed.

The force is then applied successively on each one of the remaining 11 directions shown in Figure 14 a), following the same test procedure.

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

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

If one specimen fails in one of the directions of application of the test force, the tests are repeated on another set of specimens, all of which shall comply with this new series of tests.

12.4 Insulation piercing terminals (IPT)

See Annex F.

12.5 Crimped connections in accessories

12.5.1 Requirements for crimped connections

Crimped connections shall comply with the following requirements.

– All conductor strands shall be deformed from their original cross-section form in the effective crimp zone.
– No cracks throughout the metal barrel shall be present.
– For closed barrels any burr shall not be bigger than half of the thickness of the original material.
– For open barrels the height of the burr shall not be bigger than the thickness of the original material and the width of the burr shall not be bigger than half of the thickness of the original material.

NOTE 1 An example of crimped connection complying with the above requirements is given in Annex E.

NOTE 2 A crimp is considered good if the cross-section of the conductor is reduced to about 80 % of its initial value.

Voids within the crimp should be avoided.

Compliance is checked by making an analysis of the micro-section of the crimped connection and test of 12.5.2.

Photographs of 3 crimped connections shall be taken, each connection from a minimum of 3 representative views, for example, top view, bottom view and side view. Crimping parameters shall be defined and documented by the manufacturer and shall include the crimp height and its tolerances, the minimum pull-out force and a polished microsection (cross-section) of the crimp.

Compliance is checked by verifying that the required documentation is made available.

12.5.2 Pull-out test for crimped connections for accessories

Crimped connections shall have suitable mechanical strength.

Six new terminations of each crimped connection type connected to a conductor of the size and type used inside the accessory, shall be prepared by the manufacturer, ensuring that nothing can influence the tests results. The specimens shall be allowed to recover for more than 24 h before applying any tests.

The crimp height of each specimen shall be measured and documented before the tests.

The fixing of the specimen shall be such that the pull force is applied axially to the termination under test. Any cable clamping device that is not part of the termination shall be rendered inoperative such that it has no influence on the test.

The pull-out force of each specimen shall be measured and documented as specified in 12.5.1.

The measured pull-out force shall not be lower than the minimum value specified by the manufacturer.

The test is conducted using a tensile testing machine, the head of which is travelling at a rate of between 25 mm and 50 mm per minute, applying tension to the specimen until the conductor is pulled out of the crimp barrel or the conductor breaks.

13 Construction of fixed socket-outlets

13.1 General

Socket-contact assemblies shall have sufficient resilience to ensure adequate contact pressure on plug pins.

Parts of socket-contact assemblies, which will be in contact with the portion of the pin intended to make electrical contact when the plug is fully inserted in the socket-outlet shall ensure metallic opposing contacts at least on two sides of each pin.

Compliance is checked by inspection and the tests of Clause 9, Clause 21 and Clause 22.

13.2 Requirements for socket-contacts and pins

Socket-contacts and pins of socket-outlets shall be resistant to corrosion and abrasion.

Socket-contacts and pin(s) of socket-outlets, which are made of copper or copper alloy, as specified in 26.5, are considered as complying with this requirement.

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

The pin(s) of socket-outlets shall be constructed in such a way that the mechanical strength of the pin(s) does not depend on the plastic material.

NOTE In certain designs the pin(s) of the accessories are hollow and filled with plastic.

Compliance is checked by inspection and in case of doubt by the tests of 14.2 and of Clause 21 on a new set of specimens without plastic.

13.3 Insulating linings, barriers and the like

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

Compliance is checked by inspection and by the tests of Clause 24.

13.4 Connection of conductors

Socket-outlets shall be so constructed as to permit:

– easy introduction into the terminal and reliable connection of the conductors in the terminals, except for lead wires of pilot lights;

NOTE 1 Screw terminals as shown in Figure 9 to Figure 12 are considered suitable for reliable connection of the conductors.

– easy fixing of the main part to a wall or in a mounting box;

– correct positioning of the conductors;

– adequate space between the underside of the main part and the surface on which the main part is mounted or between the sides of the main part and the enclosure (cover or box) so that, after installation of the socket-outlet, the insulation of the conductors is not necessarily pressed against live parts of different polarity.

NOTE 2 This requirement does not imply that the metal parts of the terminal are necessarily protected by insulating barriers or insulating shoulders to prevent contact with the insulation of the conductor due to incorrect installation of the terminal metal parts.

For surface type socket-outlets to be mounted on a mounting plate, a wiring channel may be needed to comply with this requirement.

Compliance is checked by inspection and by an installation test with conductors of the largest nominal cross-sectional area specified in Table 4.

In addition, for socket-outlets having screwless-type terminals or insulation-piercing terminals, the socket-outlets shall be so constructed that the connecting and/or disconnecting means of the screwless-type terminals or of the insulation-piercing terminals cannot be activated by the conductors during and after installation of the socket-outlet in a box or on a wall.

NOTE 3 This requirement does not imply that the connecting and/or disconnecting means cannot be touched by the conductors.

NOTE 4 This requirement can be met by the placement of the connecting and/or disconnecting means and/or the use of protective barriers or shoulders placed around the connecting and/or disconnecting means.

Compliance is checked by inspection and in case of doubt by the following test.

The test is carried out with a solid copper conductor having the smallest cross-sectional area, as specified in 12.3.2.

The conductor is pushed as far as possible into the terminal under test or is inserted so that adequate connection is obvious.

A test probe according to IEC 61032 test probe 1 is pushed against the connecting or disconnecting means with a force of 120 N in the direction opposite to the mounting direction as described in Figure 15 a).

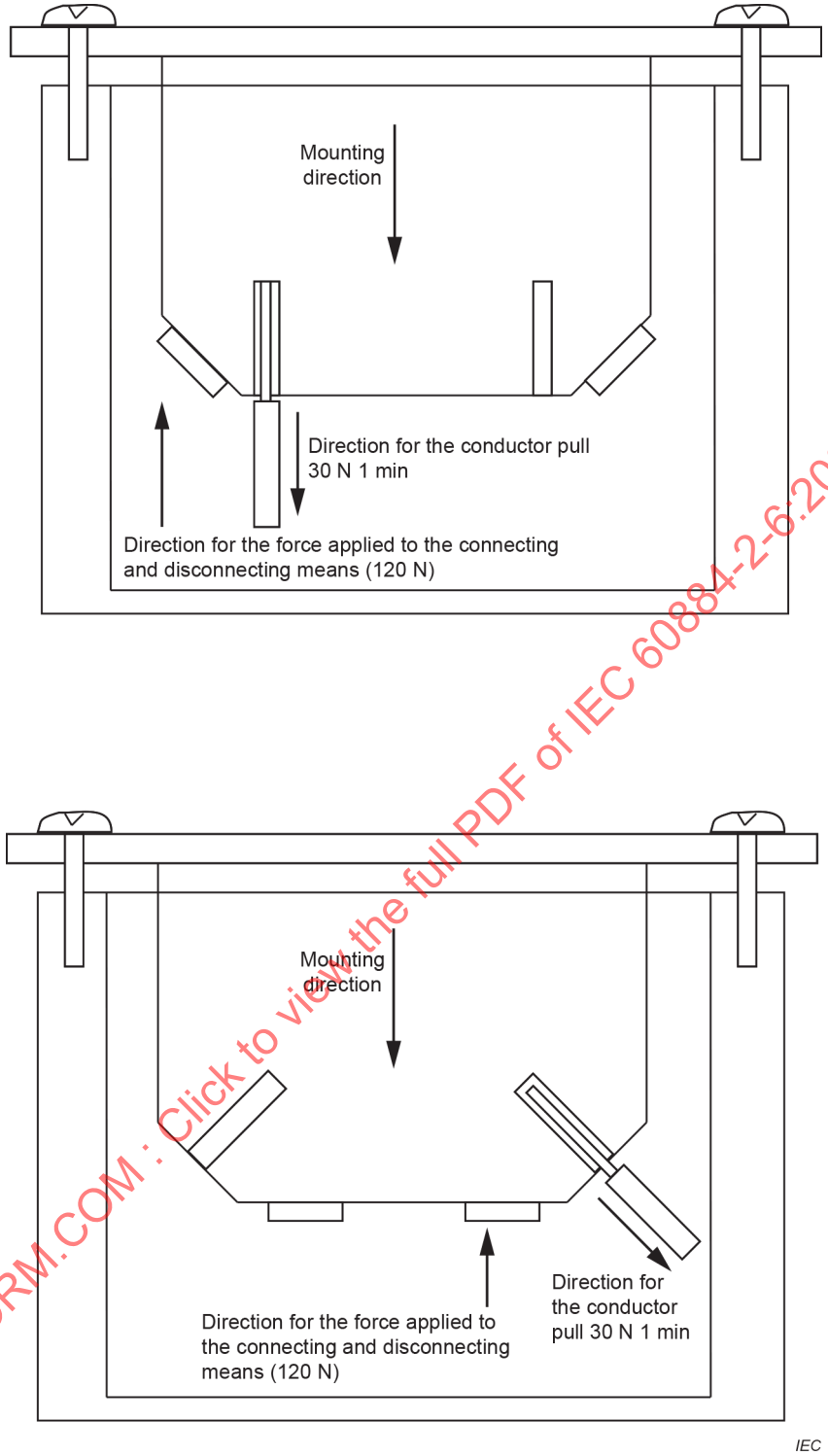
During the application of the force, the conductor, except for lead wires of pilot lights, is subjected to a pull of 30 N; the pull is applied in one smooth and continuous motion, for 1 min, in the direction of the longitudinal axis of the conductor space.

During the application of the pull, the conductor shall not come out of the screwless-type terminal.

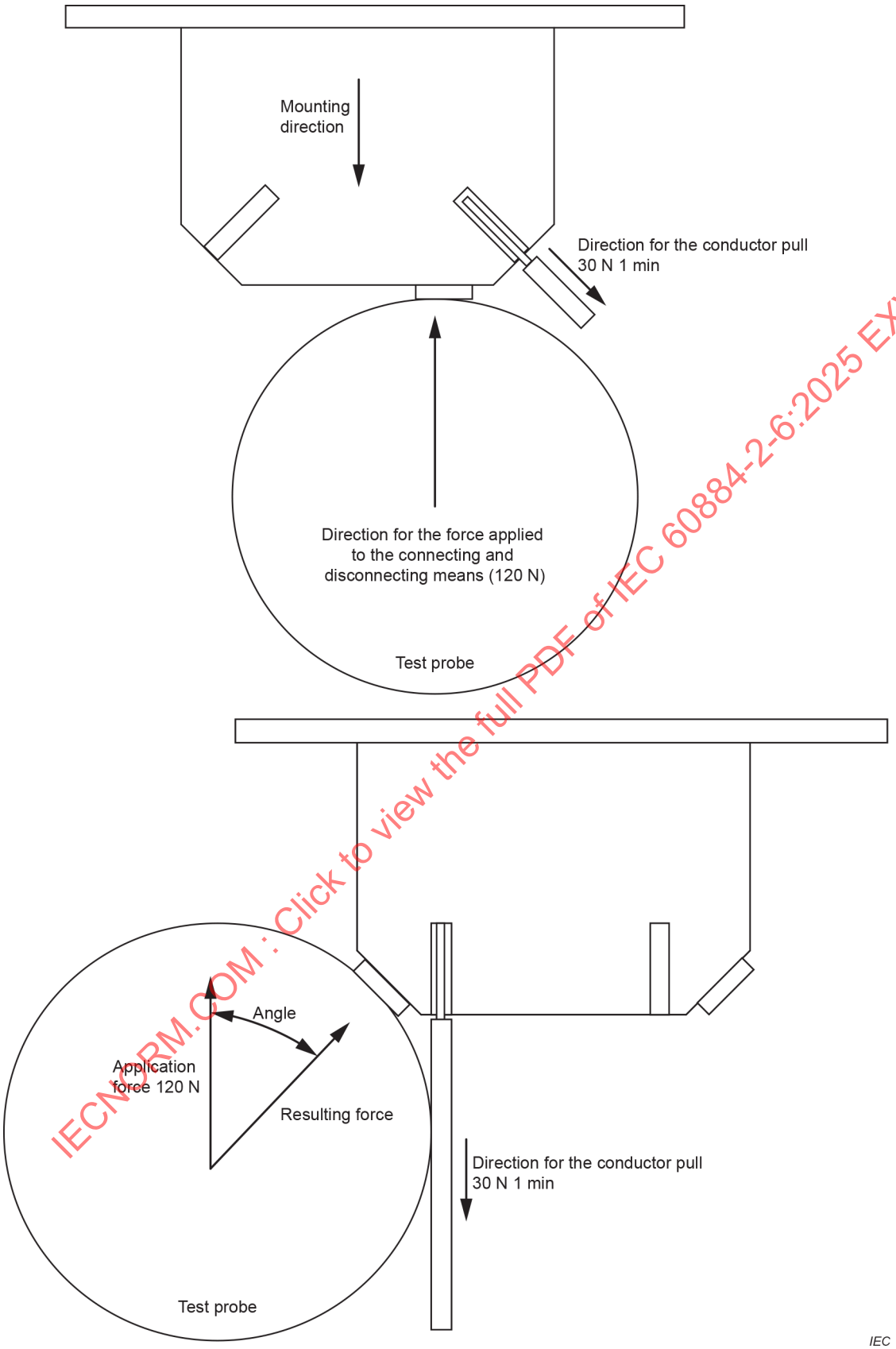
The force of 120 N shall be applied before the force of 30 N is applied. The force of 30 N is maintained on the conductor during the complete test.

Care shall be taken to ensure that the test probe does not touch the conductor during the application of the forces.

Where the axis between the application force and the axis through the force necessary to operate the connecting/disconnecting means deviates by more than 20°, it is allowed to exert the calculated resulting force directly onto the connecting/disconnecting means using the test probe; an example is shown in Figure 15 b).



a) Determination of the direction of the forces to be applied



b) Test set up

Figure 15 – Verification of the requirements of 13.4

If the angle is greater than 60° no test is necessary and the product is deemed to comply with the requirements without further tests.

If it is not possible to exert a force onto the connecting/disconnecting device, the product is deemed to comply with the requirements without further tests.

In addition, socket-outlets classified according to 7.2.4.1 (Design A) shall permit easy positioning and removal of the cover or cover-plate, without displacing the conductors or activating the connecting and/or disconnecting means of screwless-type terminals or insulation-piercing terminals.

NOTE 5 This requirement does not imply that the connecting and/or disconnecting means cannot be touched by the cover or cover plate.

Compliance is checked by inspection and by an installation test with conductors of the largest nominal cross-sectional area specified in Table 4.

13.5 Engagement of plugs

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

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

13.6 Covers provided with bushings for the entry holes for the pins

If covers are provided with bushings for the entry holes for the pins, it shall not be possible to remove them from the outside or for them to become detached inadvertently from the inside when the cover is removed.

Compliance is checked by inspection and, if necessary, by manual test.

13.7 Protection against electric shock provided by covers, cover-plates

13.7.1 Covers, cover-plates or parts of them which are intended to ensure protection against electric shock shall be held in place at two or more points by effective fixings.

Covers, cover-plates or parts of them may be fixed by means of a single fixing, for example, by a screw, provided that they are located by another means (for example, by a shoulder).

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

NOTE Non-earthed metal parts separated from live parts in such a way that creepage distances and clearances have the values specified in Table 26, are not considered as accessible if the requirements of this Subclause 13.7 are met.

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

Compliance is checked by the tests of 13.7.2, 13.7.3 or 13.7.4.

13.7.2 *For covers or cover-plates whose fixings are of the screw-type:*

by inspection only.

13.7.3 *For covers or cover-plates whose fixing is not dependent on screws and whose removal is obtained by applying a force in a direction approximately perpendicular to the mounting/supporting surface (see Table 14):*

a) when their removal may give access, with the standard test finger, to live parts:

by the tests of 24.13;

b) when their removal may give access, with the standard test finger, to non-earthed metal parts separated from live parts in such a way that creepage distances and clearances have the values shown in Table 26:

by the tests of 24.14;

c) when their removal may give access, with the standard test finger, only to

- *parts of insulating material, or*
- *earthed metal parts, or*
- *metal parts separated from live parts in such a way that creepage distances and clearances have twice the values shown in Table 26, or*
- *live parts of SELV circuits not greater than 25 V AC or 60 V DC;*

by the tests of 24.15.

Table 14 – Forces to be applied to covers, cover-plates or actuating members whose fixing is not dependent on screws

Accessibility with the standard test finger after removal of covers, cover-plates or parts of them	Tests according to subclauses	Force to be applied N			
		Number of socket-outlets complying with 24.16 and 24.17 which		Number of socket-outlets not complying with 24.16 and 24.17 which	
		shall not come off	shall come off	shall not come off	shall come off
To live parts	24.13	40	120	80	120
To non-earthed metal parts separated from live parts by creepage distances and clearances according to Table 26	24.14	10	120	20	120
To insulating parts, earthed metal parts, live parts of SELV ≤ 25 V AC or ≤ 60 V DC or metal parts separated from live parts by creepage distances twice those according to Table 26	24.15	10	120	10	120

13.7.4 *For covers or cover-plates the fixing of which is not dependent on screws and whose removal is obtained by using a tool, in accordance with the manufacturer's instructions given in an instruction sheet or in other documentation:*

by the same tests of 13.7.3 except that the covers or cover-plates or parts of them need not come off when applying a force not exceeding 120 N in directions perpendicular to the mounting/supporting surface.

13.8 Cover-plate intended for a socket-outlet with earthing contact

A cover-plate intended for a socket-outlet with earthing contact shall not be interchangeable with a cover-plate intended for a socket-outlet without earthing contact, if such interchange results in a change of the classification of the socket-outlet according to 7.1.3.

This requirement applies to accessories from the same manufacturer.

Compliance is checked by inspection and by an installation test.

13.9 Surface-type socket-outlets

Surface-type socket-outlets shall be so constructed that, when they are fixed and wired as for normal use, there are no free openings in their enclosures other than the entry openings for the pins of the plug or other openings for contacts, for example, side earthing contacts, or locking devices, etc.

Drain holes, small gaps between enclosures or boxes and conduits, cables, or earthing contacts, if any, or between enclosures or boxes and grommets or membranes and knockouts are neglected provided they do not compromise the declared IP rating.

Compliance is checked by inspection and by an installation test using a cable having conductors of the smallest nominal cross-sectional area specified in Table 15 or as declared by the manufacturer.

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

Compliance is checked by inspection.

13.10 Means for mounting the socket-outlet

Screws or other means for mounting the socket-outlet on a surface in a box or enclosure shall be easily accessible from the front. These means shall not serve any other fixing purpose.

13.11 Multiple socket-outlets with a common base

Multiple socket-outlets with a common base shall be provided with fixed links for the interconnection of the contacts in parallel. The fixing of these links shall be independent from the connection of the supply wires.

NOTE In the following country switched multiple socket-outlets, for fixed installation shall have a switch to disconnect each socket-outlet from the mains, the switch shall comply with either IEC 60669-1 or IEC 60884-2-3: ZA

13.12 Multiple socket-outlets with separate bases

Multiple socket-outlets, comprising separate bases, shall be so designed that the correct position of each base is ensured. The fixing of each base shall be independent of the fixing of the combination to the mounting surface.

Compliance with the requirements of 13.10 to 13.12 is checked by inspection.

13.13 Mounting plate of surface-type socket-outlets

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

Compliance is checked by inspection after the test of 13.4 and by the test of 24.4.

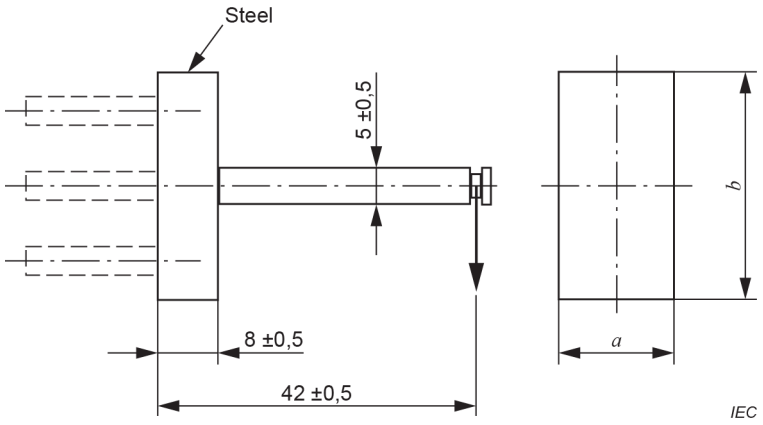
13.14 Lateral strain imposed by equipment

Socket-outlets shall withstand the lateral strain imposed by equipment likely to be introduced into them.

NOTE See 14.22.2 for the maximum strain applied by equipment to socket-outlets.

For socket-outlets having ratings up to and including 16 A and 250 V, compliance is checked by means of the device shown in Figure 16.

Dimensions in millimetres



The dimensions *a* and *b* are chosen according to the appropriate standard sheets.

NOTE Dimensions and arrangement of pins in compliance with standard sheets.

Figure 16 – Device for checking the resistance to lateral strain

Each specimen is mounted on a vertical surface with the plane through the socket-contacts horizontal. The device is then fully engaged and a weight hung on it such that the force exerted is 5 N.

The device is removed after 1 min and the socket-outlet is turned through 90° on the mounting surface. The test is carried out four times, the socket-outlet being turned through 90° after each engagement.

During the test the device shall not become disengaged from the socket-outlet.

After the tests, the socket-outlets shall comply with the requirements of 22.2 and 22.3.

13.15 Lampholders

Socket-outlets shall not be an integral part of lampholders.

Compliance is checked by inspection.

13.16 Surface-type socket-outlets having an IP code higher than IP20

Surface-type socket-outlets having an IP code higher than IP20 shall be according to their IP classification when installed in accordance the manufacturer's instructions as for normal use and without a plug in engagement.

Surface-type socket-outlets having a degree of protection from IPX4 to IPX6 shall have provision for opening a drain hole.

If a socket-outlet has a drain hole, it shall be not less than 5 mm in diameter, or 20 mm^2 in area with a width and a length of not less than 3 mm.

If the position of the lid is such that only one mounting position is possible, the drain hole shall be effective in that position. Alternatively, the drain hole(s) shall be effective in at least two positions of the socket-outlet when this is mounted on a vertical wall, one of these with the conductors entering at the top and the other with the conductors entering at the bottom.

Lid springs, if any, shall be of corrosion-resistant material, such as bronze or stainless steel.

Compliance is checked by inspection, by measurement and by the relevant tests of 16.2.

NOTE The enclosure design can incorporate a lid which closes when the plug is removed.

This requirement does not imply that the lid, if any, or the entry openings for the pins need be closed when the plug is not in position, provided that socket-outlets pass the relevant test for the verification of the ingress of water.

A drain hole in the back of the enclosure is deemed to be effective only if the design of the enclosure ensures a clearance of at least 5 mm from the mounting surface or provides a drainage channel of at least the size specified.

13.17 Earthing pins

Earthing pins, if any, shall have adequate mechanical strength.

Compliance is checked by inspection and, for pins which are not solid, by the test of 14.2 which is carried out after the tests of Clause 21.

13.18 Rotation of contacts

Earthing contacts, phase contacts and neutral contacts shall be locked against rotation.

When the product is ready for the wiring it shall not be possible to remove the earthing contacts, phase contacts and neutral contact without the use of a tool.

Compliance is checked by inspection and by manual test.

13.19 Metal strips of the earthing circuit

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

Compliance is checked by inspection.

13.20 Installation in boxes

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

Compliance is checked by inspection.

13.21 Inlet openings

Inlet openings shall allow the introduction of the conduit or the sheath of the cable so as to afford complete mechanical protection.

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

In surface-type socket-outlets the inlet opening for conduit entries, or at least two of them if there are more than one, shall be capable of accepting conduit sizes of 16, 20, 25 or 32 according to IEC 60423:2007 or a combination of at least two of any of these sizes.

In surface-type socket-outlets, the inlet opening for cable entries will preferably be capable of accepting cables having the dimensions specified in Table 15 or be as specified by the manufacturer.

In surface-type socket-outlets, the inlet opening for trunking and ducting, if any, shall be as specified by the manufacturer.

Table 15 – External cable dimension limits for surface-type socket-outlets

Rated current A	Nominal cross-sectional areas of conductors mm^2	Number of conductors	Limits of external dimensions of cables mm	
			Minimum	Maximum
10	1 up to and including 2,5	2	5,9	13,1
		3	6,3	14,0
		4	7,1	15,5
		5	7,8	17,0
13 and 16	1,5 up to and including 2,5	2	6,8	13,1
		3	7,4	14,0
	1,5 up to and including 4	4	8,4	17,9
		5	9,3	19,9
20	2,5 up to 4 inclusive	2	8,4	15,1
		3	9,2	16,2
		4	10,1	17,9
		5	11,2	19,9
25	2,5 up to 6 inclusive	2	8,4	16,8
		3	9,2	18,0
		4	10,1	20,0
		5	11,2	22,2
32	2,5 up to and including 10	2	8,4	22,6
		3	9,2	24,2
		4	10,1	26,5
		5	11,2	29,1
NOTE The limits of external dimensions of cables specified are based on IEC 60227 and IEC 60245.				

Compliance is checked by inspection and by measurement.

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

13.22 Fixing of membranes (grommets)

Membranes (grommets) in inlet openings shall be reliably fixed and shall not be displaced by the mechanical and thermal stresses occurring in normal use.

Compliance is checked by inspection and by the following test.

Membranes are tested when assembled in the accessory.

First the accessories are fitted with membranes which have been subjected to the treatment specified in 16.1.

The accessories are then placed for 2 h in a heating cabinet as described in 16.1, the temperature being maintained at (40 ± 2) °C.

Immediately after this period, a force of 30 N is applied for 5 s to various parts of the membranes by means of the tip of a straight unjointed test finger (test probe 11 of IEC 61032).

During these tests, the membranes shall not deform to such an extent that live parts become accessible.

For membranes likely to be subjected to an axial pull in normal use, an axial pull of 30 N is applied for 5 s.

During this test, the membranes shall not become detached.

The test is then repeated with membranes which have not been subjected to any treatment.

13.23 Material for membranes

It is recommended that membranes in inlet openings be so designed and be made of such material that the introduction of the cables into the accessory is permitted when the ambient temperature is low.

NOTE In the following countries compliance with this recommendation is required due to installation practices in cold conditions: AT, CA, CZ, DE, DK, FI, NO, SE.

When required, compliance is checked by the following test.

The accessories are fitted with membranes which have not been subjected to ageing treatment, those without openings being suitably pierced.

The accessories are then kept for 2 h in a freezer at a temperature of (−15 ± 2) °C.

After this period, the accessories are removed from the freezer and within 10 s, while the accessories are still cold, it shall be possible to introduce, without undue force, cables of the largest diameter through the membranes.

After the tests of 13.22 and 13.23 the membranes shall show no harmful deformation, cracks or similar damage which would lead to non-compliance with this document.

13.101 Switch poles

Switches shall be constructed to match the number of poles of the socket-outlet, except that the neutral pole is not switched in unswitched neutral socket-outlets.

The earthing contact is not considered as a pole and the earth circuit shall not be switched.

The position of the switch operating member shall be such that it does not prevent, nor shall its correct operation be prevented by, the proper insertion of the corresponding plug or plugs.

Compliance is checked by inspection and by a manual test.

13.102 Attachment of knobs

Knobs of rotary switches shall be securely coupled to the shaft or to the part operating the mechanism.

Compliance is checked by the following test.

The knob is subjected for 1 min to an axial pull of 100 N.

After this, knobs of switches having only one direction of operation are turned, if possible, without undue force, 100 times in the reverse direction.

During the test the knob shall not become detached.

13.103 Indication of the position

The actuating member of a switch, when released, shall automatically take up the position corresponding to that of the moving contacts, except that, for those with a single push-button, the actuating member may take up a single rest position.

13.104 Rest and intermediate position

Switches shall be so constructed that the moving contacts can come to rest only in the "ON" or "OFF" position, an intermediate position being, however, permissible if it corresponds to the intermediate position of the actuating member and if the insulation between the fixed and moving contacts is then adequate.

When in the intermediate position, the insulation between the fixed and moving contacts is checked by applying a voltage of substantially sine-wave form, having a frequency of 50 Hz or 60 Hz, for 1 min across the switch gap, the test voltage being 1 250 V for switched socket-outlets with interlock having a rated voltage up to and including 130 V, or 2 000 V for switched socket-outlets with interlock having a rated voltage exceeding 130 V.

Compliance with the requirements of 13.103 and 13.104 is checked by inspection, by manual test and for switches with the intermediate position by the electrical test in the preceding paragraph.

13.105 Undue arcing

Switches shall be constructed so that undue arcing cannot occur when the switch is operated slowly.

Compliance is checked by causing the switch, at the end of the test of Clause 21, to break the circuit a further ten times, the actuating member being moved steadily by hand over a period of 2 s and the moving contacts being stopped, if possible, in an intermediate position, the actuating member then being released.

During the test, no sustained arcing shall occur.

13.106 Making and breaking

Switched socket-outlets with interlock with switches operating more than one pole shall make and break all poles virtually simultaneously, except that for multiple switches with switched neutral, the neutral shall not make after or break before other poles.

Compliance is checked by inspection and by a manual test.

13.107 Action of the mechanism without cover or cover plate

The action of the mechanism, if the covers or cover plates are removable for installation purposes, shall be independent of the presence of the covers or cover plates.

Compliance is checked by connecting the switch, without cover or cover plate, of the switched socket-outlet with interlock in series with a lamp and by pressing the actuating member without undue force.

During the test the lamp shall not flicker.

14 Construction of plugs and portable socket-outlets

IEC 60884-1:2022, Clause 14 is not applicable.

15 Interlocked socket-outlets

15.101 General

Switched socket-outlets with interlock shall be so constructed that a plug cannot be inserted into or completely withdrawn from the socket-outlet while the socket contacts are live, and the socket contacts of the socket-outlet cannot be made live until a plug is almost completely in engagement.

Compliance is checked by carrying out the tests of 15.102.1 or 15.102.2 as applicable after the test of Clause 21.

15.102 Switched socket-outlets with interlock without retaining devices

15.102.1 Switched socket-outlets with interlock without retaining devices shall be:

– so constructed that the moving contacts of the switch are mechanically coupled with the socket-outlet in such a way that, during the withdrawal of the plug, they break before or substantially at the same time as the pins of the plug are disconnected from the socket contacts of the socket-outlet;

– so designed that, after engagement with the relevant plugs the interlock operates correctly;

– so designed that the operation of the interlock is not impaired by normal wear of the plug.

Compliance is checked by the test of 15.102.2 and Clause 21.

15.102.2 *Switched socket-outlets with interlock are connected as shown in Figure 101.*

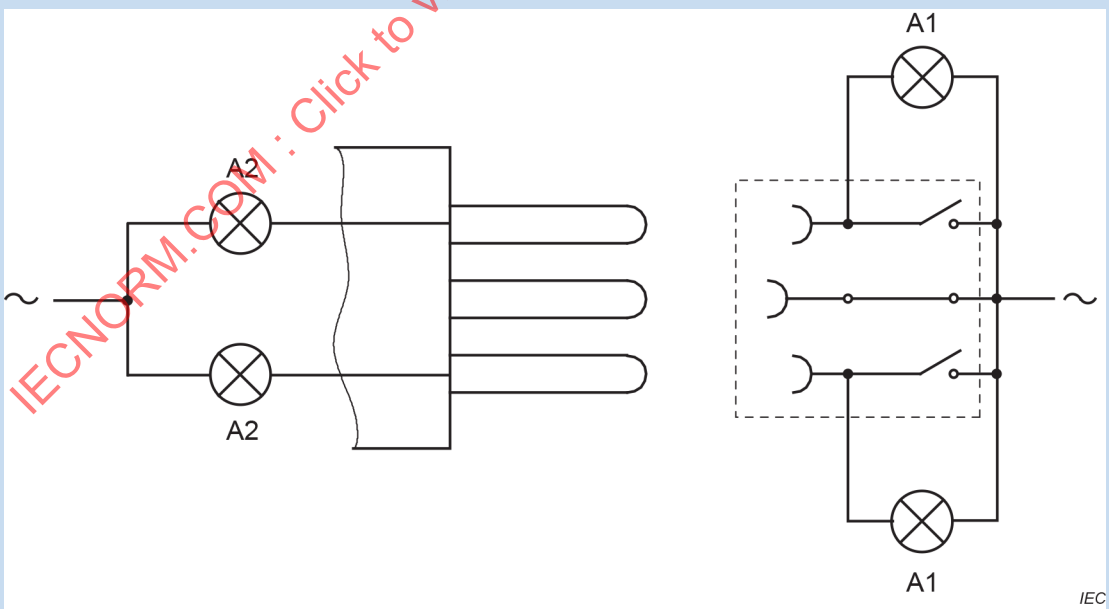


Figure 101 – Circuit for the tests of 15.101

The test is carried out as follows.

Without the plug inserted an attempt shall be made to close the switching device. The switch contacts shall not close.

This is checked by a continuity test made between the supply terminals and the contact assembly of the socket-outlet.

The plug connected as in Figure 101 is inserted and the switching device is then closed. The lamps A1 shall not light, the lamps A2 shall light.

The plug is then withdrawn slowly in the most unfavourable direction and then the lamps A1 shall light. The test is considered to be fulfilled if these conditions are met.

NOTE 1 A reduction of the brightness of the lamps A2 can occur during the time that the lamps A1 are illuminated.

NOTE 2 In case of doubt in determining the illumination time of the lamps, the test can be repeated using oscilloscopes.

The above test shall be carried out three times on each of the three specimens.

NOTE 3 For this test, specimens specially prepared by the manufacturer can be used.

15.103 Switched socket-outlets with interlock with retaining devices

15.103.1 Switched socket-outlets with interlock with retaining devices shall be:

– so constructed that the interlock is mechanically linked with the operation of a switching device so that the plug can neither be withdrawn from the socket-outlet while the contacts are alive, nor be inserted while the switching device is in the ON position;

– so designed that with any complementary accessory the interlock operates correctly.

Compliance is checked by inspection, by a manual test and by the test of 15.103.2.

15.103.2 *Switched socket-outlets with interlock with a mechanical retaining device locking the plug into the socket-outlet are subjected to the following test.*

An axial pull is applied to an appropriate plug inserted in the switched socket-outlet with interlock, with the mechanical retaining device in the locked position. The switched socket-outlet with interlock is fixed to mounting plate A of an apparatus as shown in Figure 25 so that the axis of the socket-contacts are vertical and the entry holes for the pins of the plug face downwards.

The test plug according to the relevant standard sheets shall have finely ground pins of hardened steel, having a surface roughness not exceeding 0,8 µm over their active length and spaced at the nominal distances, with a tolerance of ± 0,05 mm.

The diameter of round pins or the distance between contact surfaces for other types of pin shall be in accordance with the minimum dimension(s) given in the relevant standard sheets, with a tolerance of $^{+0,01}_{0}$ *mm.*

The pins are wiped free from grease before use.

The test plug is inserted into and withdrawn from the socket-outlet ten times. It is then again inserted, a mass being attached to it by means of a suitable clamp D. The total mass of the plug, the clamp and the carrier, shall exert a pull force equal to 120 N.

During the test the plug shall not come out of the socket-outlet and the mechanical retaining device shall remain in the locked position.

After the test, the switched socket-outlet with interlock shall show no damage within the meaning of this document.

For the purpose of this test, the earthing contact is considered as one pole.

16 Resistance to ageing, protection provided by enclosures, and resistance to humidity

16.1 Resistance to ageing

Accessories shall be resistant to ageing.

Parts intended for decorative purposes only, such as certain lids, shall be removed if possible and these parts are not subjected to the test.

Compliance is checked by the following test.

Accessories, mounted as for normal use, are subjected to a test in a heating cabinet with an atmosphere having the composition and pressure of the ambient air and ventilated by natural circulation.

Accessories having an IP code higher than IPX0 are tested after having been mounted and assembled as specified in 16.2.3.

For accessories having a lid, the lid is closed during the test.

For portable socket-outlets, the plug of the same system having the same rated current as the socket-outlet shall be inserted into the socket-outlet during the test. The plug can be suitably modified if necessary to allow the closure of the lid, if any.

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

The specimens are kept in the cabinet for seven days (168 + 4) h.

The use of an electrically heated cabinet is recommended.

Natural circulation may be provided by holes in the wall of the cabinet.

After the treatment, the specimens are removed from the cabinet and kept at a room temperature and relative humidity between 45 % and 55 % for at least four days (96 h).

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 determined 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.*

After the test, the socket-outlets shall not deviate from the dimensions specified in the standard sheets and shall show no damage impairing their future use. In case of doubt, new specimens are tested again in accordance with 16.1 and shall comply with the requirements of 9.1 and 10.2.

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

- the specimen 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 specimen plus 500 g;
- equilibrium is then restored by pressing the specimen with the forefinger, wrapped in a dry piece of rough cloth.

For portable socket-outlets, after having withdrawn the test plug from the socket-outlet the contact pressure of the contact assembly is checked as specified in 22.3 with the single-pin gauge. The gauge shall not fall from the contact assembly within 30 s.

For fixed socket-outlets, the test is then repeated on a new set of specimens with a plug of the same system having the same rated current as the socket-outlet inserted during the test. The plug can be suitably modified if necessary to allow the closure of the lid, if any.

After the test, and after having withdrawn the test plug from the socket-outlet the contact pressure of the contact assembly is checked as specified in 22.3 with the single-pin gauge. The gauge shall not fall out from the contact assembly within 30 s.

16.2 Protection provided by enclosures

16.2.1 General

Enclosures shall provide protection against access to hazardous parts, harmful effects due to ingress of solid foreign objects and harmful effects due to ingress of water in accordance with the IP designation of the accessory.

Compliance is checked by the tests of 16.2.2 and 16.2.3.

16.2.2 Protection against access to hazardous parts and against harmful effects due to ingress of solid foreign objects

16.2.2.1 General

Accessories and their enclosures shall provide a degree of protection against access to hazardous parts and against harmful effects due to ingress of solid foreign objects.

Fixed socket-outlets are mounted as in normal use on a vertical surface. Flush-type and semi-flush-type socket-outlets are mounted in an appropriate box according to the manufacturer's instructions.

Accessories with screwed cable glands or membranes are fitted and connected with cables which shall be within the connecting range specified in Table 4. Cable glands are tightened with a torque equal to two-thirds of that applied during the test of 24.7.

Screws of the enclosure are tightened with a torque equal to two-thirds of the value given in Table 7.

Parts which can be removed without the aid of a tool are removed.

If an accessory has passed the test successfully, then this test is deemed to be passed for a combination of such single accessories.

NOTE Cable glands are not filled with sealing compound or the like.

16.2.2.2 Protection against access to hazardous parts

The appropriate test specified in IEC 60529 is performed (see also Clause 10).

16.2.2.3 Protection against harmful effects due to ingress of solid foreign objects

The appropriate test specified in IEC 60529 is performed.

For the test of accessories with numeral 5 as the first characteristic, the accessories are considered to be of category 2; dust shall not penetrate in a quantity to interfere with satisfactory operation or to impair safety.

For the test of the first characteristic numeral 6, enclosures of socket-outlets are considered to be of category 1 (see 13.6 of IEC 60529:1989); no dust shall penetrate.

The test probes shall not be applied to drain holes.

16.2.3 Protection against harmful effects due to ingress of water

Accessories and their enclosures shall provide a degree of protection against harmful effects due to ingress of water in accordance with their IP classification.

Compliance is checked by the appropriate tests of IEC 60529 under the conditions specified below.

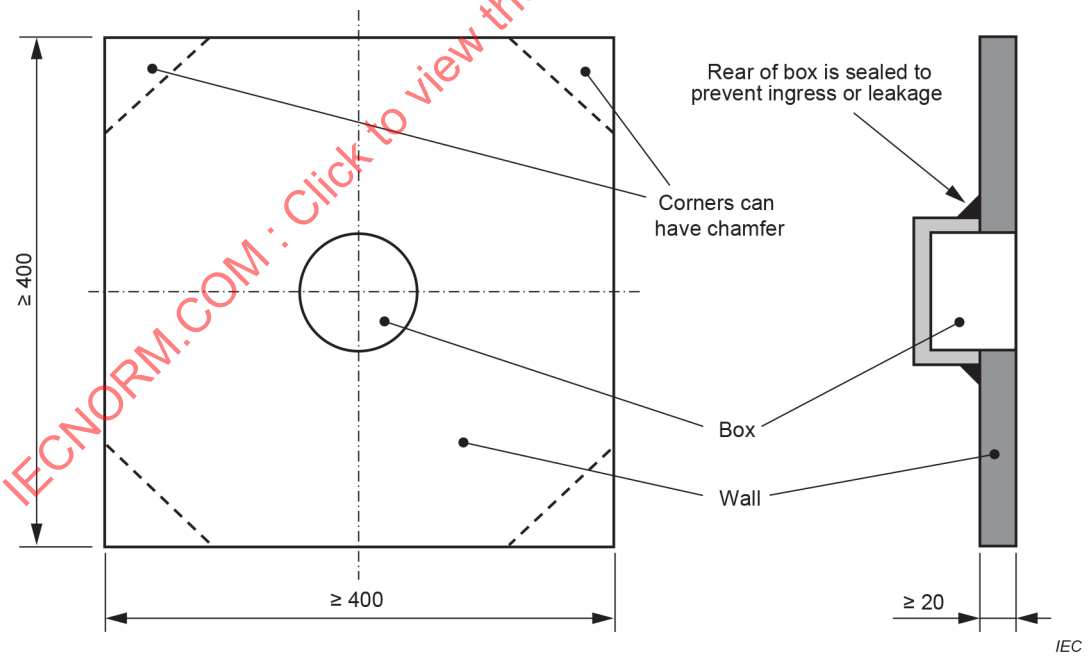
Flush-type and semi-flush-type socket-outlets are fixed in a vertical test wall according to Figure 18 a) representing the intended use of the flush-type and semi flush-type socket-outlets using an appropriate box in accordance with the manufacturer's instructions.

Where the manufacturer's instructions specify that the accessory is suitable to be installed on a rough wall, the test wall according to Figure 18 b) or Figure 18 c) is used. The test wall is made with bricks or plastic having flat smooth surfaces. When the box is mounted in the test wall, it shall fit tight against the wall.

If sealing material is used in order to seal the box into the wall, it should not influence the sealing properties of the specimen to be tested.

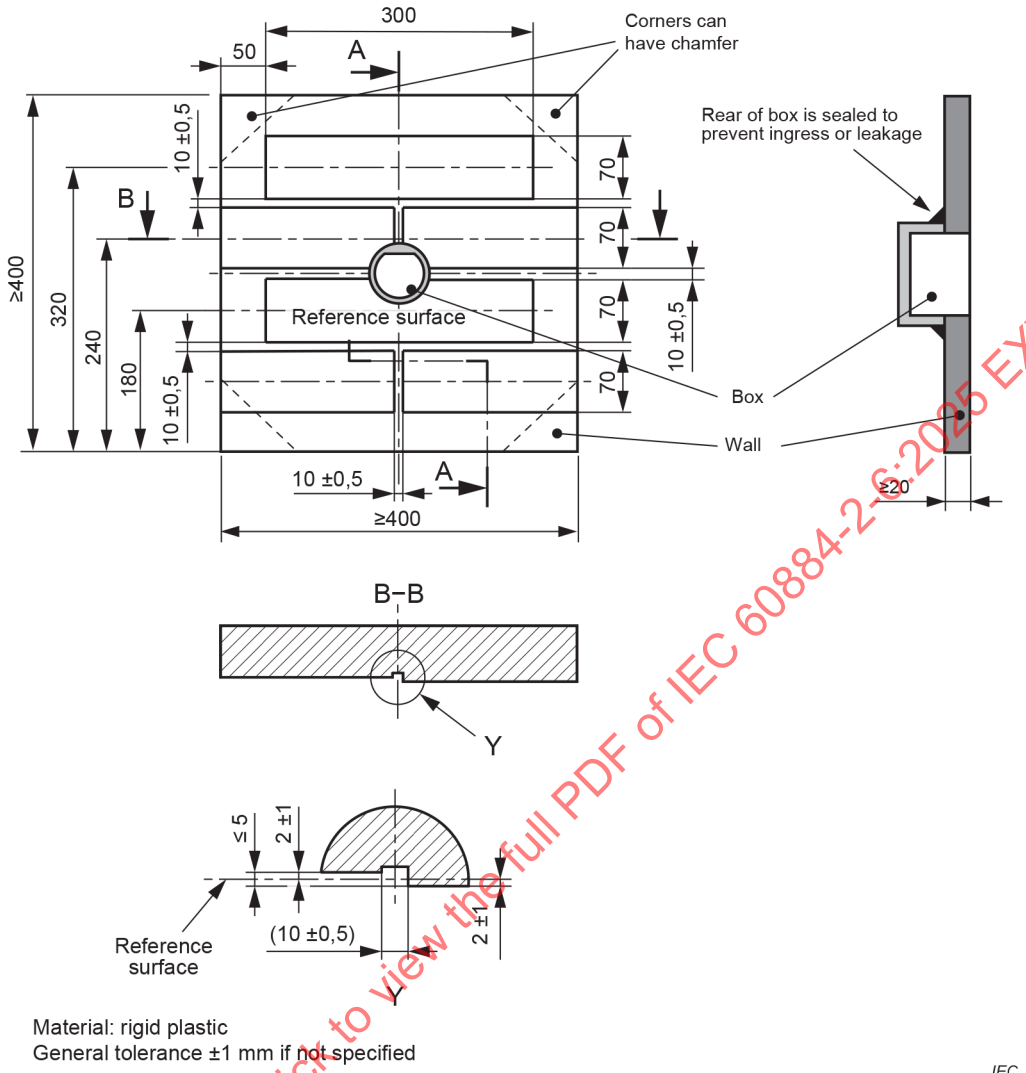
NOTE 1 Figure 18 shows examples where the edge of the box is positioned in the reference plane; other positions are possible, according to the manufacturer's instructions.

Dimensions in millimetres



a) Flat wall

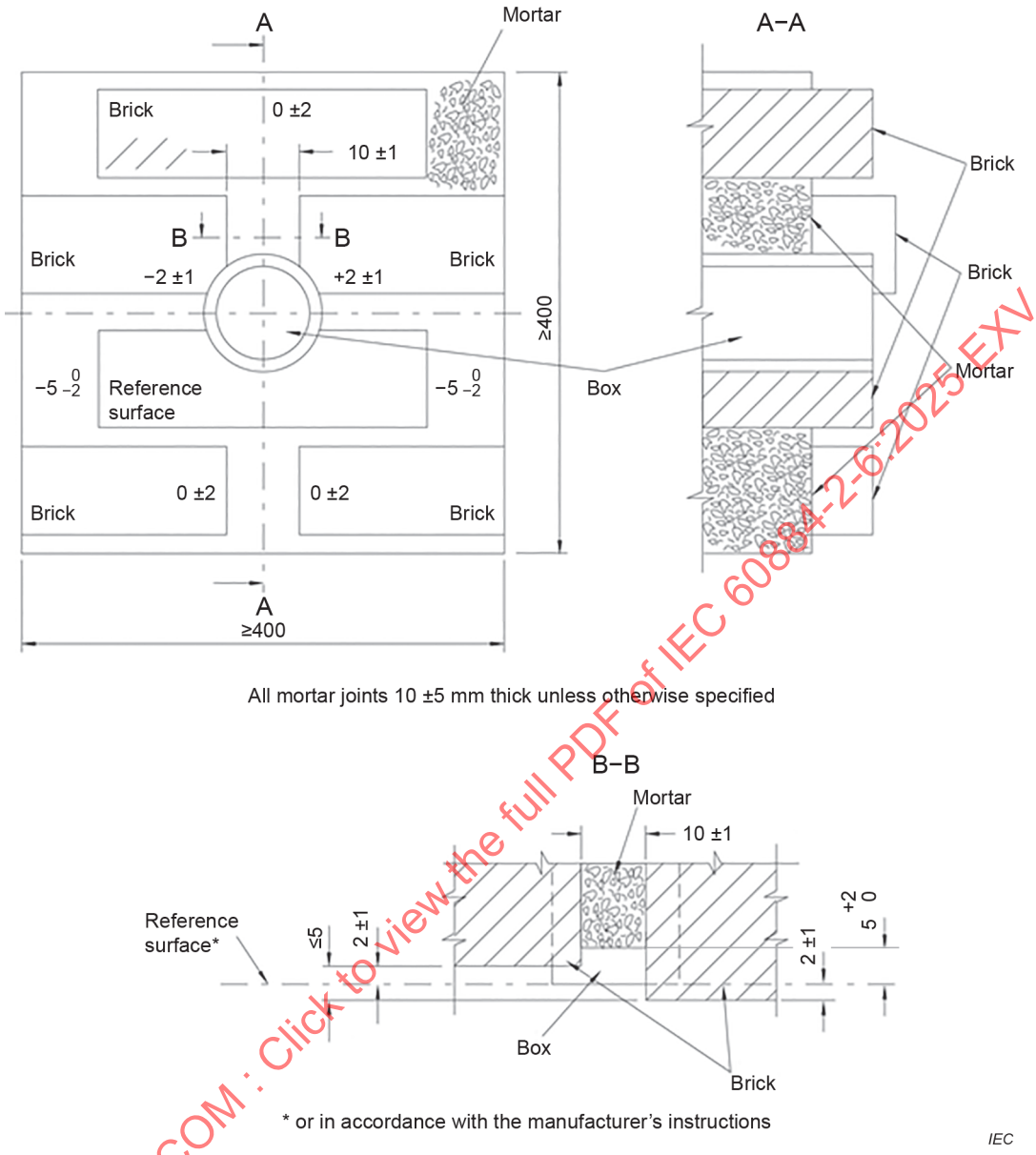
Dimensions in millimetres



The rough surface related to the reference surface shall be equivalent to Figure 18 c)

b) Plastic wall

Dimensions in millimetres



c) Brick wall

Figure 18 – Types of test wall

Surface type socket-outlets are mounted as for normal use in a vertical position and fitted with cables or conduits or both in accordance with the manufacturer's instructions. Cables shall have conductors of the largest and smallest nominal cross-sectional area given in Table 4, as appropriate to their rating.

Surface type socket-outlets are mounted on a test wall having a smooth surface with external dimensions according to Figure 18 a). The sheath of the end of the cable rises 2(+1/0) mm above the top edge of the cable gland or membrane. The entry of the cable is from below, if possible.

If accessories are tested with ratings IPX3 or IPX4, the following applies.

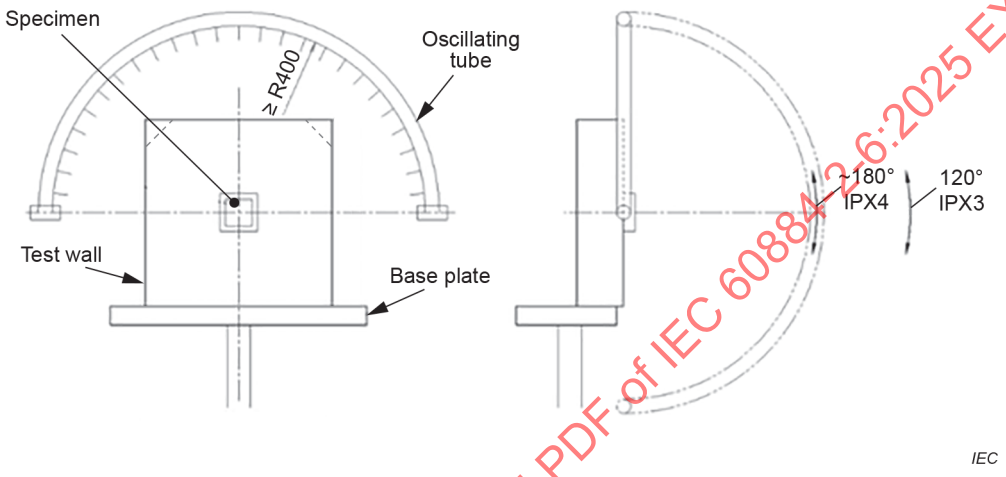
The test is performed with the test device in accordance with Figure 19. The rotation axis of the tube shall be:

– *horizontal,*

and

– *on the mounting plane of the test wall.*

The specimen shall be with the centre in the middle of the rotation axis.



1: Base plate

2: Test wall

3 Specimen

4: Oscillating tube

Figure 19 – Test set-up in accordance with 16.2.3

Portable socket-outlets are tested on a flat, horizontal surface in a position as in normal use, such that there is no strain on the flexible cable. They are fitted with flexible cables (see Table 25) having conductors of the largest and smallest nominal cross-sectional area given in Table 4, as appropriate to their rating.

Screws of the enclosure operated when mounting the accessory are tightened with a torque equal to two-thirds of the applicable torque given in Table 7.

Cable glands are tightened with a torque equal to two-thirds of that applied during the test of 24.7.

Cable glands are not filled with sealing compound or the like.

Parts which can be removed without the aid of a tool are removed.

If the enclosure of a socket-outlet that has an IP code less than IPX5 is designed with drain holes, one drain hole is opened, as for normal use, in the lowest position. If the enclosure of a socket-outlet that has an IP code equal to or greater than IPX5 is designed with drain holes, they shall not be opened.

Socket-outlets are tested without a plug in engagement and with the lid, if any, closed.

NOTE 2 In the following countries fixed socket-outlets are also tested with a mating plug having the same IP rating in engagement: AT, AU, , DE, DK.

Plugs are tested when in full engagement first with a fixed and then with a portable socket-outlet of the same system and with the same degree of protection against harmful effects due to ingress of water, if defined in the system.

NOTE 3 In the following countries, fixed socket-outlets and portable socket-outlets are also tested with the plug with the same degree of protection in engagement: AU, DE.

Care shall be taken not to disturb, for example, to knock or shake, the assembly, in such a way that the test result will be affected.

If an accessory has drain holes which have been opened, it shall be proved by inspection that any water which enters does not accumulate and that it drains away without doing any harm to the complete assembly.

The specimens shall withstand an electric strength test specified in 17.3 which shall be started within 5 min of completion of the test according to this subclause.

16.3 Resistance to humidity

Accessories shall be resistant to humidity which may occur in normal use.

Compliance is checked by the humidity treatment described in this Subclause 16.3.

Inlet openings, if any, are left open; if knock-outs are provided, one of them is opened.

Parts which can be removed without the aid of a tool, are removed and subjected to the humidity treatment along with the main part; spring lids are open during this treatment.

The humidity treatment is carried out in a humidity cabinet containing air with a relative humidity maintained between 91 % and 95 %.

The temperature t of the air in which the specimens are placed is maintained within ±1 K of any convenient value t between 20 °C and 30 °C.

NOTE 1 In the following country the temperature in the humidity cabinet is (40 ± 2) °C: CN.

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

The specimens are kept in the cabinet for

- *two days (48 h + 2 h) for accessories having an IP code of IPX0;*
- *seven days (168 h + 4 h) for accessories having an IP code higher than IPX0.*

NOTE 2 In most cases, the specimens can be brought to the specified temperature by keeping them at this temperature for at least 4 h before the humidity treatment.

NOTE 3 A relative humidity between 91 % and 95 % can be obtained by placing in the humidity cabinet a saturated solution of sodium sulphate ($Na_2 SO_4$) or potassium nitrate (KNO_3) in water, having a sufficiently large contact surface with the air.

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

After this treatment, the specimens shall comply with the insulation resistance measurement and the electric strength test as specified in Clause 17 which are carried out immediately after taking the specimens out of the humidity chamber.

17 Insulation resistance and electric strength

17.1 General

The insulation resistance and electric strength of accessories shall be adequate.

At least one pole of any pilot light or incorporated electronic devices are disconnected for the test of this Clause 17.

Compliance is checked by the following tests, which are made immediately after the test of 16.3, in the humidity cabinet or in the room in which the specimens were brought to the prescribed temperature, after re-assembly of those parts which can be removed without the aid of a tool, which were removed for the test.

17.2 Test for measuring the insulation resistance

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

The insulation resistance shall be not less than 5 MΩ.

For items g) and h) of 17.2.2, the insulation resistance shall not be less than 2 MΩ.

17.2.2 *For socket-outlets, the insulation resistance is measured consecutively:*

a) between all poles (L1, L2, L3 and N, if any) connected together and the body, the measurement being made with a plug in engagement;

b) between each pole (L1, L2, L3 and N, if any) in turn and all others, these being connected to the body with a plug in engagement;

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

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

d) between any metal part of the cord anchorage, including clamping screws, and earthing terminal(s) or earthing contact(s), if any, of portable socket-outlets;

e) between any metal part of the cord anchorage of portable socket-outlets and a metal rod of the maximum diameter of the flexible cable inserted in its place (see Table 25).

For switches of a switched socket-outlet with interlock, the insulation resistance is measured consecutively:

f) *between all poles connected together and the body, with the switch in the "ON" position;*

g) *between each pole in turn and all others connected to the body, with the switch in the "ON" position;*

h) *between the terminals which are electrically connected together when the switch is in the "ON" position, the switch being in the "OFF" position.*

The term "body" includes accessible metal parts, metal frames supporting the base of flush-type switched socket-outlets with interlock, operating keys, metal foil in contact with the outer surface of accessible external parts and operating keys of insulating material, the point of anchorage of the cord, chain or rod for switches operated by such means, fixing screws of bases or covers and cover plates, external assembly screws, earthing terminals and any metal part of the mechanism if required to be insulated from live parts (see 10.102).

Measurements c), d) and e) are not made on non-rewirable portable socket-outlets.

While wrapping the metal foil round the outer surface or placing it in contact with the inner surface of parts of insulating material, it is pressed against holes or grooves, without any appreciable force, by means of a straight unjointed test finger test probe 11 of IEC 61032.

17.2.3 For plugs, the insulation resistance is measured consecutively:

a) between all poles (L1, L2, L3 and N, if any) connected together and the body;

b) between each pole (L1, L2, L3 and N, if any) in turn and all others, these being connected to the body;

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

d) between any metal part of the cord anchorage and a metal rod of the maximum diameter of the flexible cable inserted in its place (see Table 25).

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

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

While wrapping the metal foil round the outer surface or placing it in contact with the inner surface of parts of insulating material, it is pressed against holes or grooves, without any appreciable force, by means of a straight unjointed test finger test probe 11 of IEC 61032.

17.3 Electric strength test

A voltage of substantially sine-wave form, having a frequency of 50 Hz or 60 Hz, is applied for 1 min between the parts indicated in 17.2.

The test voltage shall be as follows:

– *1 250 V for accessories having a rated voltage up to and including 130 V;*

– *2 000 V for accessories having a rated voltage exceeding 130 V.*

Accessories with an accessible metal surface according to 10.3.2 shall in addition be tested as follows:

Between the live parts (L1, L2, L3 and N, if any) connected together and the accessible metal surface:

– *2 000 V for accessories having a rated voltage up to and including 130 V;*

– *3 000 V for accessories having a rated voltage exceeding 130 V.*

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

No flashover or breakdown shall occur during the test.

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

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

Care is taken that the RMS value of the test voltage applied is measured within ±3 %.

Glow discharges without drop in the voltage are neglected.

18 Operation of earthing contacts

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

Compliance is checked by the tests of Clause 19 and Clause 21.

19 Temperature rise

19.1 General

Accessories shall be so constructed that they comply with the following temperature rise test.

Plugs and socket-outlets are tested according to 19.2, except for the following specific cases.

Fixed socket-outlets of a socket-outlet and fused plug system are tested according to 19.3. Fused plugs are tested according to IEC 60884-2-1.

Accessories with incorporated components not covered by other parts of IEC 60884 series, are tested according to 19.4.

Crimped connections are in addition submitted to the tests of 19.5.1.

Fixed socket-outlets incorporating pilot lights are in addition submitted to the tests of 19.5.2.

Non-rewirable accessories are tested as delivered.

Rewirable accessories are fitted with polyvinyl chloride insulated conductors having a nominal cross-sectional area as shown in Table 16.

Table 16 – Nominal cross-sectional areas of copper conductors for the temperature-rise test

Rated current	Nominal cross-sectional area	
A	mm^2	
	Flexible conductors for portable accessories	Rigid conductors (solid or stranded) for fixed accessories
Up to and including 13	1	1,5
Over 13 and up to and including 16	1,5	2,5
Over 16 and up to and including 20	4	4
Over 20 and up to and including 25	4	6
Over 25 and up to and including 32	6	10

The terminal screws or nuts are tightened with a torque equal to two-thirds of that specified in 12.2.8.

To ensure normal cooling of the terminals, the conductor connected to each terminal shall have a length of at least 1 m.

The test plug is fitted with insulated conductors having the same nominal cross-sectional area fitted to the socket-outlet under test, the conductor from each terminal shall be not less than 1 m.

NOTE 1 For a two-pole plug, the conductor length between terminals will not be less than 2 m.

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

The test assembly shall be allowed to dry for at least seven days when first made.

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

NOTE 2 The sides of the cavity in the pinewood block can have a cylindrical shape.

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

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

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

The test assembly shall be placed in a draught-free environment for the test.

In the case of non rewirable accessories care should be taken to minimize the influence on the structure/design/performance of the accessory when accessing the terminations of the accessory.

For accessories having three poles or more, the current during the test shall be passed through the phase contacts, where applicable. In addition, separate tests shall be made passing the current through the neutral contact, if any, and the adjacent phase contact and through the earthing contact, if any, and the nearest phase contact. For the purpose of this test, earthing contacts, irrespective of their number, are considered as one pole.

In the case of multiple socket-outlets, the test is carried out on one socket-outlet of each type and current rating with the test current as specified in Table 18 passed through that one socket-outlet.

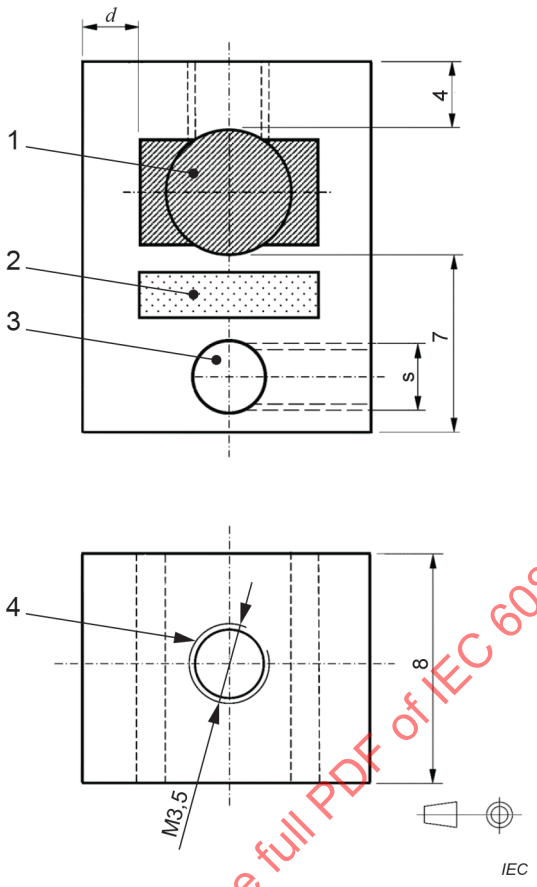
In the case of a multiple socket-outlet consisting of pre-wired single socket-outlets intended to be mounted in one single box, the test is carried out with the test current specified in Table 18 on one socket-outlet that shall be the farthest from the main terminals in the internal electrical circuit.

The temperature rise of the terminals, terminations and clamping units according to Figure 20 determined by means of thermocouples shall not exceed 45 K. Thermocouples shall be applied as close as possible to the terminals or terminations.

For the purpose of the test of 25.4, the temperature rise of external parts of insulating material not necessary to retain current-carrying parts and parts of the earthing circuit in position, even though they are in contact with them, is also determined.

NOTE 3 In the following country, when accessories incorporate elements such as dimmers, fuses, switches, energy regulators etc., the incorporated elements are to be tested in accordance with the ratings specified by the manufacturer. Any protective element (such as fuses or thermal cut-outs) is to be electrically short circuited with a link of negligible resistance, for the execution of the test: ZA.

Dimensions in millimetres



Key:

1 Pin hole (shaded area)

2 Area for mounting the thermocouple permanently

3 Space for the welded supply cable (optional: screw fixing)

4 Threaded hole for clamping screw

d 1,5 mm ≤ *d* ≤ 3 mm

s Optional threaded hole for screw fixing of supply cable. If used, the screw shall have no head and shall be tightened with the torque according to Table 7

REMARKS:

– Material: brass with at least 52 % of copper.

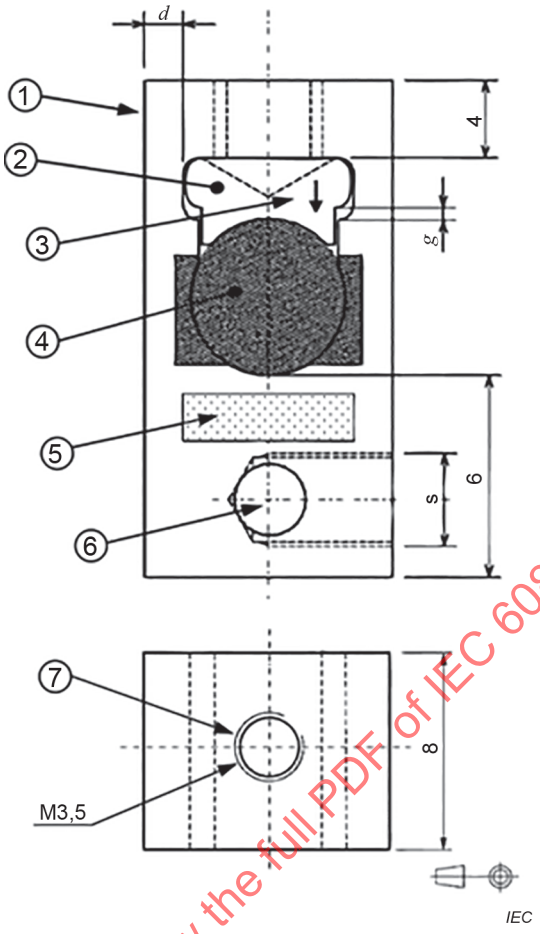
– Tolerance: ± 0,2 mm unless otherwise stated.

– The dimension(s) for the shaded area is(are) the maximum plug pin dimension(s) + 0,8 mm.

– The thermocouple should be welded in the area indicated for permanent mounting or alternatively tightened together with the pin but not directly under the clamping screw.

a) Clamping unit for solid pins

Dimensions in millimetres



Key:

1 Clamping body

2 Clamping jaw

3 Jaw moves when clamping screw is tightened

4 Pin hole (shaded area)

5 Area for mounting the thermocouple permanently

6 Space for the welded supply cable (optional: screw fixing)

7 Threaded hole for clamping screw

d 1,25 mm ≤ d ≤ 3 mm

s Optional threaded hole for screw fixing of supply cable. If used, the screw shall have no head and shall be tightened with the torque according to Table 7.

g Gap for clamping jaw to move downward when clamping screw is tightened = 0,7 mm minimum.

REMARKS:

– Material: brass with at least 52 % of copper.

– Tolerance: ± 0,2 mm unless otherwise stated.

– The dimension(s) for the shaded area is(are) the maximum plug pin dimension(s) + 0,5 mm.

– The shape and dimensions of the clamping jaw shall be adapted to the configuration of the plug pin to be tested.

b) Clamping unit for hollow pins

Figure 20 – Clamping unit for the temperature rise test of Clause 19

Socket-outlets are tested using a test plug with brass pins having the dimensions of the corresponding standard sheets.

Plugs shall be tested in a draught-free environment at the centre of a plane wooden sheet which shall be at least 20 mm thick, 500 mm wide and 500 mm high.

Plugs are tested as follows.

Clamping units having the dimensions specified in Figure 20 are fitted on each live pin and earthing pin, if any, of the plug. Each clamping unit is equipped with a thermocouple which can be mounted either together with the pin or fixed permanently within the dotted area of Figure 20.

If it is not possible to use the clamping unit of Figure 20 due to the design of the plug, the clamping unit may be modified in order to perform the test.

In this case the diameter of the screw, the threaded hole and the total volume of the modified clamping unit shall be identical to Figure 20.

The supply cable indicated in Figure 20 shall have a cross sectional area appropriate for the rated current of the accessory, selected according to Table 16, and shall have a length of at least 1 m.

The screw is then placed approximately in the middle of the bare part of the pin and tightened with a torque of 0,8 Nm.

For tests of earthing contacts of plugs having lateral earthing contacts and/or resilient earthing contacts, tests are performed using a fixed socket-outlet complying with this document and having as near-to-average characteristics as can be selected, but with minimum size of the earthing pin, if any.

19.2 Test for plugs and socket-outlets

For socket-outlets, *the test plug is inserted into the socket-outlet, and an AC or DC current as specified in Table 18 is passed for* 60^{+5}_{0} *min.*

For plugs, an AC or DC current as specified in Table 18 is then passed for 60^{+5}_{0} *min.*

For accessories with crimped connections an alternating or direct current as specified in Table 18 is passed for a period of time sufficient for the temperature rise to reach the steady-state value or for 4 h, whichever is shorter. In practice, steady-state value is reached when the variation of the temperature rise does not exceed 1 K/h.

For HL plugs and socket-outlets, an alternating or direct current as specified in Table 18 is passed for a period of time sufficient for the temperature rise to reach the steady-state value or for 4 h, whichever is shorter. In practice, steady-state value is reached when the variation of the temperature rise does not exceed 1 K/h.

19.3 Test for fixed socket-outlets in fused plug systems

For fixed socket-outlets of a socket-outlet and fused plug system, an AC or DC current as specified in Table 18 is passed for 60^{+5}_{0} *min as follows.*

a) *For a single socket-outlet the plug is inserted into the socket-outlet and 70 % of the test current is passed through the plug.*

The balance of the total test current is passed simultaneously through a looped connection, connected to the socket-outlet terminals.

The total nominal load on the supply cable is passed for 60^{+5}_{0} min.

b) For a multiple socket-outlet a plug is inserted into one socket-outlet and 70 % of the test current is passed.

A second plug is inserted into another socket-outlet and the balance of the total test current is passed simultaneously through this plug.

The total nominal load on the supply cable is passed for 60^{+5}_{0} min.

NOTE The value of 70 % relates to the fuse characteristics and is specified in the relevant national standards.

In the case of fixed socket-outlets incorporating dimmers, fuses, switches, energy regulators, etc., components connected in series to the line contacts are short circuited and components connected in parallel to the line contacts are disconnected for the purpose of this test.

19.4 Test for accessories with incorporated components not covered by other parts of IEC 60884 series

Socket-outlets and rewirable plugs with incorporated components are tested by the following tests 1) and 2):

1) with a current which is equal to the test current as indicated in Table 18, for Clause 19. For this test, incorporated components connected in series to the line contacts are short circuited and incorporated components connected in parallel to the line contacts are disconnected;

2) in the case of incorporated components in series, with a current which is equal to the rated current of the accessory or the rated current of the component(s), whichever is the lower. In the case of incorporated components in parallel, with a current which is equal to the rated current of the accessory, with the incorporated component working as in normal use,

When the incorporated components need to be supplied for their correct functioning, the test is made at the rated voltage.

Non-rewirable plugs with incorporated components are tested by the following tests 3) and 4):

3) with a current which is equal to the test current for the combination of the plug and the cable as indicated in Table 18, for Clause 19. For this test, incorporated components connected in series to the line contacts are short circuited and incorporated components connected in parallel to the line contacts are disconnected;

4) in the case of incorporated components in series, with a current which is equal to the test current for the combination of the plug and the cable as indicated in Table 18, for Clause 21, or the rated current of the component(s), whichever is the lower. In the case of incorporated components in parallel, with a current which is equal to the test current for the combination of the plug and the cable as indicated in Table 18, for Clause 21, with the incorporated component working as in normal use.

When the incorporated components need to be supplied for their correct functioning, the test is made at the rated voltage.

For the tests 1) and 3), the temperature rise of the terminals, terminations and clamping units according to Figure 20 determined by means of thermocouples shall not exceed 45 K.

For the tests 2) and 4), the temperature rise shall not be higher than the permissible values given in Table 101 of IEC 60669-2-1:2021 for Clause 17.

In the case of non-rewirable accessories care should be taken to minimize the influence on the structure/design/performance of the product when accessing the terminations of the product.

NOTE Examples of "incorporated components" are switches and fuses.

19.5 Additional tests

19.5.1 Temperature rise test for accessories with crimped connections

19.5.1.1 General

Crimped connections with flexible conductors used in the main current-carrying circuit (line and neutral) in accessories shall withstand, without harmful effect, the mechanical, electrical and thermal stresses occurring when subjected to cyclic loads.

Crimped connections used for example, for pilot lights are excluded from this requirement

The tests are performed on six connections of each crimp construction, taken from at least three specimens, using new non-moulded on or non-assembled specimens.

Accessories shall be tested in a draught-free environment.

19.5.1.2 Test

The live pins of the plug shall be inserted in the clamping units having the dimensions specified in Figure 20 together with a flexible conductors selected according to Table 16 at least 1 m long to be connected to the source. The screw of the clamping unit is placed approximately in the middle of the bare part of the pin and tightened with a torque of 0,8 Nm.

The plug is fixed on a vertical wooden sheet, being at least 20 mm thick, in such a way that the pins of the plugs are maintained in a horizontal position. The distance between specimens simultaneously under test shall be at least 150 mm, to avoid any influence on test results.

Crimped connections of socket-outlets are tested in open air (without their enclosures) fitted with the cable having a minimum length of 1 m as provided by the manufacturer. The temperature rise is measured on the conductors as close as possible to the crimped connection but not more than 10 mm away from the entrance of the crimping barrel. The contact tube is connected by a means which does not affect the test results, e.g. welding, soldering or a clamping unit, to a flexible conductor selected according to column 2 for rigid conductors (solid or stranded) for fixed accessories of Table 16.

The length of the conductor that is connected to the source shall be at least 1 m long. Care shall be taken not to influence the crimped connection when mounting the thermocouples to the conductors and the flexible conductors to the socket-contacts.

For each cycle, an overload alternating or direct current as given in Table 17 according to the nominal cross-section area of the conductor connected is passed for 45^{+1}_{0} min through the poles (the current shall not pass through the earthing circuit). The accessory shall then be left without current for 15 min (0, −1 min).

Table 17 – Test current for cycling tests on accessories with crimped connection

Cable cross-sectional area	Rated current of the accessory						
mm^2	A						
	6	**10**	**13**	**16**	**20**	**25**	**32**
0,75	9	9	10	10	-	-	-
1	10	12	13	16	-	-	-
1,5	-	13	16	20	-	-	-
2,5 (base 1,6 × I_n)	-	16	21	26	26 *	26 *	26 *
4	-	-	-	-	32	36 *	36 *
6	-	-	-	-	-	40	46 *
* The current is limited so as not to exceed a 30 K temperature rise on the cable.							

If necessary for this test, specially prepared samples may be provided by the manufacturer.

The number of cycles is 250 or 500 depending on the measurement results.

The temperature rise at the clamping units of the plug or the temperature rise at the conductor of the socket-outlet is measured for each cycle within the last 5 min before the end of the current-carrying period.

The accessory is declared compliant when the following conditions are fulfilled.

a) The temperature rise measurement of each crimped connection shall not exceed 45 K.

b) The average of the six temperature rise measurements of the crimped connections under testing recorded at the 250th cycle shall not exceed 35 K.

c) A linear trend-line of all six measurements shall be calculated and drawn through the measurement points from the 50th to the 250th cycle. The value given by each trend-line at the 250th cycle shall not exceed the value given on the trend-line at the 50th cycle by more than 5 K.

When c) is not fulfilled the test shall be extended to 500 cycles with the following additional compliance conditions.

d) The average of the six temperature rise measurements of the crimped connections under testing recorded at the 500th cycle shall not exceed 35 K.

e) A linear trend-line of all six measurements shall be calculated and drawn through the measurement points from the 250th to the 500th cycle. The value given by each trend-line at the 500th cycle shall not exceed the value given on the trend-line at the 250th cycle by more than 10 K.

The linear trend-line is calculated as follows.

$$\text{Slope: } \alpha = \frac{n\sum(xy) - \sum x \sum y}{n\sum x^2 - \left(\sum x\right)^2}$$

$$\text{Offset: } \beta = \frac{\sum y - \alpha \sum x}{n}$$

$$\text{Trendline formula: } y = \alpha x + \beta$$

where

n is the number of points to be considered;

x and y are the abbreviations for xi and yi, with i from 1 to n;

Σ is the sum from i = 1 to i = n for all xi and yi.

NOTE An example of a linear trend line calculation is given in Figure 21.

	Position sample		Measurement	
i	x	$x \times x$	y	$x \times y$
1	1	1	17	17
2	2	4	21	42
3	3	9	18	54
4	4	16	26	104
5	5	25	21	105
∑	15	55	103	322
∑ × ∑	225	3 025	10 609	103 684

α numerator / α denumerator = 65 / 50 → α = 1,3

β numerator / β denumerator = 83,5 / 5 → β = 16,7

Trend line equation: $y = 1{,}3x + 16{,}7$

x	y
1	18,0
5	23,2

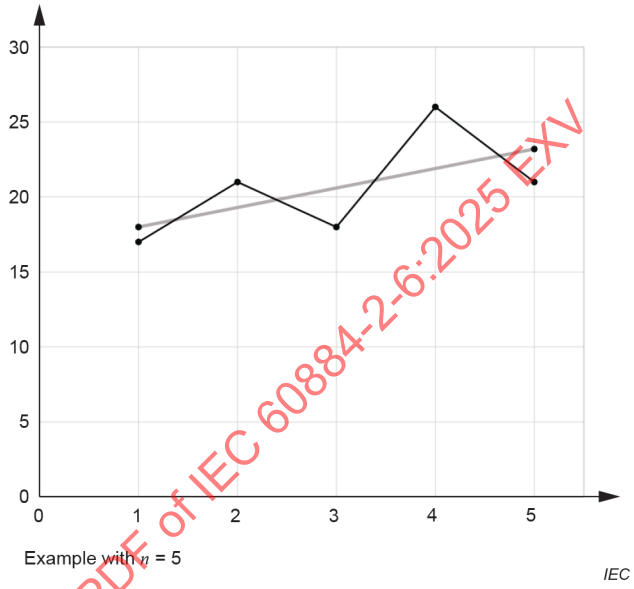


Figure 21 – Example of a trend line calculation

19.5.2 Additional test for fixed socket-outlets incorporating pilot lights

Fixed socket-outlets incorporating pilot lights or intended to incorporate pilot lights shall be so designed that in normal use the temperature of accessible surfaces is not excessive.

Compliance is checked by the following test.

The fixed socket-outlets are mounted and connected as in 19.1 with the pilot light supplied at rated voltage so that they are constantly illuminated for 1 h. The fixed socket-outlets are loaded at rated current.

The temperature rise of the external surface of the fixed socket-outlets shall not exceed 45 K for accessible surfaces of metallic material and non-metallic material.

Pilot lights using neon lamps or LEDs consuming no more than 3 mA are not tested.

20 Breaking capacity

Accessories shall have adequate breaking capacity.

For the purpose of this test, pilot lights are disconnected or removed.

Compliance is checked by testing socket-outlets and plugs with pins which are not solid, by means of an appropriate test apparatus, an example of which is shown in Figure 22.

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

In the event of failure of the shutters, the test on shuttered socket-outlets may be repeated with operations done by hand.

The rate of strokes per minute and the period during which the test current is passed shall be as close as possible to the indicated values.

Socket-outlets are tested using a test plug with brass pins having the dimensions of the corresponding standard sheets. As far as the extremities of the sleeves are concerned, it is sufficient that their dimensions are within the tolerances given in the relevant standard sheet.

NOTE In the following country, the pins are Ni-plated and the plug has near average dimensions: AU

The shapes of the extremities of the insulating sleeves are not considered of importance for the purpose of the test, provided that they are according to the relevant standard sheet.

The material of the brass pins of the test plug should contain at least 58 % copper and their micro-composition should be homogeneous.

The ends of round pins are rounded.

Plugs are tested using a fixed socket-outlet complying with this document and having as near-to-average characteristics as can be selected.

For accessories with a rated voltage lower than or equal to 250 V and a rated current lower than or equal to 32 A, the length of the stroke of test apparatus is between 50 mm and 60 mm.

The plug is inserted and withdrawn from the socket-outlet 50 times (100 strokes) at a rate of:

– *30 strokes per minute for accessories having a rated current up to and including 16 A and a rated voltage up to and including 250 V;*
– *15 strokes per minute for other accessories.*

The test voltage shall be 1,1 times the rated voltage and the test current shall be 1,25 times the rated current.

The periods during which the test current is passed from the insertion of the plug until subsequent withdrawal are as follows:

– *for accessories with rated current ≤ 16 A: $1{,}5\,^{+0{,}5}_{0}$ s*

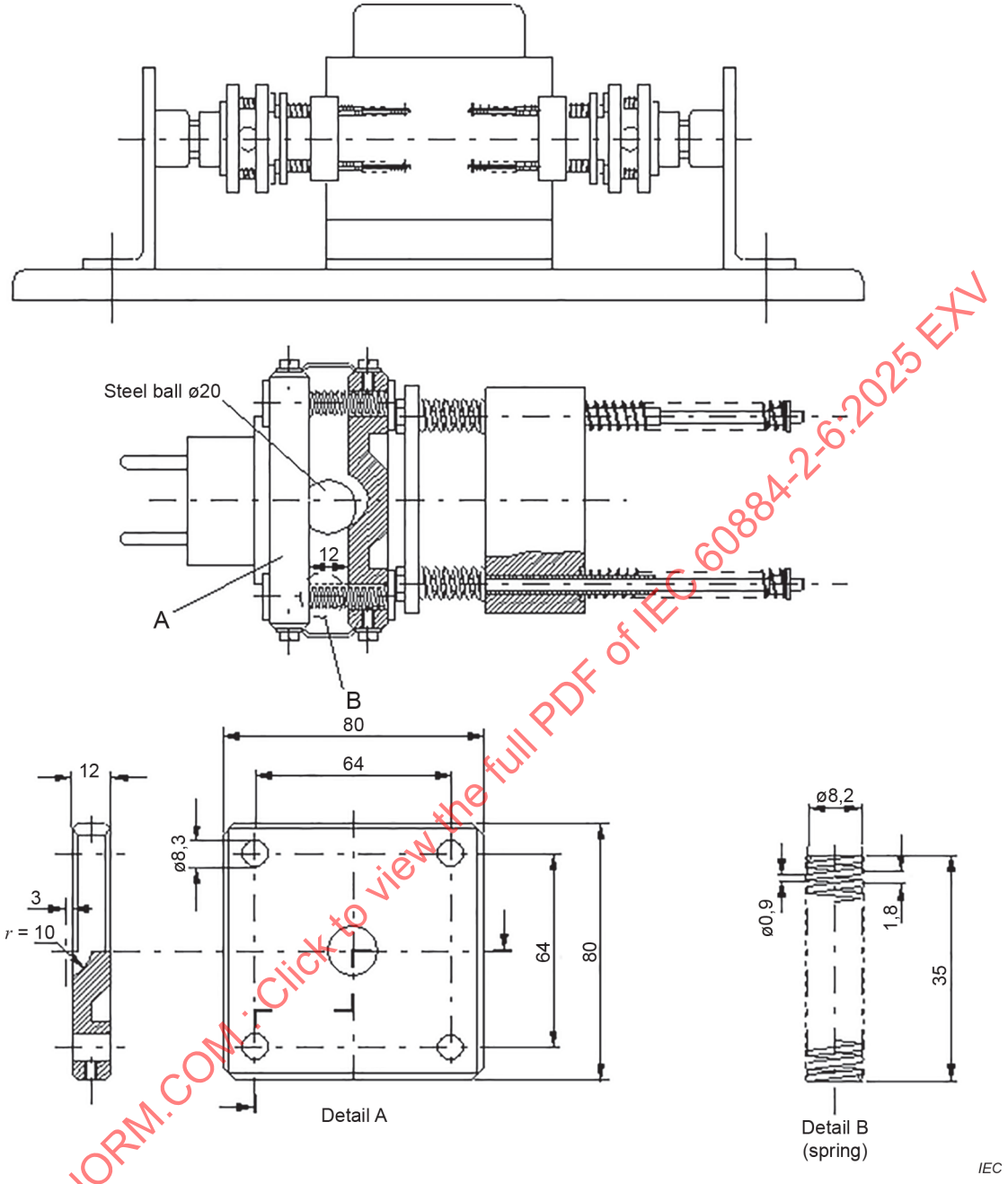
– *for accessories with rated current > 16 A: $3\,^{+0{,}5}_{0}$ s*

Accessories are tested using an alternating current with cos φ = 0,6 ± 0,05.

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

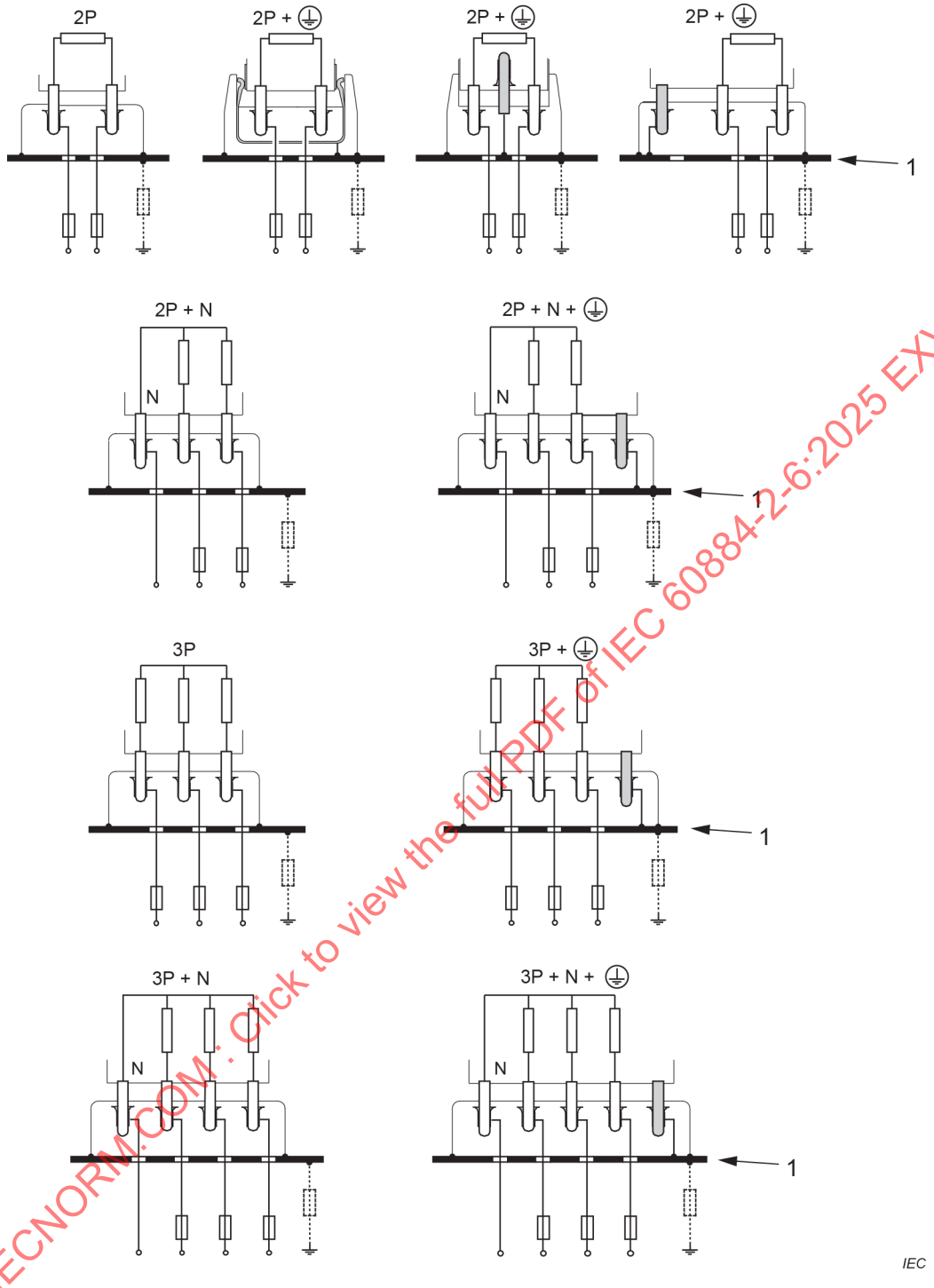
The test is carried out with the connections shown in Figure 23. Two-pole accessories with neutral contact (2P + N and 2P + N + ⏚) are connected to two phases and the neutral of a three-phase system.

Dimensions in millimetres



In this example, the springs, other than springs B, shall be chosen and adjusted in such a way that when compressed by one-third of the difference between the length in the disengaged position and the fully compressed length, they exert a force equal to 1,2 times the appropriate maximum withdrawal force specified in Clause 22.

Figure 22 – Example of apparatus for breaking capacity and normal operation test



Key:

1 Metal support and accessible metal parts of the accessory.

NOTE Shaded area represents earthed contacts.

Figure 23 – Circuit diagrams for breaking capacity and normal operation tests

Resistors and inductors are not connected in parallel except in the event that an air-core inductor is used, in which case a resistor taking approximately 1 % of the current through the inductor is connected in parallel with the said inductor.

Iron-cored inductors may be used, provided the current has a substantially sine-wave form.

For the test on three-pole accessories, three-core inductors are used.

The metal support of the accessory, if any, on which the accessory is mounted, and the accessible metal parts of the accessory, if any, shall be earthed through a wire fuse which shall not blow during the test. The fuse element shall consist of a copper wire of 0,1 mm in diameter and not less than 50 mm in length.

In the case of multiple socket-outlets, the test is carried out on one socket-outlet of each type and current rating.

During the test, no sustained arcing shall occur.

After the test, the socket-outlets entry holes for the pins shall show no damage impairing their further use.

20.101 Switches incorporated in switched socket-outlets with interlock

Switches incorporated in switched socket-outlets with interlock shall be in accordance with IEC 60669-1 or IEC 60669-2-1.

21 Normal operation

Switched socket-outlets with interlock shall withstand without excessive wear or other harmful effect, the mechanical, electrical and thermal stresses occurring in normal use.

Compliance is checked by the following test:

a) *The switch shall comply with IEC 60669-1 or IEC 60669-2-1.*

b) *The specimens are checked by carrying out 5 000 load cycles at rated voltage and rated current with a power factor 0,8 ± 0,05, with the interlocking device in operation.*

During the test the specimens are not lubricated and shall function correctly.

After the test the specimens shall withstand an electric strength test as specified in Clause 17, and a temperature rise test as specified in Clause 19, the test current being reduced to the rated current value.

After these tests the specimens shall not show:

- *wear impairing their further use;*
- *discrepancy between the position of the actuating member and that of the moving contact, if the position of the actuating member is indicated;*
- *deterioration of enclosures, insulating linings or barriers to such an extent that the switch cannot be further operated, or that the requirements of Clause 10 are no longer complied with;*
- *loosening of electrical or mechanical connections;*
- *seepage of sealing compound;*
- *relative displacement of the moving contacts of the switches.*

The humidity treatment according to 16.3 is not repeated before the electric strength test of this Clause 21.

Then the test of Clause 15 shall be performed to check the interlocking mechanism.

22 Force necessary to withdraw the plug

22.1 General

The construction of accessories shall allow the easy insertion and withdrawal of the plug, and prevent the plug from working out of the socket-outlet in normal use.

For the purpose of this test, resilient earthing contacts, irrespective of the number, are considered as one pole, and non-resilient earthing contacts, irrespective of the number, are considered not to be a pole.

NOTE A solid pin used for earthing is a non-resilient earthing contact.

Interlocked accessories are tested in the unlocked position.

For switched socket-outlets with interlock with a retaining device the test is carried out with the retaining device unlocked.

Compliance is checked as follows.

For socket-outlets, by:

– *a test to ascertain that the maximum force necessary to withdraw the test plug from the socket-outlet is not higher than the force specified in Table 19;*
– *a test to ascertain that the minimum force necessary to withdraw a single pin gauge from the individual contact assembly is not lower than the force specified in Table 19;*
– *a test to ascertain that the maximum force to operate the shutters is not higher than the force specified in 22.4.*

For plugs with resilient earthing contact assemblies, by:

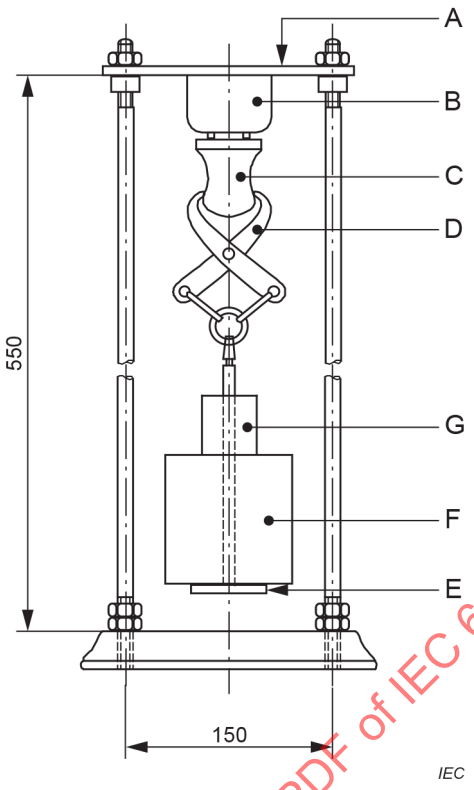
– *a test to ascertain that the maximum force necessary to withdraw a single pin gauge from the individual resilient earthing contact assembly of the plug is not higher than the force specified in Table 19, and*
– *a test to ascertain that the minimum force necessary to withdraw a single pin gauge from the individual earthing contact assembly is not lower than the force specified in Table 19.*

22.2 Verification of the maximum withdrawal force

22.2.1 Test for socket-outlets

The socket-outlet is fixed to the mounting plate A of an apparatus as shown in Figure 25, so that the axes of the socket-contacts are vertical and the entry holes for the pins of the plug face downwards.

Dimensions in millimetres



Components

A Mounting plate
B Specimen
C Test plug
D Clamp
E Carrier
F Principal weight
G Supplementary weight

NOTE Mounting plate A can also be used for the tests of 22.3, 12.3.10 and 13.1.

Figure 25 – Apparatus for verification of maximum withdrawal force

The test plugs have finely ground pins of hardened steel, having a surface roughness between 0,6 µm ($\overset{0,6}{\nabla}$) and 0,8 µm ($\overset{0,8}{\nabla}$) over their active length and spaced at the nominal distance, with a tolerance of ± 0,05 mm.

The diameter, for round pins, and the distance between contact surfaces, for other types of pins, shall have respectively the maximum specified dimensions in the corresponding standard sheets, with a tolerance of $^{0}_{-0,01}$ mm.

NOTE 1 The maximum specified dimension is the nominal plus the maximum tolerance.

NOTE 2 The symbol means that the surface finish is made by machining and material removal.

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

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

The test plug with the maximum size pins is inserted into and withdrawn from the socket-outlet ten times. It is then inserted again, 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 shown in Table 19.

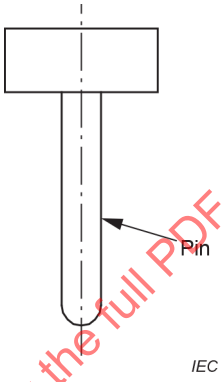
The principal mass, together with the supplementary mass, the clamp, the carrier and the plug exert a force equal to the maximum withdrawal force shown in Table 19.

The principal mass is hung on the plug without jolting and the supplementary mass is, if necessary, allowed to fall from a height of 50 mm onto the principal mass.

The plug shall not remain in the socket-outlet.

22.2.2 Test for plugs with resilient earthing contact assemblies

The test pin gauge, illustrated in Figure 26, is applied to the resilient earthing contact assembly, while the plug is held vertically and the gauge is hanging downwards.



The mass should be equally positioned around the centreline(s) of the pin.

NOTE Dimensions according to the relevant standard sheet.

Figure 26 – Gauge for the verification of minimum withdrawal force

The test pin gauge is made of hardened steel, having a surface roughness between 0,6 µm ($\overset{0,6}{\nabla}$) and 0,8 µm ($\overset{0,8}{\nabla}$) over its active length.

NOTE 1 The symbol means that the surface finish is made by machining and material removal.

The diameter, for round pins, and the distance between contact surfaces, for other types of pins, shall have respectively the maximum specified dimensions in the corresponding standard sheets, with a tolerance of $^{0}_{-0,01}$ mm. The mass of the gauge shall be such that it exerts a force equal to that specified in Table 19.

NOTE 2 The maximum specified dimension is the nominal plus the maximum tolerance.

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

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

The test pin with the maximum dimension(s) is inserted into and withdrawn from the earthing contact ten times. It is then inserted again and shall not remain in the contact assembly.

22.3 Verification of the minimum withdrawal force

The test pin gauge, illustrated in Figure 26, is applied to each individual contact with the socket-outlet or the plug held in such way that the gauge is hanging downwards.

Shutters, if any, are rendered inoperative so as not to affect the test.

The test pin gauge is made of hardened steel, having a surface roughness between 0,6 µm ($\overset{0,6}{\nabla}$) and 0,8 µm ($\overset{0,8}{\nabla}$) over its active length.

NOTE 1 The symbol means that the surface finish is made by machining and material removal.

The diameter, for round pins, and the distance between contact surfaces, for other types of pins, shall have respectively the minimum specified dimensions, with a tolerance of $^{0}_{-0,01}$ mm and a length sufficient to make adequate contact with the contact assembly. The force of the gauge shall be equal to that specified in Table 19.

If the socket-outlet is intended to accept plugs having pins with different nominal dimensions, the smallest appropriate one shall be used.

In this case, the rating of the accessory in Table 19 is the rating of the plug with the smallest dimensions for the pins.

NOTE 2 The minimum specified dimension is the nominal minus the maximum tolerance.

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

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

The test pin gauge is inserted into the contact assembly.

The test pin gauge is applied gently, and care is taken not to knock the assembly when checking the minimum withdrawal force. The gauge shall not fall from the contact assembly within 30 s.

Table 19 – Maximum and minimum withdrawal force for plugs and socket-outlets

Ratings of the accessory	Number of the poles of the accessory	Withdrawal force N		
		Multi-pin gauge maximum	Single-pin gauge minimum	Single-pin gauge maximum[a]
Up to and including 13 A	2	40	1,5	17
	3	50		
	More than 3	70		
Above 13 A up to and including 20 A	2	50	2,0	25
	3	54		
	More than 3	70		
Above 20 A up to and including 32 A	2	80	3,0	27
	3	80		
	More than 3	100		

[a] These withdrawal forces are only for testing the resilient earthing contact assembly of a plug.

22.4 Force necessary to operate the shutter when inserting the plug

The socket-outlet is fixed to a mounting plate, so that the axes of the socket-contacts are vertical and the entry holes for the pins of the plug face upwards.

A test plug having the dimensions of the corresponding standard sheets according to the socket-outlet under test shall be used.

The test arrangement shall be such that only the force to operate the shutter is measured.

For socket-outlets or plugs with earth contacts, it may be necessary to remove those contacts if they can influence the test result. In that case, some additional samples may be required.

The test plug with a supplementary mass is oriented to align the axis of the test plug pins with the axis of the socket contacts and allowed to enter the socket contact entry holes under its own weight. To facilitate the opening of the shutter the plug may be moved from side to side in any appropriate direction.

The test plug and the supplementary mass exert a force equal to 30 N.

The test plug line and neutral pins shall touch the respective socket-contacts within 5 s.

An electrical indicator, with a voltage between 40 V and 50 V included, is used to show contact with the relevant part.

23 Flexible cables and their connection

IEC 60884-1:2022, Clause 23 is not applicable.

24 Mechanical strength

24.1 General

Accessories, surface mounting boxes, screwed cable glands and shrouds shall have adequate mechanical strength so as to withstand the stresses imposed during installation and use.

Compliance is checked by the appropriate tests as follows:

- *for all kinds of fixed socket-outlets* — *24.2;*
- *for fixed socket-outlets with a main part intended to be mounted directly on a surface* — *24.4;*
- *for portable single socket-outlets:*
  - *with enclosures, covers or bodies other than of elastomeric or thermoplastic material* — *24.3;*
  - *with enclosures, covers or bodies of elastomeric or thermoplastic material* — *24.3, 24.5 and 24.6;*
- *for portable multiple socket-outlets:*
  - *with enclosures, covers or bodies other than of elastomeric or thermoplastic material* — *24.2 and 24.10;*
  - *with enclosures, covers or bodies of elastomeric or thermoplastic material* — *24.2, 24.5 and 24.10;*
- *for plugs:*

- *with enclosures, covers or bodies other than of elastomeric or thermoplastic material* — *24.3 and 24.11;*
- *with enclosures, covers or bodies of elastomeric or thermoplastic material* — *24.3, 24.5, 24.6 and 24.11;*

– *for screwed cable glands of accessories having an IP code higher than IP20* — *24.7;*

– *for plug pins provided with insulating sleeves* — *24.8;*

– *for shuttered socket-outlets* — *24.9;*

– *for surface-type mounting boxes* — *24.2;*

– *for portable socket-outlets having means for suspension* — *24.12.1, 24.12.2 and 24.12.3.*

– *for shroud of portable socket-outlets* — *24.18.*

24.2 Impact test with pendulum hammer

The specimens are checked by applying blows by means of the pendulum hammer test apparatus as described in IEC 60068-2-75 (test EHA), with an equivalent mass of 250 g.

The specimens are mounted on a sheet of plywood, 8 mm nominal thickness and approximately 175 mm square, secured at its top and bottom edges to a rigid bracket which is part of the mounting support.

The mounting support shall have a mass of (10 ± 1) kg and shall be mounted on a rigid frame by means of pivots. The frame is fixed to a solid wall.

The design of the mounting is such that:

– *the specimen can be placed in such a way that the point of impact lies in the vertical plane through the axis of the pivot,*

– *the specimen can be moved horizontally and turned about an axis perpendicular to the surface of the plywood,*

– *the plywood can be turned 60°, in both directions about a vertical axis.*

Surface type socket-outlets and surface-mounting boxes are mounted on the plywood as in normal use.

Inlet openings which are not provided with knock-outs, are left open; if they are provided with knock-outs, one of them is opened.

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

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

Flush-type screw fixing socket-outlets shall be fixed by means of screws to lugs recessed in the hornbeam block. Flush-type claw fixing socket-outlets shall be fixed to the block by means of the claws.

Before applying the blows, fixing screws of main parts and covers are tightened with a torque equal to two-thirds of that specified in Table 7.

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

The striking element is allowed to fall from a height specified in Table 23.

Table 23 – Height of fall for impact tests

Height of fall mm	Parts of enclosures to be subjected to the impact [a]	
	Accessories having an IP code IPX0 or maximum IPX2 for fixed socket-outlets	Accessories having an IP code higher than IPX0 or higher than IPX2 for fixed socket-outlets
80	A and B	–
120	C	A and B
160	D	C
200	–	D

[a] A Parts on the front surface, including the parts which are recessed.

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

C Parts which project more than 15 mm and not more than 25 mm from the mounting surface (distance from the wall) after mounting as in normal use, with the exception of the above parts A.

D Parts which project more than 25 mm from the mounting surface (distance from the wall) after mounting as in normal use, with the exception of the above parts A.

The impact energy determined by the part of the specimen which projects most from the mounting surface is applied on all parts of the specimen, with the exception of those specified in A of Table 23.

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

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

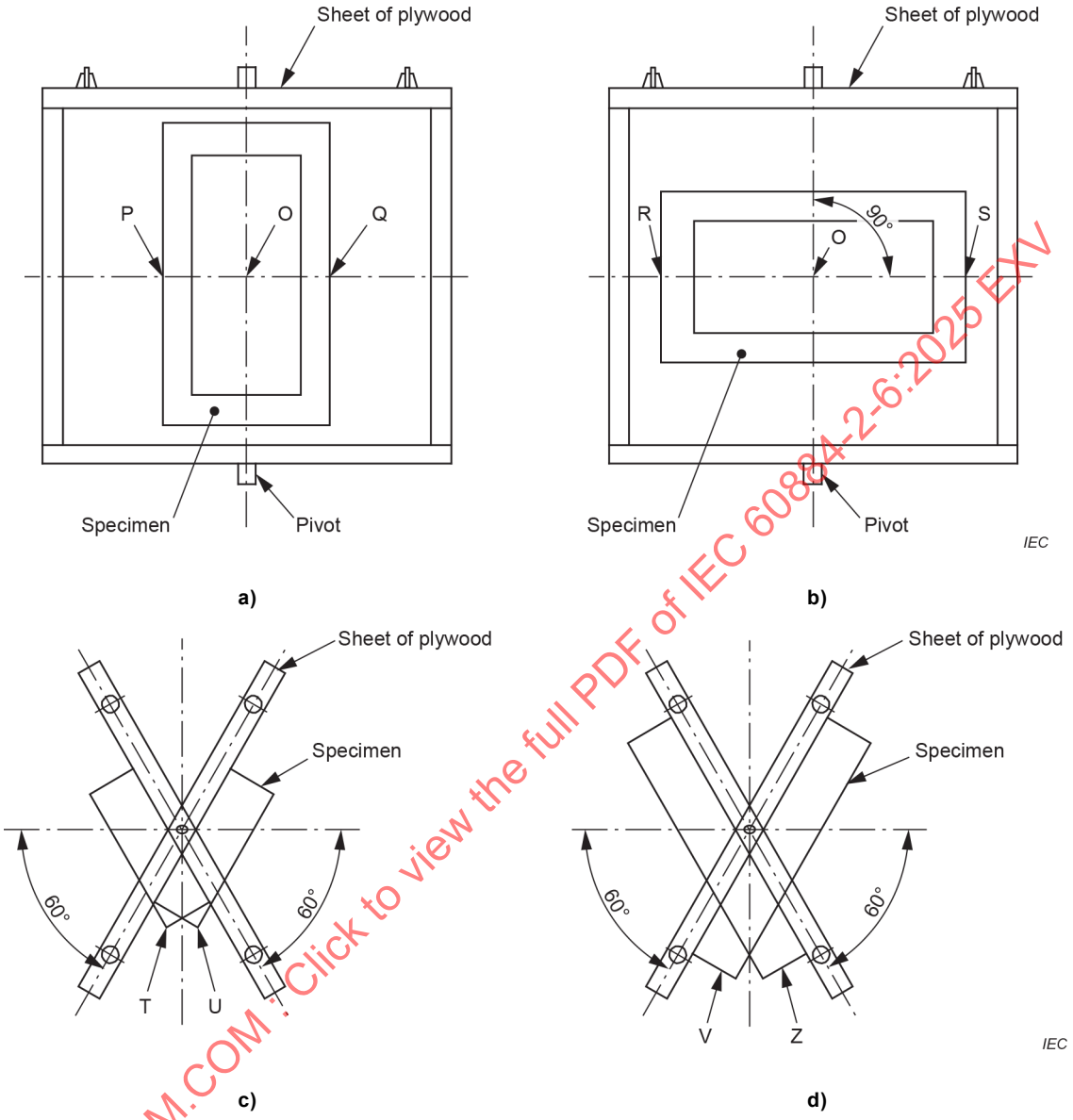
The following blows are applied:

– *for parts specified in A (see Table 23), five blows (see Figure 29 a) and Figure 29 b)):*
  - *one blow to the centre,*
  - *one blow on each of the two most unfavourable points between the centre and the edges, after the specimen has been moved horizontally,*
  - *one blow on similar points, after the specimen has been turned 90° about its axis perpendicular to the plywood;*
– *for parts specified in B (as far as applicable), C and D (see Table 23), four blows:*
  - *one blow is applied on one of the sides of the specimen where the blow can be applied, after the plywood sheet has been turned 60° about a vertical axis (see Figure 29 c));*
  - *one blow on the opposite side of the specimen where blows can be applied, after the plywood sheet has been turned 60° about a vertical axis, in the opposite direction (see Figure 29 c)).*

After the specimen has been turned 90° about its axis perpendicular to the plywood sheet:

– *one blow is applied on one of the sides of the specimen where the blow can be applied, after the plywood sheet has been turned 60° about a vertical axis (see Figure 29 d));*

– *one blow on the opposite side of the specimen where blows can be applied, after the plywood sheet has been turned 60° about a vertical axis in the opposite direction (see Figure 29 d)).*



Application of the blows			
Sketch	**Total number of blows**	**Points of application**	**Parts to be tested**
Figure 29 a)	3	One at the centre One between O and P [a] One between O and Q [a]	A
Figure 29 b)	2	One between O and R [a] One between O and S [a]	A
Figure 29 c)	2	One on the surface T [a] One on the surface U [a]	B, C and D
Figure 29 d)	2	One on the surface V [a] One on the surface Z [a]	B, C and D
[a] The blow is applied to the most unfavourable point.			

Figure 29 – Sketches showing the application of the blows according to Table 23

If inlet openings are provided, the specimen is mounted in such a way that the two lines of blows are, as closely as possible, equidistant from these openings.

Cover-plates and other covers of multiple socket-outlets are treated as though they were the corresponding number of separate covers, but only one blow is applied to any one point.

For socket-outlets having an IP code higher than IPX0, the test is made with the lids, if any, closed and, in addition the appropriate number of blows is applied to those parts which are exposed when the lids are open.

After the tests, specimens shall show no damage impairing their further use, in particular, live parts shall not become accessible as defined in 10.2 and they shall not be damaged in a such way as to impair the creepage distances and clearances as specified in Clause 27. In case of doubt the specimens shall be verified and comply with the requirements of 9.1, 10.2, 10.5 and of Clause 27.

After the test on a lens (window for pilot lights) the lens may be cracked and/or dislodged, but it shall not be possible to touch live parts with

- *the test probe B of IEC 61032 under the conditions stated in 10.2;*
- *the test probe 11 of IEC 61032 under the conditions stated in 10.2, but with a force of 10 N;*
- *the steel wire of Figure 8, applied with a force of 1 N, for accessories with increased protection.*

In case of doubt, it is verified that it is possible to remove and replace external parts such as boxes, enclosures, covers and cover-plates, without these parts or their insulating lining being broken.

If a cover-plate backed by an inner cover is broken, the test is repeated on the inner cover, which shall remain unbroken.

NOTE Damage to the finish, small dents which do not reduce creepage distances or clearances below the value specified in 27.1 and small chips which do not adversely affect the protection against electric shock or the protection against the harmful ingress of water are neglected.

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

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

24.3 Tumble barrel test

Rewirable portable accessories are fitted with the flexible cable specified in 23.2 having the smallest nominal cross-sectional area specified in Table 4 and a free length of approximately 100 mm measured from the outer end of the guard.

Terminal screws and assembly screws are tightened with a torque equal to two-thirds of that specified in Table 7.

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

The specimens are individually subjected to the test Ec: Rough handling shocks, primarily for equipment-type specimens, procedure 2 of IEC 60068-2-31, the number of falls being:

- *1 000 if the mass of the specimen without flexible cable does not exceed 100 g,*

– *500 if the mass of the specimen without flexible cable exceeds 100 g, but does not exceed 200 g, and*

– *100 if the mass of the specimen without flexible cable exceeds 200 g.*

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

After the test, the specimens shall comply with the following criteria:

– *no part shall have become detached or loosened, partial detachment of a part may be accepted provided that the protection against electric shock is not affected and that it does not impair the safety of the accessory;*

– *the pins shall not have become so deformed that the plug cannot be introduced into a socket-outlet complying with the relevant standard sheet and also so that the pins fail to comply with the requirements of 9.1 and 10.4;*

– *the pins shall not turn when a torque of 0,4 Nm is applied, first in one direction for 1 min and then in the opposite direction for 1 min.*

The shutters of socket-outlets shall be tested again according to 10.5 performed at ambient temperature.

NOTE During the examination after the test, special attention is paid to the connection of the flexible cable.

Small pieces may be broken off without causing rejection provided that the protection against electric shock is not affected.

Damage to the finish and small dents which do not reduce the creepage distances or clearances below the values specified in 27.1 are ignored.

24.4 Test for fixed socket-outlets with a main part intended to be mounted directly on a surface

The main parts of surface type socket-outlets are first fixed to a cylinder of rigid steel sheet, having a radius equal to 4,5 times the distance between fixing holes but, in any case, no less than 200 mm. The axes of the holes are in a plane perpendicular to the axis of the cylinder and parallel to the radius through the centre of the distance between the holes.

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

The main parts of socket-outlets are then fixed in a similar manner to a flat steel sheet.

During and after the tests, the main parts of socket-outlets shall show no damage impairing their further use.

24.5 Impact test at low temperature

The specimens are subjected to an impact test by means of an apparatus as shown in Figure 30.

The apparatus, positioned on a pad of sponge rubber 40 mm thick, is placed together with the specimens in a freezer at a temperature of (−15 ± 2) °C, for at least 16 h.

At the end of this period, the following test is carried out inside the freezer: each specimen, in turn, is placed in the normal position of use as shown in Figure 30, and a weight is allowed to fall from a height of 100 mm. The mass of the falling weight is (1 000 ± 2) g.

Dimensions in millimetres

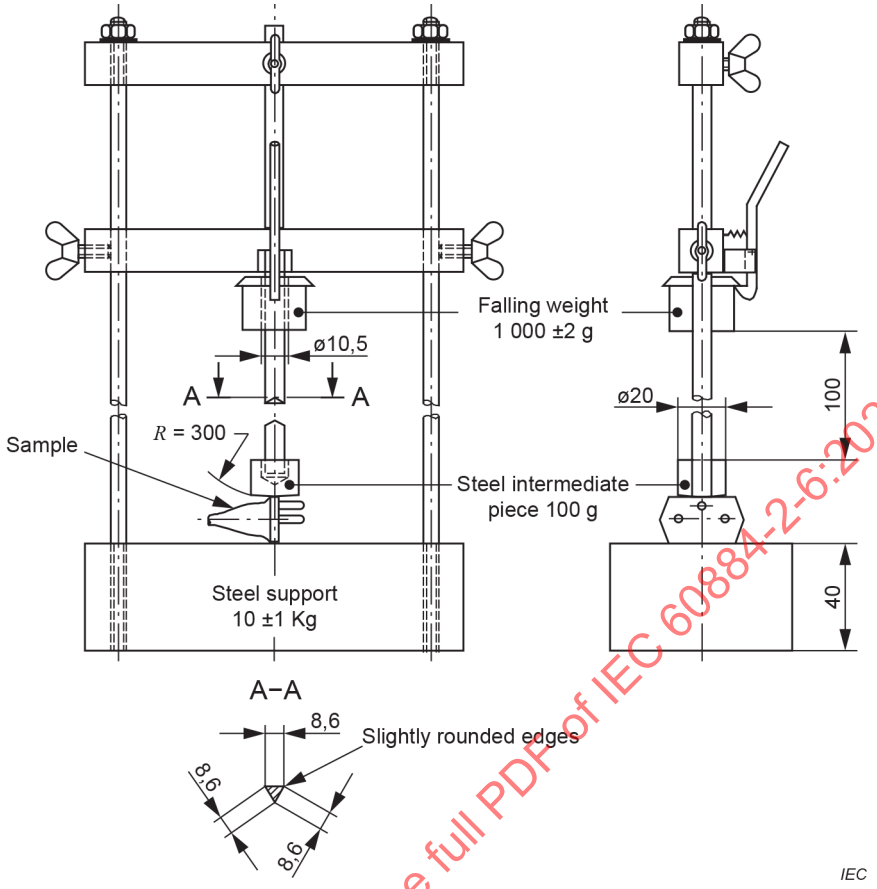


Figure 30 – Apparatus for impact test at low temperature of 24.5

After the tests, specimens shall show no damage impairing their further use, in particular, live parts shall not become accessible as defined in 10.2 and they shall not be damaged in a such way as to impair the creepage distances and clearances as specified in Clause 27. In case of doubt the specimens shall be verified and comply with the requirements of 9.1, 10.2, 10.5 and of Clause 27.

24.6 Compression test

The specimens are subjected to a compression test as shown in Figure 6, the temperature of the pressure plate, of the base and of the specimens being (23 ± 2) °C and the force applied being 300 N.

The specimens are first placed in position a), as shown in Figure 6, and the force is applied for 1 min. They are then placed in position b), as shown in Figure 6, and again subjected to the force for 1 min.

The specimens are removed from the test apparatus and are left to recover for 15 min. After this period specimens shall show no damage impairing their further use, in particular, live parts shall not become accessible as defined in 10.2 and they shall not be damaged in a such way as to impair the creepage distances and clearances as specified in Clause 27. In case of doubt the specimens shall be verified and comply with the requirements of 9.1, 10.2, 10.5 and of Clause 27.

24.7 Torque test for cable glands

Screwed cable glands are fitted with a cylindrical metal rod having a diameter, in millimetres, equal to the nearest whole number below the internal diameter, in millimetres, of the packing.

The cable glands are then tightened by means of a suitable spanner; the torque shown in Table 24 being applied for 1 min.

Table 24 – Torque test values for cable glands

Diameter of test rod mm	Torque Nm	
	Metal cable glands	**Cable glands of moulded material**
Up to and including 14	6,25	3,75
Above 14, up to and including 20	7,5	5,0
Above 20	10,0	7,5

After the test the screwed cable glands shall be visually inspected and shall not be damaged in such a way that the IP rating is not maintained. In case of doubt the relevant IP test shall be performed.

24.8 Abrasion test on insulating sleeves of plug pins

Plug pins provided with insulating sleeves are subjected to the following test by means of an apparatus as shown in Figure 31.

Dimensions in millimetres

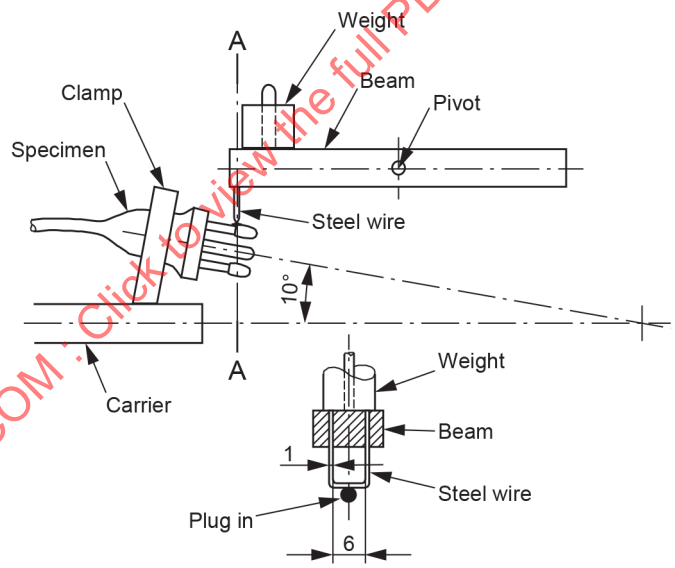


Figure 31 – Apparatus for abrasion test on insulating sleeves of plug pins

The test apparatus comprises a horizontally disposed beam, which is pivoted about its centre point. A short length of steel wire, 1 mm in diameter and bent into a U-shape, the base of the U being straight, is rigidly attached, at both ends, to one end of the beam, so that the straight part projects below the beam and is parallel to the axis of the beam pivot.

The plug is held by a suitable clamp in such a position that the straight part of the steel wire rests on the plug pin, perpendicular to it. The pin slopes downwards at an angle of 10° to the horizontal.

The beam is loaded so that the wire exerts a force of 4 N on the pin.

The plug is moved backwards and forwards in a horizontal direction in the plane of the axis of the beam, so that the wire rubs along the pin. The length of the pin thus abraded is approximately 9 mm, of which approximately 7 mm is over the insulating sleeve. The number of movements is 20 000 (10 000 in each direction) and the rate of operation is 30 movements per minute.

The test is made on one pin of each specimen.

After the test, the pins shall show no damage which may affect safety or impair the further use of the plug, in particular, the insulating sleeve shall not have punctured or rucked up.

24.9 Mechanical test on shutters

Shuttered socket-outlets shall have the shutter so designed that it withstands the mechanical force which may be expected in normal use, for example when a pin of a plug is inadvertently forced against the shutter of a socket-outlet entry hole.

Compliance is checked by the following tests, which are carried out on specimens which have been submitted to the test according to Clause 21, both with and without previous treatment as in 16.1.

One pin from a plug of the same system is applied for 1 min with a force of 40 N against the shutter of an entry hole in a direction perpendicular to the front surface of the socket-outlet.

For shutters provided as the only means to prevent single pole insertion, the force shall be 75 N instead of 40 N.

Where the socket-outlet is designed to accept plugs of different types, the test is carried out with a pin from a plug with the largest size pin.

The pin shall not come into contact with live parts.

An electrical indicator with a voltage not less than 40 V and not more than 50 V is used to show contact with the relevant part.

After the test, the specimens shall show no damage impairing their future use.

A plug complying with corresponding standard sheet is inserted and withdrawn 5 times and the shutters shall operate as intended.

Small dents on the surface which do not adversely affect further use of the socket-outlet are ignored.

24.10 Test for multiple portable socket-outlets

Rewirable multiple portable socket-outlets are fitted with the lightest type of flexible cable of the smallest nominal cross-sectional area specified in Table 4.

The free end of the flexible cable is fixed to a wall at a height of 750 mm above the floor, as shown in Figure 32.

Dimensions in millimetres

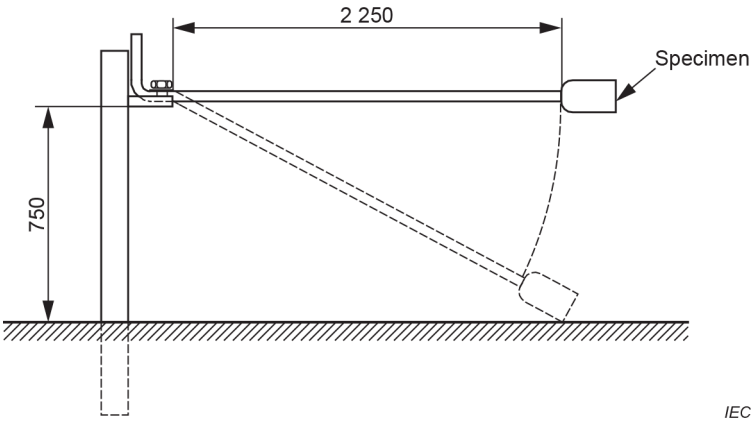


Figure 32 – Arrangement for mechanical strength test on multiple portable socket-outlets

The specimen is held so that the flexible cable is horizontal and then it is allowed to fall onto a concrete floor, eight times, the flexible cable being rotated through 45° at its fixing after each fall.

After the test, no part shall have become detached or loosened; partial detachment of a part may be accepted provided that the protection against electric shock is not affected and that it does not impair the safety of the accessory. Specimens shall show no damage impairing their further use; in particular, live parts shall not become accessible as defined in 10.2 and they shall not be damaged in a such way as to impair the creepage distances and clearances as specified in Clause 27. In case of doubt the specimens shall be verified and comply with the requirements of 9.1, 10.2, 10.5 and of Clause 27.

Accessories having an IP code higher than IPX0 shall be submitted again to the relevant test as specified in 16.2.

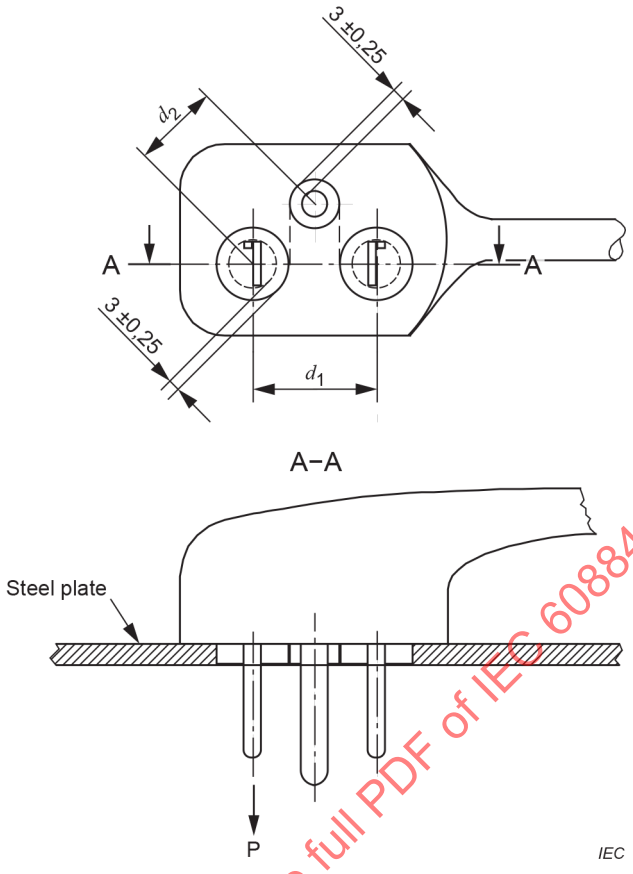
The shutters of socket-outlets shall be tested again according to 10.5 performed at ambient temperature. Small chips and dents which do not adversely affect the protection against electric shock or the protection against the harmful effects due to ingress of water are ignored.

24.11 Retention test for pins

This test is carried out on new specimens.

The plug is placed on a rigid steel plate provided with holes suitable for the pins of the plug as shown as an example in Figure 33.

Dimensions in millimetres



Key

P Applied pull

Figure 33 – Example of test arrangement to verify the retention of pins in the body of the plug

The distances between the centres of the holes (for example, d_1 and d_2) shall be the same as the distances between the centres of the circle circumscribed around the cross-sectional area of each pin in the standard sheet of the plug.

Each hole shall have a diameter equal to that of the circle circumscribed around the cross-sectional area of the pin plus (6 ± 0,5) mm.

The plug is positioned on the steel plate in such a way that the centres of the circles circumscribing the pins coincide with the centres of the holes.

A pull P equal to the maximum withdrawal force as given in Table 19, is applied, without jerks, for 1 min on each pin in turn, in the direction of the longitudinal axis of the pin.

The pull is applied within a heating cabinet at a temperature of (70 ± 2) °C, 1 h after the plug has been placed in the heating cabinet.

After the test, the plug is allowed to cool down to ambient temperature and it shall be verified that no pin has been displaced in the body of the plug by more than 1 mm.

24.12 Mechanical test for means for suspension of portable socket-outlets

24.12.1 *Barriers, between the space intended for the suspension means fixed to the mounting surface and the live parts, likely to be subjected to mechanical strain when the portable socket-outlet is suspended on a mounting surface, are tested as follows.*

A cylindrical steel rod, having a diameter of 3 mm and a hemispherical end with a radius of 1,5 mm, is pushed perpendicular to the supporting mounting surface, in the most unfavourable position, for 10 s against the barrier, the force being equal to 1,5 times the maximum plug withdrawal force (as specified in Table 19).

The rod shall not pierce the barrier.

24.12.2 *The portable socket-outlet, fitted with an appropriate flexible cable, is suspended on the mounting surface as in normal use, by means of a cylindrical steel rod having the same dimensions as the rod described in 24.12.1, and a length sufficient to touch the rear of the barrier.*

A pull equal to the force specified in 23.2 for checking the flexible cable anchorage is applied, in the most unfavourable position, to the flexible cable for 10 s.

During the test, the portable socket-outlet means for suspension on a mounting surface shall not break in a way which allows live parts to become accessible to the test probe B of IEC 61032.

24.12.3 *The portable socket-outlet is suspended on the mounting surface as in normal use, using a round head screw with shank diameter of 3 mm, and is subjected to a pull test with the maximum withdrawal force specified, for the corresponding plug, in Table 19, applied without jerks.*

The pull force is applied for 10 s perpendicular to the engagement face of the socket-outlet giving the greatest strain on the suspension means.

During the test, the portable socket-outlet means for suspension on a wall shall not break in a way which allows live parts to become accessible to the test probe B of IEC 61032.

Where more than one means of suspension exist, the tests of 24.12.1, 24.12.2 and 24.12.3 shall be carried out on each means of suspension.

24.13 Tests on covers, cover-plates or parts of them according to 13.7.3 a)

24.13.1 *When checking the forces necessary to retain or remove covers, cover-plates or parts of them, the accessories are mounted as for normal use.*

Flush-type socket-outlets are fixed in appropriate mounting boxes, which are installed as for normal use so that the rims of the boxes are flush with the walls and covers or cover-plates, or parts of them, are fitted.

Plugs and portable socket-outlets are fixed in a suitable manner so that the force can be applied to the cover, cover-plates or parts of them.

If the covers or cover-plates, or parts of them, are provided with locking means which can be operated without the aid of a tool, these means are unlocked.

For fixed socket-outlets, compliance is checked according to 24.13.2 and 24.13.3.

For plugs and portable socket-outlets compliance is checked according to 24.13.4.

24.13.2 *Verification of the retention of covers or cover-plates is carried out as follows.*

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

– *40 N, for covers, cover-plates or parts of them complying with the tests of 24.16 and 24.17, or*
– *80 N, for other covers, cover-plates or parts of them.*

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

The test is then repeated on new specimens, the cover or cover-plate being fitted on the wall after a sheet of hard material, (1 ± 0,1) mm thick, has been fitted around the supporting frame as shown in Figure 34.

NOTE The sheet of hard material is used to simulate wallpaper and can consist of a number of pieces.

After the test, the specimens shall show no damage impairing their future use.

24.13.3 *Verification of the removal of covers or cover-plates is carried out as follows.*

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

The covers or cover-plates shall come off.

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

The test is then repeated on new specimens, the cover or cover-plate being fitted on the wall after a sheet of hard material, (1 ± 0,1) mm thick, has been fitted around the supporting frame, as shown in Figure 34.

Dimensions in millimetres

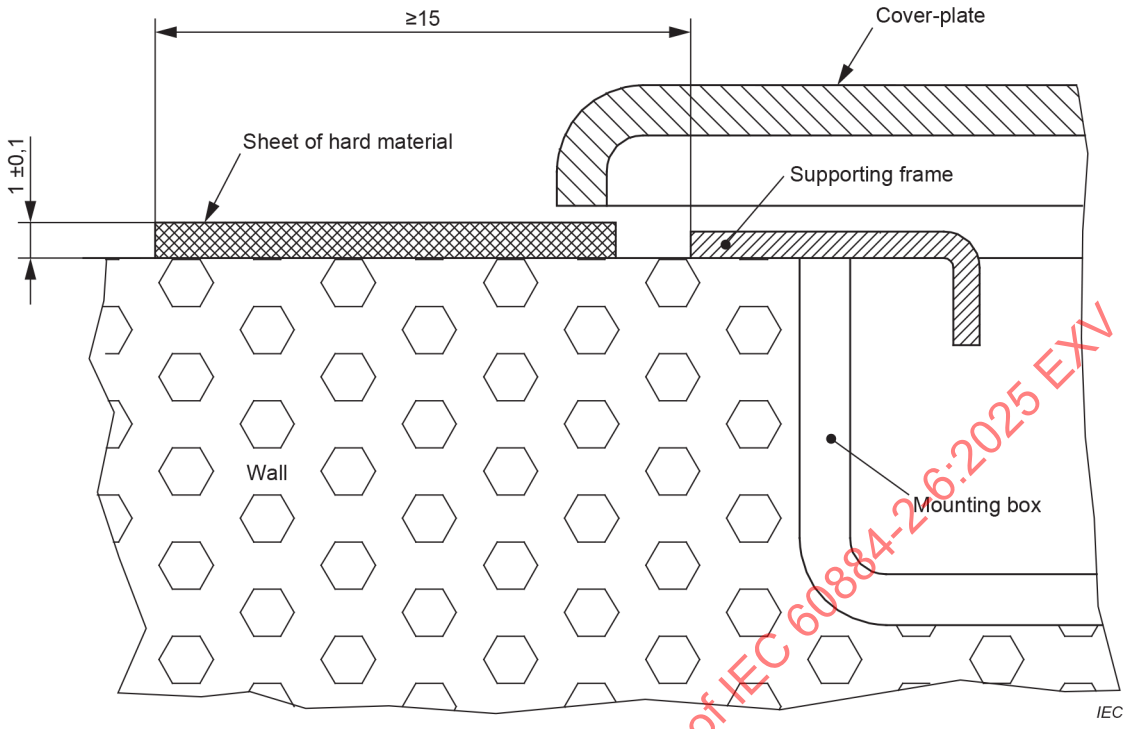


Figure 34 – Arrangement for test on covers or cover-plates

After the test, the specimens shall show no damage impairing their future use.

24.13.4 *For plugs and portable socket-outlets, a force is gradually applied until 80 N is achieved and maintained for 1 min, to covers, cover-plates or parts of them while the other parts of the accessory are fixed.*

The test shall be carried out in the most unfavourable conditions.

During the test the covers, cover-plates or parts of them shall not come off.

The test is then repeated with a force of 120 N.

a) *For rewirable plugs and rewirable portable socket-outlets, the cover, the cover-plate or parts of them may come off during the test but the specimen shall show no damage impairing further use.*

b) *For non-rewirable, non-moulded-on accessories, during the test, the cover, the cover-plate or parts of them may come off but the accessories shall be permanently useless (see 14.1).*

24.14 Tests on covers, cover-plates or parts of them according to 13.7.3 b)

The test is carried out as described in 24.13, but applying the following forces for the purposes of 24.13.2:

– *10 N, for covers or cover-plates complying with the tests of 24.16 and 24.17;*

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

24.15 Tests on covers, cover-plates or parts of them according to 13.7.3 c)

The test is carried out as described in 24.13, but applying the force of 10 N for all covers or cover-plates for the purposes of 24.13.2.

24.16 Verification of the outline of covers fixed without screws on a mounting surface or supporting surface

The gauge shown in Figure 35 is pushed toward each side of each cover or cover-plate which is fixed without screws on a mounting or supporting surface, as shown in Figure 36. The face B resting on the mounting/supporting surface, with the face A perpendicular to it, the gauge is applied at right angles to each side under test.

Dimensions in millimetres

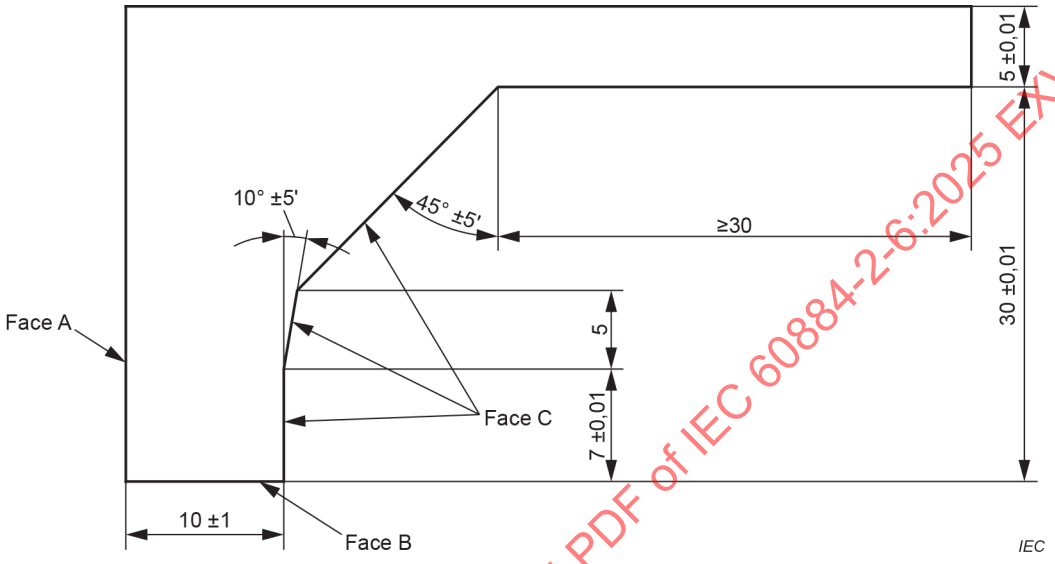
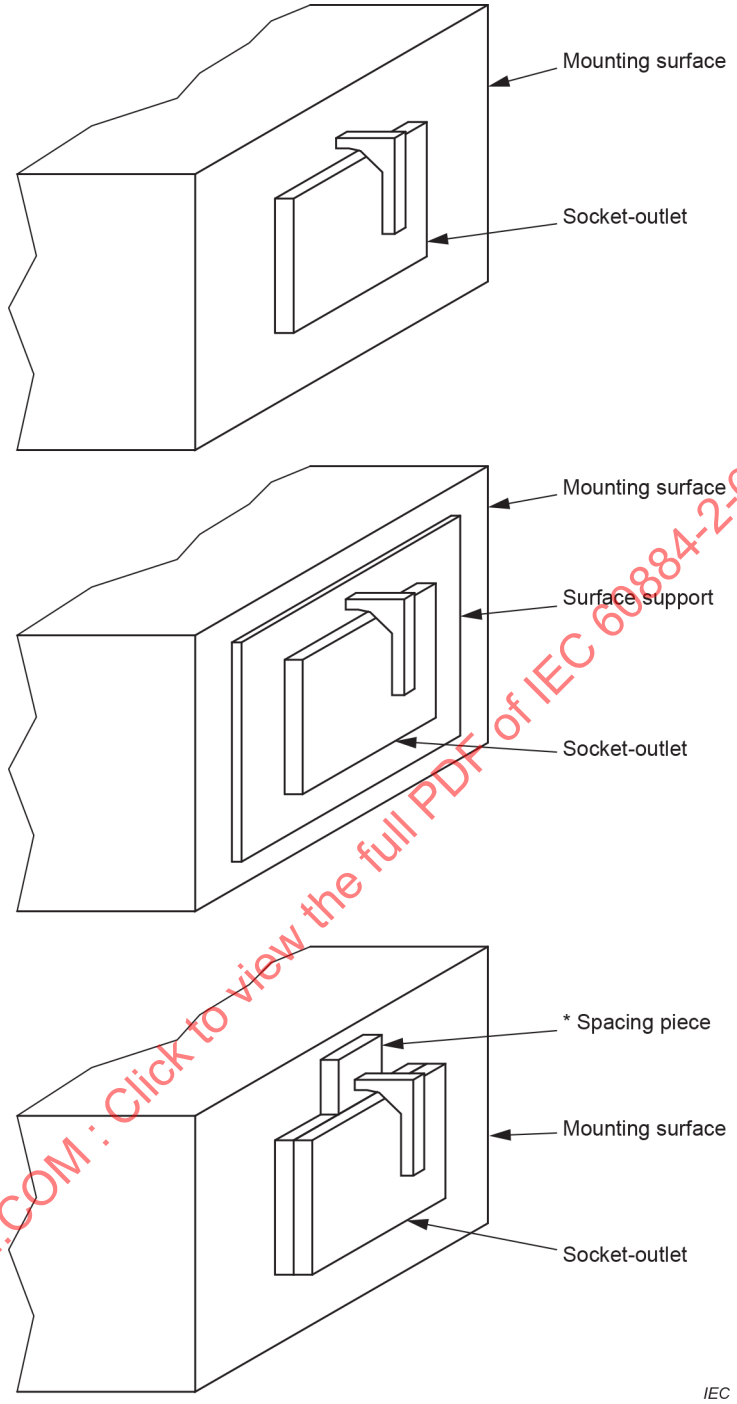


Figure 35 – Gauge (thickness about 2 mm) for the verification of the outline of covers or cover-plates

Dimensions in millimetres



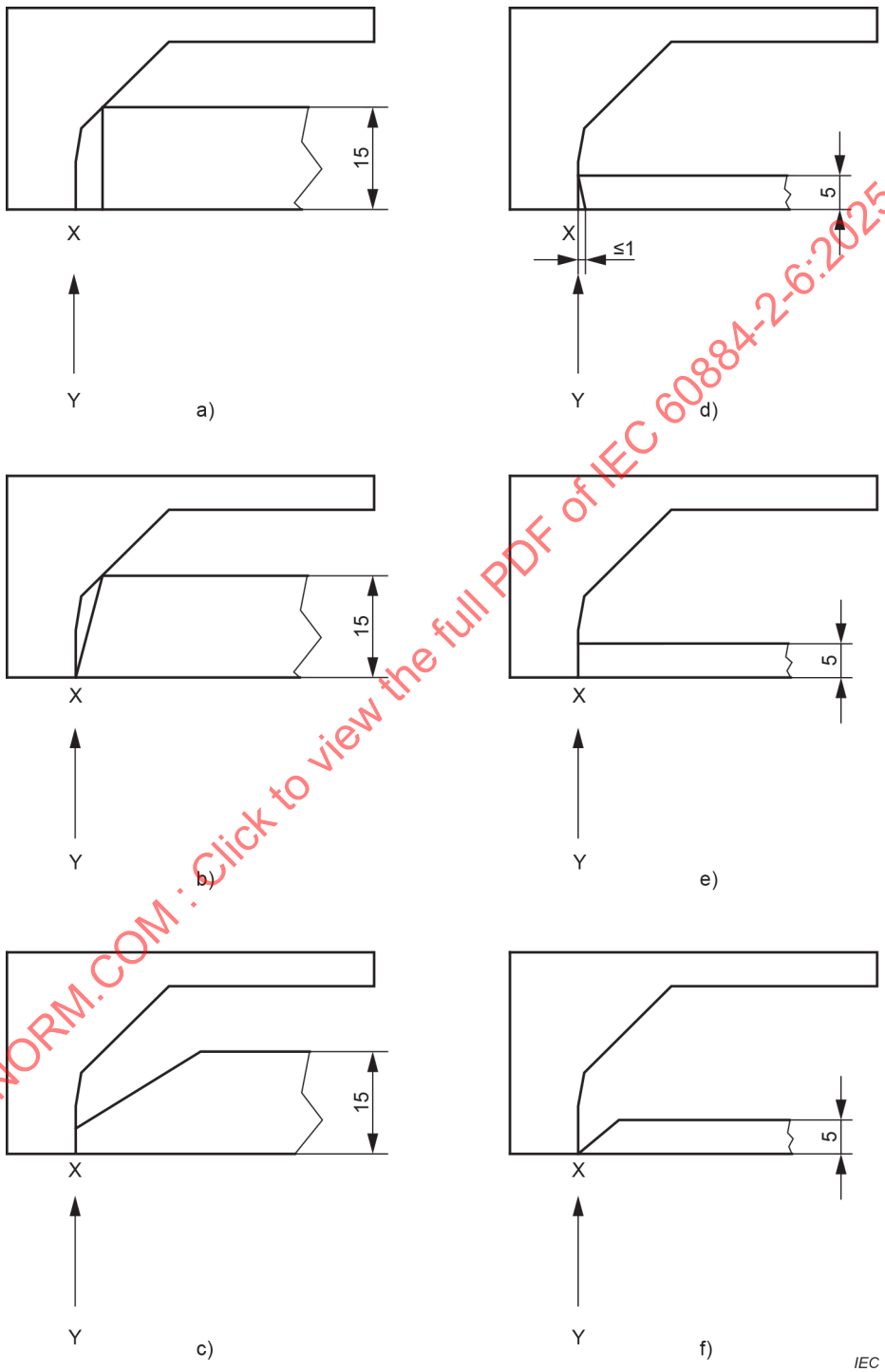
* Spacing piece having the same thickness as that of the supporting part.

Figure 36 – Examples of application of the gauge of Figure 35 on covers fixed without screws on a mounting surface or supporting surface

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

The distances between face C of the gauge and the outline of the side under test, measured parallel to face B, shall not decrease (with the exception of grooves, holes, reverse tapers or the like, placed at a distance less than 7 mm from a plane including face B and complying with the test of 24.17) when measurements are repeated, starting from point X in the direction of the arrow Y (see Figure 37).

Dimensions in millimetres



Cases a) and b) do not comply.

Cases c), d), e) and f) comply (compliance shall, however, also be checked with the requirements of 24.17, using the gauge shown in Figure 38).

Figure 37 – Examples of application of the gauge of Figure 35 in accordance with the requirements of 24.16

24.17 Verification of grooves, holes and reverse tapers

A gauge according to Figure 38, applied with a force of 1 N shall not enter more than 1,0 mm from the upper part of any groove, hole or reverse taper, or the like, when the gauge is applied parallel to the mounting/supporting surface and perpendicular to the part under test, as shown in Figure 39.

Verification as to whether, according to Figure 38, the gauge has entered by more than 1,0 mm is made with reference to a surface perpendicular to face B and including the upper part of the outline of the grooves, holes, reverse tapers or the like.

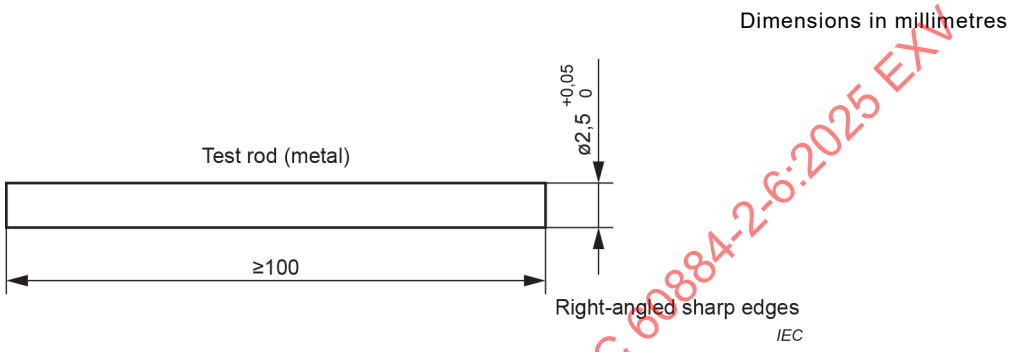


Figure 38 – Gauge for verification of grooves, holes and reverse tapers

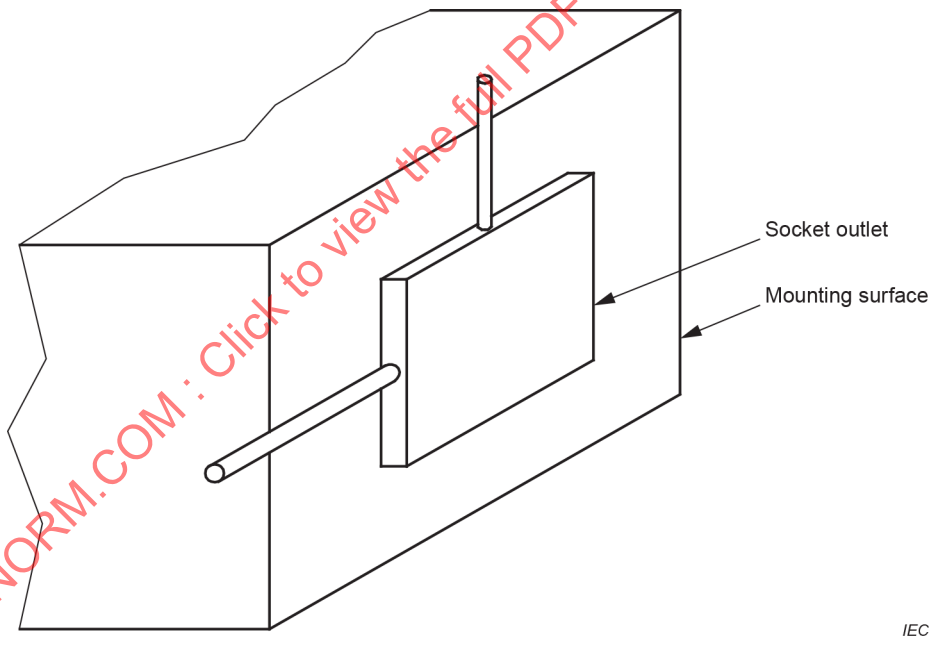


Figure 39 – Sketch showing the direction of application of the gauge of Figure 38

24.18 Compression test on shrouds of portable socket-outlets

The shrouds of portable socket-outlets are subjected to a compression test at an ambient temperature of (25 ± 5) °C in an apparatus similar to that shown in Figure 41.

The apparatus comprises two steel jaws, having a cylindrical face of 25 mm radius, a width of 15 mm and a length of 50 mm. The length of 50 mm can be increased, depending on the size of the accessory to be tested.

The corners are rounded with a radius of 2,5 mm.

The specimens are clamped in such a way that the front face of the jaws coincides with the front face of the shroud.

The force applied through the jaws is (20 ± 2) N.

After 1 min, and while the shrouds are still under pressure, the dimensions shall comply with the appropriate standard sheet.

The test is repeated with the specimen rotated 90°.

25 Resistance to heat

25.1 General

Accessories and surface-type mounting boxes shall be resistant to heat.

Compliance is checked by the relevant tests according to Table 25.

Table 25 – Resistance to heat of different types or parts of accessories

Specimen		Test according to 25.2	Test according to 25.3	Test according to 25.4	Test according to 25.5
A	Surface-mounting boxes, separable covers, separable cover-plates and separable frames with the exception of parts of the front surface zone of thermoplastic material of 2 mm width surrounding the phase and neutral pin entry holes	-	-	X	-
B	Portable accessories with the exception of the parts covered by A	X	X	X	X
C	Portable accessories made of natural or synthetic rubber or a mixture of both or PVC with the exception of parts covered by A	X	X	-	X
D	Fixed socket-outlets with the exception of the parts covered by A	X	X	X	-
E	Fixed socket-outlets made of natural or synthetic rubber or a mixture of both with the exception of parts covered by A	X	X	-	-
X: test applicable -: test not applicable					

Parts intended for decorative purposes, such as certain lids, are not submitted to any of these tests.

25.2 Basic heating test

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

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

After the test, the specimens are then allowed to cool down to approximately room temperature. There shall be no access to live parts which are normally not accessible when the specimens are mounted as in normal use, even if the probe B of IEC 61032 is applied with a force not exceeding 5 N.

After the test, markings shall still be legible.

After the tests, specimens shall show no damage impairing their further use; in particular, live parts shall not become accessible as defined in 10.2 and they shall not be damaged in a such way as to impair the creepage distances and clearances as specified in Clause 27. In case of doubt the specimens shall be verified and comply with the requirements of 9.1, 10.2, 10.5 and of Clause 27. Discoloration, blisters or slight displacement of the sealing compound is disregarded.

25.3 Ball-pressure test at 125 °C

Parts of insulating material necessary to retain current-carrying parts and parts of the earthing circuit in position, as well as parts of the front surface zone of thermoplastic material, 2 mm wide, surrounding the phase and neutral pin entry holes of socket-outlets, shall be subjected to a ball-pressure test by means of the apparatus shown in Figure 40, except that the insulating parts necessary to retain the earthing terminals in position in a box shall be tested as specified in 25.4.

Dimensions in millimetres

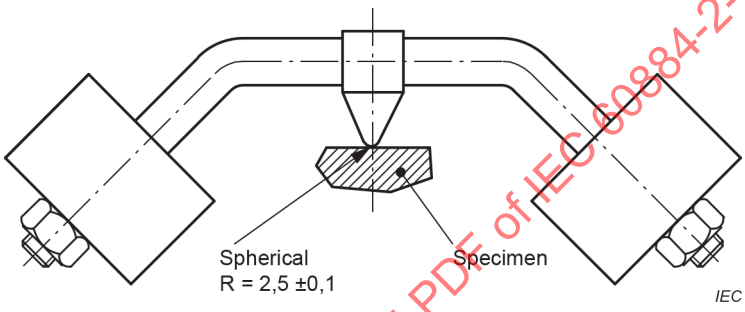


Figure 40 – Ball pressure test apparatus

If it is not possible to carry out the test with material from an actual sample due to bending, size, protruding parts or such like, an appropriately aged sample of the same material produced by the same process with equivalent processing parameters can be used.

When it is not possible to carry out the test on the specimens, a new set of aged specimens can be used. The test shall be carried out on a cut piece at least 2 mm thick or if this is not possible, no more than four layers, each cut from the same specimen, may be used, in which case the total thickness of the layers shall be not less than 2,5 mm.

The part under test shall be placed on a steel plate at least 3 mm thick and in direct contact with it.

The surface of the part to be tested is placed in the horizontal position and the hemispherical tip of the test equipment is pressed against the surface with a force of 20 N.

The test load and the supporting means shall be placed within the heating cabinet for a sufficient time to ensure that they have attained the stabilized testing temperature before the test commences.

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

After 1 h the ball shall be removed from the specimen. The specimen is then immersed within 10 s, in cold water for cooling down to approximately room temperature.

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

25.4 Ball-pressure test at 70 °C or higher

Parts of insulating material not necessary to retain current-carrying parts and parts of the earthing circuit in position, even though they are in contact with them, are subjected to a ball-pressure test in accordance with 25.3, but the test is made at a temperature of (70 ± 2) °C, or (40 ± 2) °C plus the highest temperature rise determined for the relevant part during the test of Clause 19, whichever is the higher.

25.5 Compression test

The specimens are subjected to a compression test by means of an apparatus as shown in Figure 41, the test being made in a heating cabinet at a temperature of (80 ± 2) °C.

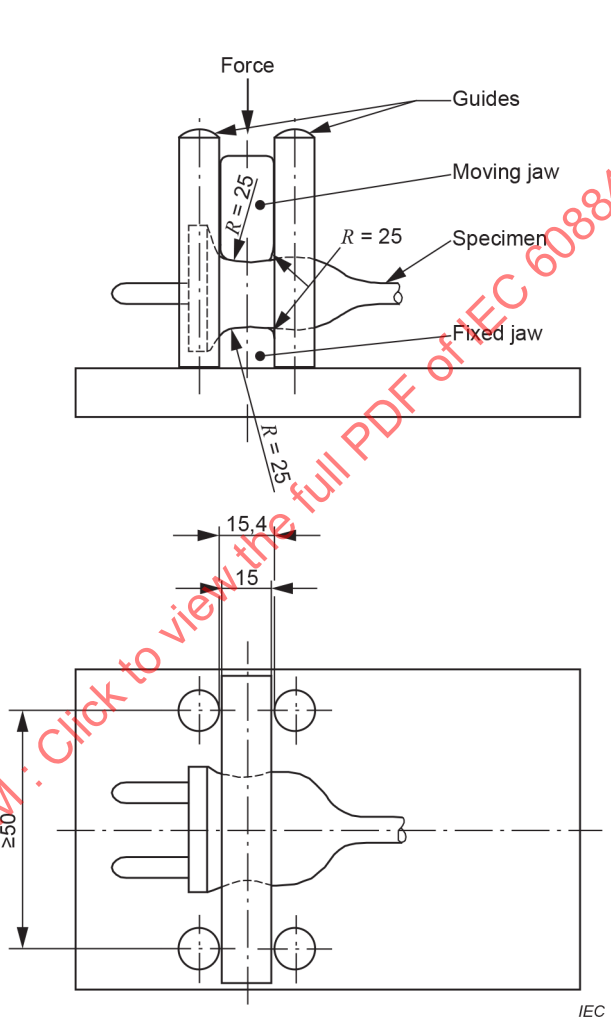


Figure 41 – Apparatus for compression test for the verification of resistance to heat specification of 25.5

The apparatus comprises two steel jaws, having a cylindrical face of 25 mm radius, a width of 15 mm and a length of 50 mm. The length of 50 mm can be increased, depending on the size of the accessory to be tested.

The corners are rounded with a radius of 2,5 mm.

The specimen is clamped between the jaws in such a way that these press against it in the area where it is gripped in normal use, the centre line of the jaws coinciding as nearly as possible with the centre of this area. The force applied through the jaws is 20 N.

After 1 h, the jaws are removed and the specimens shall show no damage impairing their future use; in particular, live parts shall not become accessible as defined in 10.2 and they shall not be damaged in a such way as to impair the creepage distances and clearances as specified in Clause 27. In case of doubt the specimens shall be verified and comply with the requirements of 10.2 and of Clause 27.

26 Screws, current-carrying parts and connections

26.1 General

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

Mechanical connections to be used during installation of accessories may be made using thread-forming screws or thread-cutting screws only when the screws are supplied together with the piece in which they are intended to be inserted. In addition, thread-cutting screws intended to be used during installation shall be captive with the relevant part of the accessory.

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

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

NOTE 1 The requirements for the verification of terminals are given in Clause 12.

The screws or nuts are tightened and loosened:

– *10 times for screws in engagement with a thread of insulating material and for screws of insulating material;*
– *five times for 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 carried out by means of a suitable screwdriver or a suitable tool, applying a torque as specified in Table 7.

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

NOTE 2 Screws or nuts which are operated when connecting accessories, include screws for fixing covers or cover plates, etc., but not connecting means for screwed conduits and screws for fixing the main part of a fixed socket-outlet.

The shape of the blade of the screwdriver used for the test should match the head of the screw to be tested. The screws and nuts should not be tightened in jerks. Damage to covers is ignored.

26.2 Correct insertion of screws

For screws in engagement with a thread of insulating material which are operated when mounting the accessory during installation, their correct introduction into the screw hole or nut shall be ensured.

Compliance is checked by inspection and by manual test.

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

26.3 Contact pressure of electrical connections

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

This requirement does not preclude designs with flat tinsel cord where the contact pressure is obtained from insulating parts having such properties as to ensure reliable and permanent contact under all conditions of normal use, especially in view of shrinking, ageing or cold flow of the insulating part.

Connections made by insulation piercing of tinsel cord shall be reliable.

Compliance is checked by inspection and according to relevant parts of Annex F.

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

26.4 Screws and rivets used both as electrical and mechanical connections

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

Compliance is checked by inspection and by manual test.

NOTE 1 Spring washers can provide satisfactory locking.

NOTE 2 For rivets, it is possible that a non-circular shank or an appropriate notch will be sufficient.

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

26.5 Material of current-carrying parts

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

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

Examples of metals that are deemed to comply with the requirements of 26.5, when used within the permissible temperature range and under normal conditions of chemical pollution, are as follows:

– copper;
– an alloy containing at least 58 % copper for parts made from cold-rolled sheet or at least 50 % copper for other parts;
– stainless steel containing at least 13 % chromium and not more than 0,09 % carbon;
– steel provided with an electroplated coating of zinc according to ISO 2081, the coating having a thickness of at least:
  - 5 µm, service condition ISO no. 1, for accessories classified IP code IPX0;
  - 12 µm, service condition ISO no. 2, for accessories classified IP code IPX4;
  - 25 µm, service condition ISO no. 3, for accessories classified IP code IPX5 and IPX6;
– steel provided with an electroplated coating of nickel and chromium according to ISO 1456, the coating having a thickness of at least:
  - 20 µm, service condition ISO no. 2, for accessories classified IP code IPX0;
  - 30 µm, service condition ISO no. 3, for accessories classified IP code IPX4;

- 40 µm, service condition ISO no. 4, for accessories classified IP code IPX5 and IPX6;

– steel provided with an electroplated coating of tin according to ISO 2093, the coating having a thickness of at least:
  - 12 µm, service condition ISO no. 2, for accessories classified IP code IPX0;
  - 20 µm, service condition ISO no. 3, for accessories classified IP code IPX4;
  - 30 µm, service condition ISO no. 4, for accessories classified IP code IPX5 and IPX6.

NOTE In the following country, the use of any type of zinc alloy for current-carrying parts is not allowed: BR, ZA

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

Under moist conditions, metals showing a great difference of electro-chemical potential with respect to each other should not be used in contact with each other. Corrosion due to electrochemical action between dissimilar metals that are in contact is minimized if the combined electrochemical potential is below about 0,6 V.

The requirements of 26.5 do not apply to screws, nuts, washers, clamping plates and similar parts of terminals.

26.6 Contacts subjected to sliding actions

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

Compliance with the requirements of 26.5 and 26.6 is checked by inspection and, in case of doubt, by chemical analysis.

26.7 Thread-forming and thread-cutting screws

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

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

Compliance is checked by inspection.

27 Creepage distances, clearances and distances through sealing compound

27.1 General

Creepage distances, clearances and distances through sealing compound shall be not less than the values shown in Table 26.

Table 26 – Creepage distances, clearances and distances through insulating sealing compound

Description		mm
Creepage distance:		
1	between live parts of different polarity	4[a]
2	between live parts and	
	– accessible surface of parts of insulating material	3
	– earthed metal parts including parts of earthing circuit	3
	– metal frames supporting the main part of flush-type socket-outlets	3
	– screws or devices for fixing main parts, covers or cover-plates of fixed socket-outlets	3
	– external assembly screws, other than screws which are on the engagement face of plugs and are isolated from the earthing circuit	3
3	between pins of plugs and metal parts connected to them, when fully engaged, and a socket-outlet of the same system having accessible unearthed metal parts[b], made according to the most unfavourable construction[c]	6[d]
4	between the accessible unearthed metal parts[b] of a socket-outlet and a fully engaged plug of the same system having pins and metal parts connected to them made according to the most unfavourable construction[c]	6[d]
5	between live parts of a socket-outlet (without a plug) or of a plug and their accessible unearthed or functional earthed metal parts[b]	6[d]
Clearance:		
6	between live parts of different polarity[f]	3
7	between live parts and	
	– accessible surface of parts of insulating material	3
	– earthed metal parts not mentioned under items 8 and 9 including parts of earthing circuit,	3
	– metal frames supporting the main part of flush-type socket-outlets	3
	– screws or devices for fixing main parts, covers or cover-plates of fixed socket-outlets	3
	– external assembly screws, other than screws which are on the engagement face of plugs and are isolated from the earthing circuit	3
8	between live parts and	
	– exclusively earthed metal boxes[e] with the socket-outlet in the most unfavourable position	3
	– unearthed metal boxes, without insulating lining with the socket-outlet in the most unfavourable position	4,5
	– accessible unearthed or functional earthed metal parts[b] of socket-outlets and plugs	6[d]
9	between live parts and the surfaces on which the main part of a socket-outlet for surface mounting is mounted	6
10	between live parts and the bottom of any conductor recess, if any, in the main part of a socket-outlet for surface mounting	3
Distance through insulating sealing compound:		
11	between live parts covered with at least 2 mm of sealing compound and the surface on which the main part of a socket-outlet for surface mounting is mounted	4[a]
12	between live parts covered with at least 2 mm of sealing compound and the bottom of any conductor recess, if any, in the main part of a socket-outlet for surface mounting	2,5

[a] This value is reduced to 3 mm for accessories having a rated voltage up to and including 250 V.

[b] With the exception of screws and the like.

[c] The most unfavourable construction may be checked by means of a gauge which is based on the standard sheets relevant to the system concerned.

[d] This value is reduced to 4,5 mm for accessories having a rated voltage up to and including 250 V.

[e] Exclusively earthed metal boxes are those suitable only for use in installations where earthing of metal boxes is required.

[f] Clearances between live parts of different polarity are reduced to 1 mm between the lead wires in the pinch of a neon lamp or LED or similar lighting sources with external resistor.

Compliance is checked by measurement.

For rewirable accessories, the measurements are made on the specimen fitted with conductors of the largest nominal cross-sectional area specified in Table 4 and also without conductors.

The conductor shall be inserted into the terminal and connected in such a way that the core insulation touches the metal part of the clamping unit or, where the core insulation is prevented by construction from touching the metal part, the outside of the obstruction.

For non-rewirable accessories, the measurements are made on the specimen as delivered.

Socket-outlets are checked when in engagement with a plug and also without a plug.

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

For surface-type socket-outlets classified IP20 according to IEC 60529, the most unfavourable conduit or cable or trunking or ducting as specified by the manufacturer is introduced for a distance of 1 mm into the socket-outlet in accordance with 13.21. If the metal frame supporting the base of a flush-type socket-outlet is movable, this frame is placed in the most unfavourable position.

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

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

NOTE 3 The surface on which the main part of a socket-outlet for surface mounting is mounted includes any surface in contact with the main part when the socket-outlet is installed. If the main part is provided with a metal plate at the back, this plate is not regarded as the mounting surface.

27.2 Insulating sealing compound

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

Compliance is checked by inspection.

27.101 Additional requirement for switches incorporated in switched socket-outlets with interlock

For switches incorporated in switched socket-outlets with interlock, the creepage distances, clearances and distances through sealing compound shall be in accordance with IEC 60669-1 or IEC 60669-2-1.

Compliance is checked by measurement.

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

28.1 Resistance to abnormal heat and to fire

28.1.1 General

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

Compliance is checked by the test of 28.1.2 and, in addition, for plugs with pins provided with insulating sleeves, by the test of 28.1.3.

28.1.2 Glow-wire test

The test is performed according to IEC 60695-2-10:2021 and IEC 60695-2-11:2021 under the following conditions:

– *for parts made of insulating material necessary to retain current-carrying parts and parts of the earthing circuit of fixed accessories in position, by the test carried out at 850 °C, with the exception of parts of insulating material needed to retain the earth terminal in position in a box, which shall be tested at a temperature of 650 °C;*

NOTE 1 Side earthing contacts fixed to the base of the socket-outlet are not considered to be retained in position by a removable cover when the plug is not inserted.

– *for parts of insulating material necessary to retain current-carrying parts, and parts of the earthing circuit of portable accessories in position, by the test carried out at a temperature of 750 °C;*

– *for parts of insulating material not necessary to retain current-carrying parts and parts of the earthing circuit in position, even though they are in contact with them, by the test carried out at a temperature of 650 °C.*

A current-carrying part or a part of the earthing circuit retained by mechanical means is considered to be retained in position. The use of grease or the like is not considered to be a mechanical means.

External conductors cannot be considered as retaining the current-carrying parts.

In case of doubt, to determine whether an insulating material is necessary to retain current-carrying parts and parts of the earthing circuit in position, the accessory is examined without conductors while held in positions most likely to cause displacement of the current-carrying parts or parts of the earthing circuit with the insulating material in question removed.

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

Small parts, where each surface lies completely within a circle of 15 mm diameter, or where any part of the surface lies outside a 15 mm diameter circle and where it is not possible to fit a circle of 8 mm diameter on any of the surfaces, are not subjected to the test of this Subclause 28.1.2 (see Figure 42 for diagrammatic representation).

Dimensions in millimetres

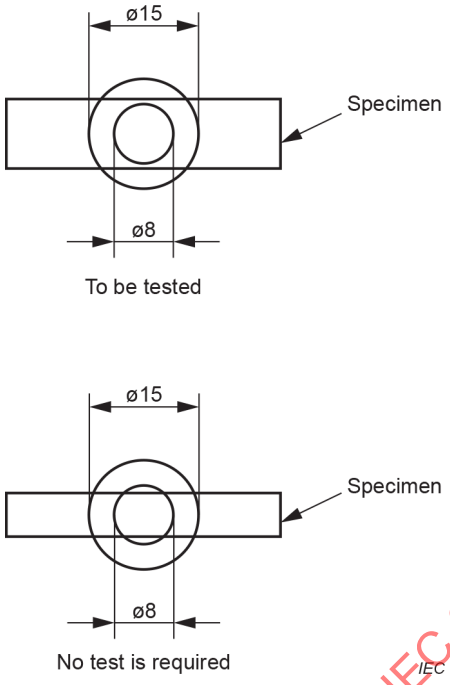


Figure 42 – Diagrammatic representation of 28.1.2

When checking a surface, projections on the surfaces and holes which are not greater than 2 mm on the largest dimension are disregarded.

The tests are not carried out on parts of ceramic material.

NOTE 2 The glow-wire test is applied to ensure that an electrically heated test wire under defined test conditions does not cause ignition of insulating parts or to ensure that a part of insulating material, which might be ignited by the heated test wire under defined conditions, has a limited time to burn without spreading fire by flame or burning parts or droplets falling down from the tested parts onto the pinewood board covered with a tissue paper.

If possible, the specimen should be a complete accessory.

If the test cannot be made on a complete accessory, a suitable part can be cut from it for the purpose of the test.

The test is made on one specimen.

The test is made applying the glow-wire once.

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

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

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

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

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

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

If the material to be tested is not accessible due to the presence of moulded-on material, the moulded-on material should be removed to gain access. Alternatively, the manufacturer may provide the product as separate components and drawings to allow material retaining in position the current-carrying parts to be tested.

28.1.3 Test for pins with insulating sleeves

The specimen of a plug with pins provided with insulating sleeves is tested by means of the test apparatus as shown in Figure 43.

This test apparatus consists of an insulating plate A and of a metal part B: between these two parts an air space of 3 mm shall be provided and this distance shall be obtained through means which do not impair the air circulation around the pins.

The front surface of the insulating plate A shall be round and flat and have a diameter equal to twice the maximum permissible dimension of the engagement face of the plug given in the relevant standard sheet.

The thickness of this insulating plate shall be 5 mm.

The metal part B shall be of brass and have, for a distance of at least 20 mm, the same shape as the maximum outline of the plug according to the relevant standard sheet.

The rest of this metal part shall be so shaped that the accessory under test is heated through it by conduction, and the heat transmission to the accessory under test by convection or radiation is reduced to a minimum.

A thermocouple shall be inserted at a distance of 7 mm from the front surface of the metal part in a symmetrical position, as shown in Figure 43.

The dimensions of the holes for the pins in the metal part B shall be 0,1 mm larger than the maximum dimensions of the pins given in the relevant standard sheet and the distances between the pins shall be the same as those given in the relevant standard sheet; the depth of the holes shall be sufficient.

The metal part B can be made of two or more component pieces, for hole cleaning purposes.

The specimens are inserted in the test apparatus, placed in the most unfavourable horizontal position, when the test apparatus has reached a steady temperature, measured by means of the thermocouple, of (120 ± 5) °C for accessories having a rated current of 2,5 A, and (180 ± 5) °C for accessories having a higher current rating.

The temperature is maintained at the relevant values for 3 h.

The specimens are then removed from the test apparatus and are allowed to cool down to room temperature, at which they are maintained for at least 4 h.

The insulating sleeves of the pins of the specimens are then submitted to an impact test in accordance with Clause 30 but carried out at ambient temperature, and subject to visual inspection.

During visual inspection, no cracks on the insulating sleeves should be visible with normal or corrected vision without additional magnification, and the dimensions of the insulating sleeves should not have changed so as to impair protection against accidental contact.

Dimensions in millimetres

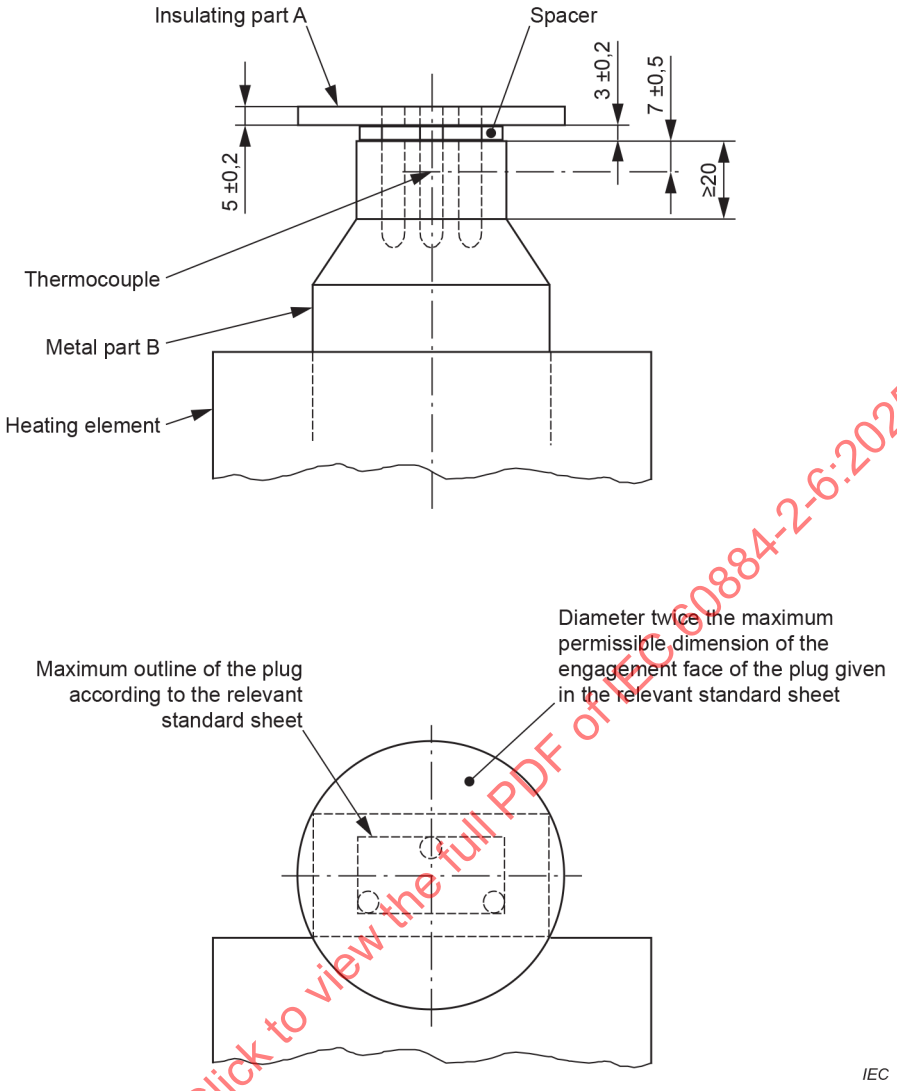


Figure 43 – Apparatus for testing resistance to abnormal heat of insulating sleeves of plug pins

28.2 Resistance to tracking

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

NOTE In the following country, for accessories having an IP code higher than and including IPX0, parts of insulating material retaining live parts in position must be of material resistant to tracking: SG.

Compliance is checked in accordance with IEC 60112.

Ceramic parts are not tested.

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

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

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

29 Resistance to rusting

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

Compliance is checked by the following test.

All grease is removed from the parts to be tested, using a suitable degreasing agent.

The parts are then immersed for 10 min in a 10 % solution of ammonium chloride in water at a temperature of (20 ± 5) °C.

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

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

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

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

30 Additional tests on pins provided with insulating sleeves

IEC 60884-1:2022, Clause 30 is not applicable.

31 EMC requirements

31.1 Immunity

The operation of accessories within the scope of this document, in normal use, is not affected by electromagnetic disturbances.

Therefore, no test is required.

If the accessory has an incorporated active electronic circuit, for example, an electronic switch, additional requirements on EMC shall be fulfilled according to the relevant products standards.

31.2 Emission

Accessories within the scope of this document are intended for continuous use; in normal use they do not generate electromagnetic disturbances.

Therefore, no test is required.

If the accessory has an incorporated active electronic circuit, for example, an electronic switch, additional requirements on EMC shall be fulfilled according to the relevant products standards.

32 Electromagnetic fields (EMF) requirements

Accessories within the scope of this document are intended for continuous use; in normal use they do not generate an additional electromagnetic field beside the one originating from the flowing current.

Therefore, no test is required.

If the accessory has an incorporated active electronic circuit, for example, an electronic switch, additional requirements on EMF shall be fulfilled according to the relevant products standards.

Annex A
(normative)

Safety-related routine tests for factory-wired portable accessories (protection against electric shock and correct polarity)

IEC 60884-1:2022, Annex A is not applicable.

Annex B
(informative)

Alternative gripping tests

IEC 60884-1:2022, Annex B is not applicable.

Annex C
(normative)

Switches incorporated in portable socket-outlets

IEC 60884-1:2022, Annex C is not applicable.

Annex D
(normative)

Requirements for plugs and fixed or portable socket-outlets intended to be used with AWG cables

NOTE The following modifications to this document are applicable for plugs and fixed or portable socket-outlets intended to be used with AWG cables. The clause numbers in this annex refer to the clause numbers in the main body text of this document.

1 Scope

Clause 1 of this document is applicable except as follows:

Replacement of the first paragraph by:

This part of IEC 60884 applies to plugs and fixed or portable socket-outlets for AC only, with or without earthing contact, with a rated voltage greater than 50 V but not exceeding 250 V and a rated current not exceeding 30 A, intended for household and similar purposes, either indoors or outdoors, intended to be used with AWG cables.

Replace the second paragraph by:

The rated current is limited to 15 A maximum for fixed socket-outlets provided with screwless-type terminals.

2 Normative references

Clause 2 of this document is applicable.

3 Terms and definitions

Clause 3 of this document is applicable.

4 General requirements

Clause 4 of this document is applicable.

5 General remarks on tests

Clause 5 of this document is applicable.

6 Ratings

Clause 6 of this document is applicable except as follows:

Replacement of Table 2 by the following new one:

Table 2 – Preferred combinations of types and ratings

Type	Rated current		
	15 A	20 A	30 A
2P (plug)	125 V	_	_
	250 V	250 V	_
1P +N (plug)	125 V	125 V	_
2P + N	_	_	125/250 V
1P + N + ⏚	125 V	125 V	_
2P + N + ⏚	_	_	125/250 V
2P + ⏚	250 V	250 V	250 V

7 Classification

Clause 7 of this document is applicable.

8 Marking

Clause 8 of this document is applicable except as follows:

8.1 *Addition of the following dash after dash 9:*

– *size of AWG conductor(s) marked on the socket-outlet.*

8.2 *Addition of the following text at the end of the subclause:*

Non-removable terminal screws may be used to indicate conductor connections as follows: white (silver) colour for the neutral conductor and green colour for earthing conductor. These indicators may be used in place of the letter N or symbol ⏚ respectively.

9 Checking of dimensions

Clause 9 of this document is applicable.

10 Protection against electric shock

Clause 10 of this document is applicable except as follows:

10.2 Replacement of the fourth paragraph by the following paragraph:

The test is carried out on the specimen mounted as for normal use and fitted with conductors of the smallest AWG size, the test being then repeated using conductors of the largest AWG size, specified in Table 4.

11 Provision for earthing

Clause 11 of this document is applicable.

12 Terminals and terminations

Clause 12 of this document is applicable except as follows:

Replacement of Table 4 by the following new one:

Table 4 – Relationship between rated current and the AWG size

Current	Rigid (solid or stranded) copper conductors		Flexible copper conductors	
	Fixed type accessories		Portable type accessories	
	AWG size	Diameter of the largest conductor	AWG size	Diameter of the largest conductor
		mm		mm
15 A	14 up to 12 inclusive	2,45	18 up to 14 inclusive	2,08
20 A	12 up to 10 inclusive	3,09	14 up to 12 inclusive	2,70
30 A	10 up to 8 inclusive	3,89	12 up to 10 inclusive	3,36
NOTE Standardized values and configurations of existing systems are reported in IEC TR 60083.				

Replacement of Figure 9 to Figure 12 and associated keys and tables as follows:

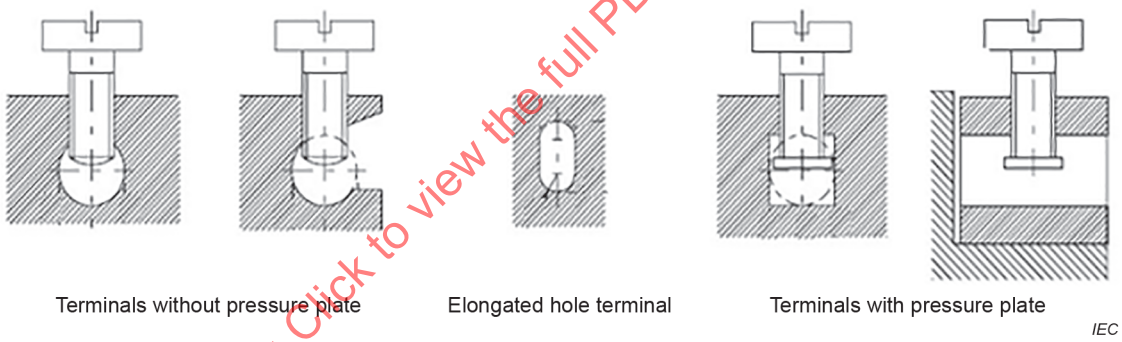


Figure 9 – Pillar terminals

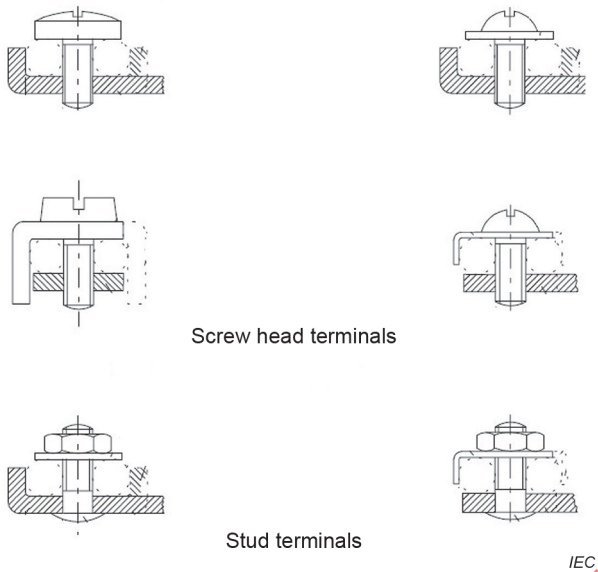


Figure 10 – Screw head terminals and stud terminals

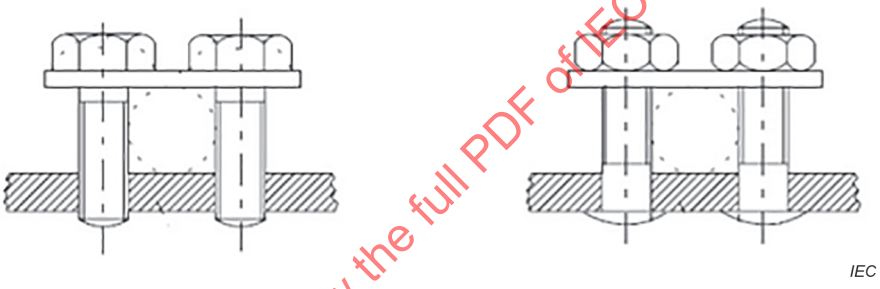


Figure 11 – Saddle terminals

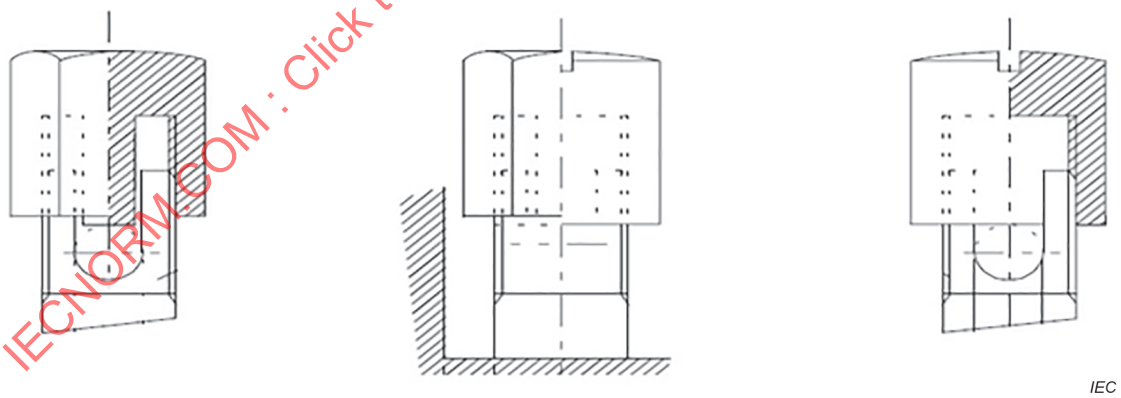


Figure 12 – Mantle terminals

12.2.1 *Replacement of the last two paragraphs by the following two paragraphs:*

The conductor space shall be at least that indicated in column 3 or 5 of Table 4.

Compliance is checked by inspection, by measurement, by fitting the smallest and largest AWG sizes specified.

12.2.5 *Replacement of the third paragraph by the following paragraph:*

The terminal is placed in the test apparatus according to Figure 7 and fitted with rigid, solid, stranded and/or flexible conductor(s), according to Table 4 first with the smallest and then with the largest AWG size, the clamping screw(s) or nut(s) being tightened with the torque according to Table 7.

12.2.6 *Replacement of the fourth paragraph by the following paragraph:*

The terminals are fitted with rigid solid or stranded conductors for fixed socket-outlets and flexible conductors for plugs and portable socket-outlets using conductors of the smallest and largest AWG size specified in Table 4, the terminal screws being tightened with a torque equal to two-thirds of the torque shown in the appropriate column of Table 7.

Replacement of Table 5 by the following new table:

Table 5 – Values for pull test for screw-type terminals

Nominal cross-sectional area and AWG size of conductors accepted by the terminal AWG	Pull N
18 up to 16 inclusive	40
Above 16 up to 14 inclusive	50
Above 14 up to 12 inclusive	50
Above 12 up to 10 inclusive	60
Above 10 up to 8 inclusive	80

12.2.7 *Replacement of the third paragraph by the following paragraph:*

The terminals are fitted with conductors having the largest AWG size specified in Table 4.

Replacement of Table 6 by the following new one:

Table 6 – Composition of conductors

AWG size	Number of wires (*n*) and nominal diameter of wires *n* × mm		
AWG	Flexible conductor	Rigid solid conductor	Rigid stranded conductor
18	16 × 0,255	-	-
16	26 × 0,255	-	-
14	41 × 0,255	1 × 1,63	7 × 0,615
12	65 × 0,255	1 × 2,05	7 × 0,775
10	104 × 0,255	1 × 2,59	7 × 0,978
8	168 × 0,255	-	7 × 1,230

12.2.8 *Replacement of the third paragraph by the following paragraph:*

A rigid solid copper conductor of the AWG size specified in Table 4 is placed in the terminal.

Replace the seventh paragraph by:

Screws and nuts are tightened and loosened five times by means of a suitable test screwdriver or spanner, the torque applied when tightening being equal to the torque shown in the appropriate column of Table 7.

12.2.9 *Delete the note.*

12.2.11 *This subclause is not applicable.*

12.3.2 *Replace Table 8 by the following new one:*

Table 8 – Relationship between rated current and connectable AWG size for screwless-type terminals

Rated current A	AWG size	Diameter of rigid conductor mm
15	14	1,63

Replacement of the last paragraph by the following paragraph:

Compliance is checked by inspection and by fitting the specified conductors of the smallest and largest AWG sizes as marked on the device.

12.3.10 *Replacement of the third paragraph by the following paragraph:*

The test is carried out with solid rigid copper conductors, first with conductors having the largest AWG size, and then with conductors having the smallest AWG size specified in Table 8.

Replacement of the seventh paragraph by the following paragraph:

The test is then repeated with rigid stranded copper conductors having the AWG sizes specified in 12.3.2; these conductors are, however, connected and disconnected only once.

Replacement of Table 10 by the following new one:

Table 10 – Values for flexing under mechanical load test for copper conductors

AWG size	Diameter of bushing hole mm	Height *H* mm	Mass for conductor kg
14	9,5	280	0,7
12	9,5	280	0,9
10	9,5	280	1,4
8	9,5	280	2,0

12.3.11 *Replacement of the first paragraph of item a) by the following paragraph:*

a) The test is carried out loading the screwless-type terminals for 1 h with an alternating current as specified in Table 11 and connecting rigid solid conductors 1 m long.

Replacement of Table 11 by the following new one:

Table 11 – Test current for the verification of electrical and thermal stresses in normal use for screwless-type terminals

Rated current A	Test current A	AWG size
15	21	14

12.3.12 *Replacement of the eighth paragraph after the NOTE by the following paragraph:*

A clamping unit is fitted as for normal use with a rigid solid copper conductor having an AWG size 16 and is submitted to a first test sequence; the same clamping unit is submitted to a second test sequence using the conductor having a AWG size 14, unless the first test sequence has failed.

Delete Table 12.

Replacement of Table 13 by the following new one:

Table 13 – Deflection test forces

AWG size of the test conductor	Force for deflecting the test conductor [a] N
14	1,0
12	1,5
[a] The forces are chosen so that they stress the conductors close to the limit of elasticity.	

13 Construction of fixed socket-outlets

Clause 13 of this document is applicable except as follows:

13.4 *Replacement of the second paragraph after NOTE 2 by the following paragraph:*

Compliance is checked by inspection and by an installation test with conductors of the largest AWG size specified in Table 4.

13.4 *Replacement of the last paragraph by the following paragraph:*

Compliance is checked by inspection and by an installation test with conductors of the largest AWG size specified in Table 4.

13.9 *Replacement of the third paragraph by the following paragraph:*

Compliance is checked by inspection and by an installation test using a cable having conductors of the smallest AWG size specified in Table 15.

13.14 *In the second paragraph, replacement of "16 A" by "20 A".*

13.21 *Replacement of Table 15 by the following new table:*

Table 15 – External cable limits for surface-type socket-outlets

Rated current A	AWG size	Number of conductors	Limits of external dimensions of cables mm	
			Minimum	Maximum
15	14,12	2	4,14 × 9,91	4,06 × 11,43
		3	4,14 × 11,43	8,76 DIA
20	12,10	2	4,06 × 11,43	5,33 × 12,52
		3	8,76	10,92
30	10, 8	2	5,33 × 12,52	7,37 × 14,73
		3	10,92	14,10

14 Construction of plugs and portable socket-outlets

Clause 14 of this document is applicable except as follows:

14.9.2 *Replacement of the first paragraph by:*

A 6 mm length of insulation is removed from the end of a flexible conductor, having the minimum required AWG size specified in Table 4. 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.

14.9.3 *Replacement of the first paragraph by:*

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 AWG size 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.

14.14 *Replacement of the second paragraph by the following paragraph:*

Compliance is checked by inspection, after fitting conductors of the largest AWG size specified in Table 4.

15 Interlocked socket-outlets

Clause 15 of this document is applicable.

16 Resistance to ageing, protection provided by enclosures, and resistance to humidity

Clause 16 of this document is applicable except as follows:

16.2.3 *Replacement of the first paragraph after Figure 18 by:*

Surface type socket-outlets are mounted as for normal use in a vertical position and fitted with cables or conduits or both in accordance with the manufacturer's instructions. Cables shall have conductors of the largest and smallest AWG size given in Table 4, as appropriate to their rating.

Replacement of the first paragraph after Figure 19 by:

Portable socket-outlets are tested on a flat, horizontal surface in a position as in normal use, such that there is no strain on the flexible cable. They are fitted with flexible cables (see Table 20) having conductors of the largest and smallest AWG size given in Table 4, as appropriate to their rating.

17 Insulation resistance and electric strength

Clause 17 of this document is applicable.

18 Operation of earthing contacts

Clause 18 of this document is applicable.

19 Temperature rise

Clause 19 of this document is applicable except as follows:

Replacement of Table 16 by the following new table:

Table 16 – AWG sizes of copper conductors for temperature rise test

Rated current of accessory	Flexible conductors for portable accessories	Rigid conductors (solid or stranded) for fixed accessories
	Nominal cross-sectional area	Nominal cross-sectional area
	AWG	AWG
Up to and including 15 A	14	14
Over 15 A up to and including 20 A	12	12
Over 20 A up to and including 30 A	10	10

Table 17 – Test current for cycling tests on accessories with crimped connection

Replace "16" by "20" in two locations in column 5 and replace "32" by "30" in column 6.

Cable cross-sectional area	Rated current of the accessory						
mm^2	A						
	6	**10**	**13**	**16**	**20**	**25**	**32**
0,75	9	9	10	10	-	-	-
1	10	12	13	16	-	-	-
1,5	-	13	20	20	-	-	-
2,5 (base 1,6 × I_n)	-	20	21	26	26 *	26 *	26 *
4	-	-	-	-	30	36 *	36 *
6	-	-	-	-	-	40	46 *
* The current is limited so as not to exceed a 30 K temperature rise on the cable.							

20 Breaking capacity

Clause 20 of this document is applicable except as follows:

Replacement of "16 A" by "20 A" in three locations in the two dashed lists.

21 Normal operation

Clause 21 of this document is applicable except as follows.

Replacement of "16 A" by "20 A" in four locations: in the first and second dashed lists and in the paragraph directly following Figure 24.

23 Flexible cables and their connection

Clause 23 of this document is applicable except as follows:

23.2 *Replacement of the third paragraph by the following paragraph:*

Rewirable accessories are first tested with a cable having the smallest AWG size, and then with a cable having the largest AWG size, as shown in Table 20.

Replacement of Table 20 by the following new table:

Table 20 – External dimensions of flexible cables to be accommodated by cord anchorages

Rating of accessory	Number of poles [b]	Types of flexible cable (cable references)		Number of conductors and nominal cross-sectional area	Limits for external dimensions for flexible cables mm	
				AWG	Minimum	Maximum
Up to and including 15 A [a]	2	[c]		2 × 18	2,67 × 5,16	3,56 × 6,65
				2 × 16	3,94 × 7,24	3,94 × 7,75
				2 × 14 [d]	5,84 × 10,92	5,84 × 10,92
Up to and including 15 A	3	[c]		3 × 18	5,84	10,16
				3 × 16	6,60	10,92
				3 × 14	9,14	14,60
				3 × 12	10,80	16,64
Over 15 A up to and including 20 A	3	[c]		3 × 14	9,14	14,60
				3 x 12	10,80	16,64
Over 20 A up to and including 30 A	3	[c]		3 × 12	10,80	16,64
				3 × 10	14,35	18,29
Over 20 A up to and including 30 A	4	[c]		4 × 14	9,91	15,75
				4 × 12	11,81	18,03
				4 × 10	15,88	19,68
				4 × 8	23,50	26,67

[a] Exclusively designed for two-conductor flat flexible cables.

[b] Earthing contacts, irrespective of their number, are considered as one pole.

[c] The accessory shall accommodate the type of cable as stipulated in instructions accompanying the accessory.

[d] Only one size two-conductor flat cable.

Replacement of the fifth paragraph after Table 20 by:

The flexible cable is then subjected 100 times to a pull of:

– 60 N if the rated current is 15 A,
– 100 N if the rated current is 20 A or 30 A.

Replacement of Table 21 by the following new table:

Table 21 – Torque test values for cord anchorages

Rating of plug or portable socket-outlet	Flexible cable (number of conductors × AWG size conductor)				
	2 × 20	2 × 18	3 × 20	3 × 18	(2 or more) × 18
Up to and including 20 A	0,10 Nm	0,15 Nm	0,15 Nm	0,25 Nm	0,25 Nm
Above 20 A	-	-	-	-	0,42 Nm

In the last paragraph, replacement of "16 A" by "30 A".

Replacement of Table 22 by the following new table:

Table 22 – Maximum dimensions of flexible cables to be accommodated in rewirable accessories

Rating of accessory	Number of poles [b]	Types of flexible cable (cable references)	Number of conductors and AWG size AWG	Maximum dimensions for flexible cables mm
Up to and including 15 A	2	c	2 × 14	13,97
Up to and including 15 A	3	c	3 × 14	14,60
Over 15 A up to and including 20 A	3	c	3 × 12	16,64
Over 20 A up to and including 30 A	3	c	3 × 10	18,29
Over 20 A up to and including 30 A	4	c	4 × 8	26,67

[a] void

[b] Earthing contacts, irrespective of their number, are considered as one pole.

[c] The accessory shall accommodate the type of cable as stipulated in instructions accompanying the accessory.

23.3 *Replace the first paragraph by:*

Non-rewirable plugs and non-rewirable portable socket-outlets shall be provided with a flexible cable having conductors with AWG sizes in relation to the rating of the accessory as given in the relevant columns of Table 18.

Replacement of Table 18 by the following new table:

Table 18 – Relationship between rating of accessories, AWG size of test conductors and test currents for the tests of temperature rise (Clause 19) and normal operation (Clause 21)

Rating of accessory	Rewirable fixed accessories		Rewirable portable accessories		Non-rewirable portable socket-outlets			Non-rewirable plugs		
	Test current		Test current		AWG size	Test current		AWG size	Test current	
	A		A			A			A	
	Clause 19	Clause 21	Clause 19	Clause 21		Clause 19	Clause 21		Clause 19	Clause 21
15 A 125 V/250 V	19	15	19	15	16	19	15	18	14	10
								16	16	13
								14	19	15
20 A 125 V/250 V	25	20	25	20	12	25	20	14	23	18
								12	25	20
30 A 125 V/250 V	38	30	38	30	10	38	30	12	31	25
								10	38	30

23.4 *Replacement of the fourth and fifth paragraphs after Figure 28 by:*

The flexible cable is loaded with a mass such that the force applied is 20 N.

A current equal to 15 A is passed through the conductors.

24 Mechanical strength

Clause 24 of this document is applicable accept as follows:

24.2 *Replacement of the first paragraph by:*

Rewirable portable accessories are fitted with the flexible cable specified in 23.2 having the smallest AWG size specified in Table 4 and a free length of approximately 100 mm measured from the outer end of the guard.

24.10 Test for multiple portable socket-outlets

Replacement of the first paragraph by:

Rewirable multiple portable socket-outlets are fitted with the lightest type of flexible cable of the smallest AWG size specified in Table 4.

25 Resistance to heat

Clause 25 of this document is applicable.

26 Screws, current-carrying parts and connections

Clause 26 of this document is applicable.

27 Creepage distances, clearances and distances through sealing compound

Clause 27 of this document is applicable except as follows:

27.1 *Replacement of the second paragraph after Table 26 by the following paragraph:*

For rewirable accessories, the measurements are made on the specimen fitted with conductors of the largest AWG size specified in Table 4 and also without conductors.

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

Clause 28 of this document is applicable.

29 Resistance to rusting

Clause 29 of this document is applicable.

30 Additional tests on pins provided with insulating sleeves

Clause 30 of this document is applicable.

31 EMC requirements

Clause 31 of this document is applicable.

32 Electromagnetic fields (EMF) requirements

Clause 32 of this document is applicable.

Annex E
(informative)

Tests to be applied during the production of crimped connections in accessories

NOTE In the following countries, Annex E is normative: DE, DK.

E.1 General

During the production of crimped connections in accessories the following tests shall be carried out.

Minimum to be checked during the production and documented:

– the crimp height;
– the pull out force;
– the micro-section of the crimped connection.

The limit values of the crimp height and the pull out force are defined by the manufacturer and are given in the test report. These limit values are the reference values for the test during the production.

As the type tests have been done on samples that fall within the tolerances as defined by the manufacturer, the manufacturer shall have performed a risk analysis when setting the tolerances, and shall detail how the limits on crimp height and pull out force have been established.

NOTE Possible ways to validate the borders of the tolerances are cycling tests on special prepared samples at the border of the tolerances and/or microscopic analysis of samples at the borderline of the tolerance.

E.2 Stripping of the conductor

When stripping the conductors the requirements of 9.4 of IEC 60352-2:2006 shall be taken into account.

E.3 Crimp height

The crimp height during production shall remain between the limit lines as given by the manufacturer in the test report. The test is carried out according to IEC 60352-2:2006, 12.2.

E.4 Pull out force

The test is carried out according to IEC 60512-16-4:2008. The values which have been validated during the production shall be between the limit lines as given by the manufacturer in the test report.

E.5 Microscopic analysis of the prepared crimped connection

The micro-section of the crimped connection is the basis for the validation of the quality of the crimp connection obtained with the crimp tool. The micro-section shall be carried out during the type test, in case of tool replacement and modifications.

The micro-section and the evaluation shall be documented and kept for at least 10 years.

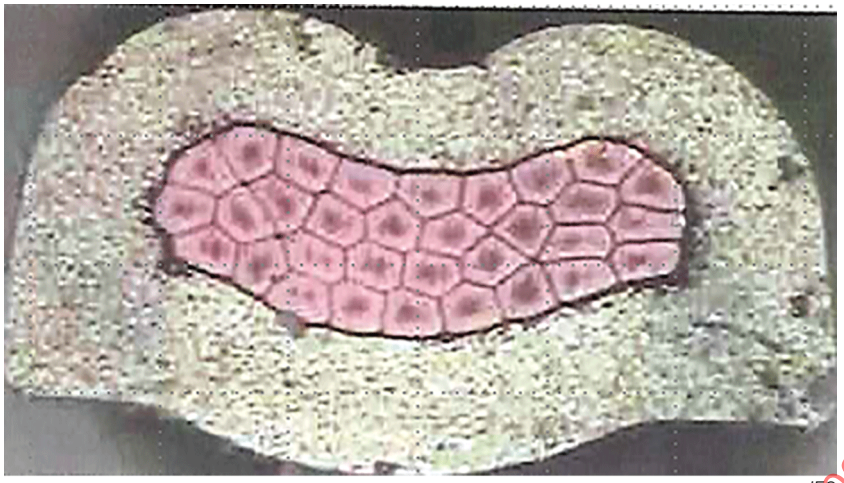


Figure E.1 – Example of a well performed crimp connection with closed barrel

E.6 Process quality

The quality of the complete crimping process shall be tested on all crimped terminations of at least 50 specimens by confirming the crimp height as well as the pull out force.

The test results shall remain between the limit lines as given by the manufacturer in the test report.

E.7 Production validation

During the running manufacturing process the crimp height as well as the pull out force according to the manufacturer's declaration shall be tested according to a statistical process control method.

Three specimens of each type shall be tested at the beginning and end of a production lot, however at least every 8 h or after 5 000 samples whichever is reached first.

For lots smaller than 1 000 samples the test has to be performed only at the beginning.

The test results shall remain between the limit lines as given by the manufacturer in the test report.

The test results shall be documented by the manufacturer and kept for at least 10 years.

Annex F
(normative)

Additional requirements for accessories provided with insulation-piercing terminals

NOTE The following modifications to this document are applicable for accessories provided with insulation-piercing terminals. The clause numbers in this annex refer to the clause numbers in the main body text of this document that are modified.

1 Scope

Replace the second paragraph by:

The rated current is limited to 16 A maximum for accessories provided with screwless-type terminals or with insulation-piercing terminals.

NOTE 1 In the following country, the application of IPT is under consideration: ZA.

NOTE 2 In the following country the use of IPT is not fully applicable due to safety concerns related to installation conditions: DE

3 Terms and definitions

Addition of the following new term entries:

3.47
insulation-piercing terminal
IPT
connecting device for the connection and possible disconnection of one or more conductors, the connection being made by piercing, boring through, cutting through, displacing or making ineffective in some other manner the insulation of the conductor(s) without previous stripping

Note 1 to entry: The removal of the sheath of the cable, if necessary, is not considered as a previous stripping.

Note 2 to entry: Examples of IPTs are given in Figure F.1.

3.47.1
reusable IPT
reusable insulation-piercing terminal
IPT that can be used more than once

3.47.2
non-reusable IPT
non-reusable insulation-piercing terminal
IPT that can be used only once, by removing the accessory from the circuit only by cutting the conductors or by removing and damaging the accessory in such a way that it cannot be reused

7 Classification

7.1 Accessories classification

Addition of the following new subclauses:

7.1.7 IPT classification according to the method of making the connection

7.1.7.1 with a general purpose tool;

7.1.7.2 with a special tool, only allowed for non-reusable IPT;

7.1.7.3 by hand.

7.1.8 IPT classification according to reusability

7.1.8.1 Reusable IPT;

7.1.8.2 Non-reusable IPT.

Accessories provided with non-reusable IPT can only be used in trunking systems in accordance with IEC 61084.

8 Marking

8.1 General

Add after the last line of 8.1 the following paragraphs:

In addition, accessories with IPTs shall be marked with the following:

– length of the conductor to be inserted into the IPT, if applicable;
– an indication of the suitability to accept rigid (solid and stranded) conductors only, if applicable.

8.2 Symbols

Add before NOTE 1 of 8.2 the following line:

For IPT terminals: suitability to accept rigid conductors only..... r

8.3 Particular requirements for fixed socket-outlets

Add the following dashes before the last dashed list item:

– length of the conductor to be inserted into the IPT, if applicable;
– indication of the suitability to accept rigid (solid and stranded) conductors only for IPT, for these socket-outlets having this restriction;

8.4 Particular requirements for portable accessories

Replace the content of 8.4 by the following:

For plugs and portable socket-outlets, the marking specified in 8.1, other than:

– the type reference;
– the length of the conductor to be inserted into the IPT;

shall be easily discernible when the accessory is wired and assembled.

Plugs and portable socket-outlets for equipment of class II shall not be marked with the symbol for class II construction.

NOTE The type reference of rewirable portable accessories can be marked on the inside of the enclosure or cover.

Addition of the following new subclause:

8.9 Manufacturer's documentation for IPTs

The following shall be indicated in the manufacturer's documentation for IPTs.

– The connection and disconnection procedure, if necessary.
– The method of connection according to 7.1.7, if necessary.
– For non-reusable IPT, information that the product shall only be used in cable trunking systems and how the product shall be installed in order to have the possibility to replace it, without impairing the safety of the installation.
– An indication that the accessory is equipped with non-reusable insulation piercing terminals, if applicable.
– Clear information that the conductor shall not be stripped before connecting it to the terminal, unless the manufacturer has designed the product for this purpose.

12 Terminals and terminations

12.1 General

Replace 12.1 by the following:

All the tests on terminals, with the exception of the tests of 12.3.11, 12.3.12 and 12.4.11, shall be carried out after the tests of 16.1.

Rewirable accessories shall be provided with screw-type terminals or with screwless-type terminals or with IPTs.

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

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

Non-rewirable accessories shall be provided with soldered, welded, crimped, non-reusable insulation piercing terminals or equally effective permanent connections (termination). Screw connections and snap-on connections shall not be used.

IPT requiring a special tool in accordance with classification 7.1.7.2, can only be used for non-reusable IPT.

Accessories provided with non-reusable IPT can only be used in trunking systems in accordance with IEC 61084.

Non-reusable IPT can be used in non-rewirable accessories only.

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

Compliance is checked by inspection and by the tests of 12.2 or 12.3 or 12.4, as applicable.

Addition of the following new subclause.

12.4 Insulation piercing terminals (IPT)

12.4.1 IPTs shall be of the type suitable for rigid copper conductors only or shall be of the type suitable for both rigid and flexible conductors.