

Plugs, socket-outlets and couplers for industrial purposes —

Part 2: Dimensional interchangeability requirements for pin and contact-tube accessories

ICS 29.120.30

National foreword

This British Standard is the UK implementation of EN 60309-2:1999+A2:2012. It is derived from IEC 60309-2:1999, incorporating amendment 1:2005 and amendment 2:2012. It supersedes BS EN 60309-2:1999 which will be withdrawn on 13 July 2015.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to IEC text carry the number of the IEC amendment. For example, text altered by IEC amendment 1 is indicated by A1 A1.

The CENELEC common modifications have been implemented at the appropriate places in the text. The start and finish of each common modification is indicated in the text by tags C C. Where a common modification has been introduced by amendment, the tags carry the number of the amendment. For example, the common modifications introduced by CENELEC amendment A11 are indicated by C11 C11.

The UK participation in its preparation was entrusted by Technical Committee PEL/23, Electrical accessories, to Subcommittee PEL/23/4, Protected type plugs and sockets.

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

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English version

Plugs, socket-outlets and couplers for industrial purposes — Part 2: Dimensional interchangeability requirements for pin and contact-tube accessories

(IEC 60309-2:1999)

Prises de courant pour usages industriels —
Partie 2: Règles d'interchangeabilité dimensionnelle
pour les appareils à broches et alvéoles
(CEI 60309-2:1999)

Stecker, Steckdosen und Kupplungen für
industrielle Anwendungen —
Teil 2: Anforderungen und Hauptmaße für die
Austauschbarkeit von Stift- und
Buchsensteckvorrichtungen
(IEC 60309-2:1999)

This European Standard was approved by CENELEC on 1999-05-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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

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

CENELEC members are the national electrotechnical committees of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

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

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Foreword

The text of document 23H/89/FDIS, future edition 4 of IEC 60309-2, prepared by SC 23H, Industrial plugs and socket outlets, of IEC TC 23, Electrical accessories, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60309-2 on 1999-05-01.

This European Standard supersedes EN 60309-2:1998.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2000-02-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2002-05-01

This Part 2 is to be used in conjunction with EN 60309-1:1999.

Annexes designated “normative” are part of the body of the standard.

In this standard, Annex ZA and Annex ZB are normative.

Annex ZA and Annex ZB have been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60309-2:1999 was approved by CENELEC as a European Standard without any modification.

Foreword to amendment A11

This amendment to the European Standard EN 60309-2:1999 was prepared by the CENELEC BTWG 112-1, Improvement of EN 60309-1 and EN 60309-2. The text of the draft was submitted to the Unique Acceptance Procedure and was approved by CENELEC as amendment A11 to EN 60309-2:1999 on 2004-05-01.

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- latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2004-11-01
- latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 2004-11-01

Foreword to amendment A1

The text of document 23H/175/FDIS, future amendment 1 to IEC 60309-2:1999, prepared by SC 23H, Industrial plugs and socket-outlets, of IEC TC 23, Electrical accessories, was submitted to the IEC-CENELEC parallel vote.

A draft amendment, containing common modifications to IEC 60309-2:1999 and this future amendment 1, was prepared by CENELEC BTWG 112-1, Improvement of EN 60309-1 and EN 60309-2, and was submitted to the formal vote.

The combined texts were approved by CENELEC as amendment A1 to EN 60309-2:1999 on 2006-11-01.

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- latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 2009-11-01

Annex ZC has been added by CENELEC.

Endorsement notice

The text of amendment 1:2005 to the International Standard IEC 60309-2:1999 was approved by CENELEC as an amendment to the European Standard with agreed common modifications.

Foreword to amendment A2

The text of document 23H/275/FDIS, future edition 4 of IEC 60309-2:1999/A2, prepared by SC 23H, “Industrial plugs and socket-outlets”, of IEC TC 23, “Electrical accessories” was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60309-2:1999/A2:2012.

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Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

This standard covers the Principle Elements of the Safety Objectives for Electrical Equipment Designed for Use within Certain Voltage Limits (LVD – 2006/95/EC).

Endorsement notice

The text of the International Standard IEC 60309-2:1999/A2:2012 was approved by CENELEC as a European Standard without any modification.

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Introduction

This standard is divided into several parts:

— *Part 1: General requirements, comprising clauses of a general character.*

Subsequent parts: Particular requirements dealing with particular types. The clauses of these particular requirements supplement or modify the corresponding clauses in Part 1. Where the text of subsequent parts indicates an “addition” to or a “replacement” of the relevant requirement, test specification or explanation of Part 1, these changes are made to the relevant text of Part 1, which then becomes part of the standard. Where no change is necessary, the words “This clause of Part 1 is applicable” are used.

1 Scope

Replacement:

This standard applies to plugs and socket-outlets, cable couplers and appliance couplers with a rated operating voltage not exceeding A_2 1000 A_2 V, 500 Hz and a rated current not exceeding 125 A, primarily intended for industrial use, either indoors or outdoors.

NOTE All references for accessories with a rated current of more than 125 A in part 1 are not applicable to this part 2.

This standard applies to plugs and socket-outlets, cable couplers and appliance couplers with pins and contact tubes of standardized configurations.

This standard applies to plugs and socket-outlets, cable couplers and appliance couplers, hereinafter referred to as accessories, for use when the ambient temperature is normally within the range $-25\text{ }^{\circ}\text{C}$ to $40\text{ }^{\circ}\text{C}$.

The use of these accessories on building sites and for agricultural, commercial and domestic applications is not precluded.

A_2 This standard applies to accessories with screwless type terminals or insulation piercing terminals, with a rated current up to and including 32 A for series I and 30 A for series II. A_2

Socket-outlets or appliance inlets incorporated in or fixed to electrical equipment are within the scope of this standard. This standard also applies to accessories intended to be used in extra-low voltage installations.

NOTE This standard does not apply to accessories primarily intended for domestic and similar general purposes.

In locations where special conditions prevail, for example on board ship or where explosions are liable to occur, additional requirements may be necessary.

C_1 This European Standard applies to Series I products only.

Series II products are not allowed and not suitable for use in Europe: reference and requirements for Series II products are reported in this standard for information only and shall be ignored.

This European Standard applies to products intended to be used with cables with metric sizes (mm^2) only. Reference and requirements to AWG and MCM cables are present in the relevant IEC publication and they are reported in this standard for information only.

See Annex ZC for a list of references to Series II and/or AWG/MCM cable which are excluded from this standard. C_1

2 Definitions

This clause of part 1 is applicable except as follows:

Additional subclause:

2.101

phase inverter

a plug or an appliance inlet with operating means to interchange the position of two phase pins without disconnecting them from the conductors

3 Normative references

This clause of part 1 is applicable except as follows:

Addition:

IEC 60617-2:1996, *Graphical symbols for diagrams — Part 2: Symbol elements, qualifying symbols and other symbols having general application.*

^{A2} IEC 60364-4-41, *Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock* ^{A2}

4 General

This clause of part 1 is applicable except as follows:

4.1 The last paragraph of this subclause of Part 1 is not applicable.

Additional subclause:

4.101 If gauges are used, they shall be of hardened steel, all corners shall be slightly rounded-off with a maximum radius of 0,1 mm, and the surface finish for all measurement surfaces shall be $\sqrt{Ra}$ min., if not otherwise specified.

In this standard:

- 2P + $\frac{1}{2}$ covers both 2P + $\frac{1}{2}$ and 1P + N + $\frac{1}{2}$ and
- 3P + $\frac{1}{2}$ covers both 3P + $\frac{1}{2}$ and 2P + N + $\frac{1}{2}$
- unless specifically excluded (see Table 104).

5 Standard ratings

This clause of part 1 is applicable except as follows:

5.2 Replacement:

Standard rated currents are given in Table 101.

Table 101

Series I A	Series II A
16	20
32	30
63	60
125	100

^{A1} 5.101 The standard IP ratings according to IEC 60529 are:

- IP44,
- IP67,
- IP66/IP67. ^{A1}

6 Classification

^{A1} This clause of part 1 is applicable: ^{A1}

7 Marking

This clause of part 1 is applicable except as follows:

7.1 Modification:

Delete the note

Addition:

The symbol indicating the position of the earthing contact or of the minor key or keyway shall be placed before or above the figure for the rated operating voltage, and separated from it by a line.

These markings shall be placed after that for rated current, separated from it by a dash if an oblique line separates the symbol indicating the position of the earthing contact or of the minor key or keyway from the figure for the rated operating voltage.

If a symbol for nature of supply is used, it shall be placed next to or below the marking for rated operating voltage.

For three-phase accessories it is not necessary to mark the voltage phase to neutral, if any.

The marking for rated current(s), position of the earthing contact or the minor key, keyway, rated operating voltage(s) and nature of supply accordingly may be as follows:

For series I:

16 A - 9 h/400 V~, or 16 - 9 h/400~, or 16 - $\frac{9 \text{ h}}{400 \sim}$, or

16 A - 9 h/380-415 V~, or 16 - 9 h/380-415~, or 16 - $\frac{9 \text{ h}}{380 - 415 \sim}$

32 A - 6 h/230/400 V~, or 32 - 6 h/230/400~, or 32 - $\frac{6 \text{ h}}{230 / 400 \sim}$, or

32 A - $\frac{6 \text{ h} / 220 / 380 \text{ V} \sim}{240 / 415 \text{ V} \sim}$, or 32 - $\frac{6 \text{ h} / 220 / 380 \sim}{240 / 415 \text{ V} \sim}$, or 32 - $\frac{6 \text{ h}}{220 / 380 \sim}$
240 / 415 ~

For series II

20 A - 7 h/480 V a.c. or 20 A - 7 h/480~, or 20 A - $\frac{7 \text{ h}}{480 \sim}$

30 A - 7 h/480 V, 3 Phase, or 30 A - 7 h/480, 3Φ, or 30 A - $\frac{7 \text{ h}}{480 \text{ V}, 3\Phi}$

60 A - 7 h/277/480 V, 3 Phase Y, or 60 A - 7 h/277/480, 3ΦY, or 60 A - $\frac{7 \text{ h}}{277 / 480 \text{ V}, 3\Phi Y}$

It is allowed to put the symbols for a.c. (∼) and d.c. (— or —) after the values (IEC 60617-2).

The drawings of standard sheets 2-I, 2-II, 2-III and 2-IV show accessories with the symbol 6 h and those of standard sheets 2-VIII and 2-IX accessories with the symbol 12 h.

For accessories having rated operating voltages exceeding 50 V, the symbol indicating the position of the earthing contact shall be a numeral followed by the letter h.

The numeral is derived from the position of the earth contact tube, when compared with the face of a clock, the socket-outlet or connector being viewed from the front with the keyway at the sixth hour.

For accessories having rated operating voltages not exceeding 50 V, the symbol indicating the position of the minor key shall be a numeral followed by the letter h.

The numeral is derived from the position of the minor key, when compared with the face of a clock, the socket-outlet or connector being viewed from the front with the major key at the sixth hour.

For plugs and appliance inlets, the symbol indicating the position of the earthing contact or the minor keyway shall be the same as that for the corresponding socket-outlet or connector.

Contact tubes of socket-outlets and connectors shall be positioned in the clockwise order when viewed from the front as shown in the standard sheets (see also 7.5).

Pins of plugs and appliance inlets shall be positioned in the opposite order viewed from the front.

A1 7.2 This clause of Part 1 is applicable. **A1**

7.4 Replacement

For plugs and connectors, the marking specified in 7.1 shall be easily discernible when the accessory is wired ready for use.

The marking for insulation voltage shall be on the main part; it shall not be visible when the accessory is mounted and wired as in normal use.

NOTE 1 The term “ready for use” does not imply that the plug or connector is engaged with its complementary accessory.

NOTE 2 The term “main part” of a plug or a connector means the part carrying the contacts.

Compliance is checked by inspection.

7.5 Replacement

For rewirable accessories, the contacts shall be indicated by the following symbols.

- for accessories with three contacts (phase + neutral + earth, or, phase + phase + earth):
L/+, unmarked, $\oplus$ or $\equiv$
except for Series II clock position 4 h and 5 h which are marked:
N, unmarked, $\oplus$ or $\equiv$
- for accessories with four contacts (three phase + earth):
L1, L2, L3, $\oplus$ or $\equiv$ or alternatively 1, 2, 3, $\oplus$ or $\equiv$
except for Series II clock position 12 h (phase + centre tap + phase + earth) which is marked:
L1, N, L2, $\oplus$ or $\equiv$
- for accessories with five contacts (three phase + neutral + earth):
L1, L2, L3, N, $\oplus$ or $\equiv$ or alternatively 1, 2, 3, N $\oplus$ or $\equiv$
- for a period of time the marking R1, S2, T3 may be used instead of L1, L2, L3.
- **A1** for accessories having a rated operating voltage not exceeding 50 V, 8 h clock position for portable electric incubator : +12, +24. **A1**

These symbols shall be placed close to the relevant terminals; they shall not be placed on screws, removable washers or other removable parts.

For phase inverters these symbols shall conform in one position with the requirements of 7.1. In the other position of the inverting means, the phase marking need not conform.

NOTE The terminals for pilot conductors are not required to be indicated.

The figures used with the letters may be written as an index. It is recommended that where practicable the symbol $\oplus$ be used.

Compliance is checked by inspection.

7.7 Modification:

This subclause of part 1 is applicable except for the following addition:

Add:

The 2P + N + earth, 12 h, Series II accessories shall use the indicating colour orange.

8 Dimensions

This clause of part 1 is applicable except as follows:

8.1 Replacement:

Accessories shall comply with the relevant standard sheets as specified below:

— accessories having rated operating voltages exceeding 50 V:

- | | |
|--|--------------------------|
| ● 16/20 A and 32/30 A: | Sheets 2-I and 2-II; |
| ● 63/60 A and 125/100 A, without pilot contact: | Sheets 2-III and 2-IV; |
| ● 63/60 A and 125/100 A, with pilot contact: | Sheets 2-IIIa and 2-IVa; |
| ● mechanical interlock for 16 A to 125 A accessories | Sheet 2-V |

— accessories having rated operating voltage not exceeding 50 V:

16/20 A and 32/30 A: Sheets 2-VIII and 2-IX.

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 the accessories complying with the standard sheets, especially with regard to interchangeability and non-interchangeability.

Compliance is checked by means of gauges or by measurement for those dimensions not covered by gauges,

— *for accessories having rated operating voltages exceeding 50 V according to:*

- *Figure 101 and Figure 102 for socket-outlets and connectors;*
- *Figure 107 and Figure 108 for plugs and appliance inlets;*

— *for accessories having rated operating voltages not exceeding 50 V according to:*

- *Figure 110 and Figure 112 for 16/20 A and 32/30 A accessories.*

The gauges shall be moved axially to the centre line of the accessory with a force as shown in the Table 102, applied for 1 min.

Table 102

Rated operating voltage V	Rated current A		Force (max.) for “GO” gauge N	Force (max.) for “NOT GO” gauge $N \begin{pmatrix} 0 \\ -1 \end{pmatrix}$
	Series I	Series II		
Not exceeding 50 V	16	20	150	30
	32	30	150	30
Exceeding 50 V	16	20	60	20
	32	30	90	30
	63	60	165	55
	125	100	240	80

Before the test, the test specimen of insulating material shall be stored at a temperature of $(20 \pm 5) ^\circ\text{C}$ and a relative humidity between 45 % and 75 % for four weeks.

A₁) For accessories having rated operating voltages not exceeding 50 V, the position of the minor key or keyway shall be as shown in Tables 103-1 or 103-2. **A₁)**

For accessories having rated operating voltages exceeding 50 V, the position of the earthing contact shall be as shown in Table 104.

Compliance is checked by inspection.

Table 103-1 — General purpose accessories with rated voltage not exceeding 50 V

Rated operating voltage V	Frequency Hz	Minor key or keyway position ^a
20 to 25	50 and 60	No minor key or keyway
40 to 50	50 and 60	12
20 to 25 and 40 to 50	100 up to and including 200	4
	300	2
	400	3
	Over 400 up to and including 500	11
	Direct current	10

^a The minor key or keyway position is indicated by the relevant number (see 7.1).

Table 103-2 — Special application accessories with rated voltage not exceeding 50 V

Rated operating voltage	Rated current	Numbers of poles	Other characteristics and application	Minor key or keyway position ^a
25 V	32 A	3	Portable electric incubators – use at 12 V d.c. or 24 V d.c. on ambulances or helicopters	8

^a The minor key or keyway is indicated by the relevant number.

Positions 1 and 9 are reserved for future standardization. For constructional reasons, positions 5, 6 and 7 cannot be used.

A2

Table 104

Number of contacts	Type	Frequency	Rated operating voltage	Accessories earthing-contact position ^a	
		Hz	V	16/20 A 32/30 A	63/60 A 125/100 A
3 contacts	1P+N+ $\perp$ Series II	50 and 60	100 to 130	4	4
		60	277	5	5
	2P+ $\perp$ Series I and II	50 and 60	100 to 130	4	4
			200 to 250	6	6
		50 and 60	380 to 415	9	9
			480 to 500	7	7
			Supply from an isolating transformer	12	12
		100 up to and including 300	Over 50	10	10
		Over 300 up to and including 500	Over 50	2	2
		Direct current	Over 50 up to and including 250 ^d	3	3
Over 250	8		8		
4 contacts	2P+N+ $\perp$ Series II	50 and 60	125/250 single-phase	12	12
	Series I	50 and 60	Supply from an isolating transformer	12	12
	3P+ $\perp$ Series I and II	50 and 60	100 to 130	4	4
			200 to 250	9	9
			380 to 415	6	6
		60	440 to 460 ^b	11	11
		50 and 60	480 to 500	7	7
			600 to 690	5	5
		50	380	3	3
		60	440 ^c		
		50 and 60	1000	-	8
		100 up to and including 300	Over 50	10	10
	Over 300 up to and including 500	Over 50	2	2	
5 contacts	3P+N+ $\perp$ Series I and II	50 and 60	57/100 to 75/130	4	4
			120/208 to 144/250	9	9
			200/346 to 240/415	6	6
			277/480 to 288/500	7	7
			347/600 to 400/690	5	5
		60	250/440 to 265/460 ^b	11	11
		50 60	220/380 250/440 ^c	3	3
		50 and 60	Supply from an isolating transformer	12	12
		100 up to and including 300	Over 50	10	10
		Over 300 up to and including 500	Over 50	2	2
All types		All rated operating voltage and/or frequencies not covered by other configurations. This clock counter position can additionally be used in special applications where a distinction to standardized positions is needed		1	1

NOTE The positions shown by a dash (-) are not standardized.

^a The earthing-contact position is indicated by the relevant numeral (see 7.1).^b Mainly for marine installations.^c Only for refrigerated containers (standardized ISO).^d This configuration is required to have an earthing contact because it covers voltages above the upper limits of ELV (d.c.) according to IEC 60364-4-41.

8.2 Replacement:

For accessories having rated operating voltages exceeding 50 V, it shall not be possible to engage plugs or connectors with socket-outlets or appliance inlets having different ratings, or having different contact combinations.

In addition, for all accessories the design shall be such that improper connections shall not be possible between:

- the earth and/or pilot plug-contact and a live socket-contact, or a live plug-contact and the earth and/or pilot socket-contact;
- the phase plug-contacts and the neutral socket-contact, if any;
- the neutral plug-contact and a phase socket-contact.

Compliance is checked by inspection, with the following exception:

For the two last indents, compliance is not required between three contacts accessories Series I and II, 4 h, since these have reciprocal contact positions.

NOTE These conflicting versions have both been in use for many years and resolution of this problem has been found to be impractical.

It shall not be possible to engage plugs with socket-outlets or connectors having different earthing-contact positions or minor key positions.

Compliance is checked by inspection and tests using the methods indicated below. These tests are made after storage of test specimens of insulating material at a temperature of $(20 \pm 5)^\circ\text{C}$ and with relative humidity between 45 % and 75 % for four weeks.

For accessories having thermoplastic housing, this test is made at a temperature of $(35 \pm 2)^\circ\text{C}$, both the accessories and the gauges being at this temperature.

a) Checking plugs and appliance inlets

For plugs and appliance inlets with rated operating voltage exceeding 50 V, gauges according to Figure 109 are used.

For plugs and appliance inlets with rated operating voltage not exceeding 50 V, gauges according to Figure 113 are used.

First test (key)

The socket-gauge shown in Figure 109 is placed before the plug in such a way that during the test the key shall hit the lower part of the shroud of the gauge approximately in the middle.

The force F is slowly increased in such a way that the total force given in Table 105 is exerted after 15 s. After that the full force is applied for 1 min.

The forces used are given in Table 105.

Table 105

Rated current Series I/II	A	16/20	32/30	63/60	125/100
Force F	N	175	210	385	560

When the force is applied the gauge is not permitted to move more than 4 mm in relation to the shroud of the plug or appliance inlet.

After the test, the plug and appliance inlet shall not be damaged in such a way that impairs further use of the accessory.

These forces are equal to 1,4 times the corresponding withdrawal forces.

Second test (earth-pin)

The force F shall be applied to the earth-pin in the same manner and for the same duration as in the previous test.

After that test, the plug and appliance inlet shall comply with the relevant standard sheet.

b) Checking socket-outlets and connectors

For socket-outlets and connectors having rated operating voltages exceeding 50 V, gauges according to Figure 104 are used.

For socket-outlets and connectors having rated operating voltages not exceeding 50 V, gauges according to Figure 111 are used.

First test (shroud)

The first test is carried out on all different clock positions, except for the one corresponding to the socket-outlet or connector to be used.

The test specimen shall be fixed and supported in such a way that the rigidity of the socket-outlet or connector is not influenced.

Arrangement for test shall be according to Figure 103.

The gauge shown in Figure 104 shall hit two opposite points of the accessory at the same time. The axis of the gauge and of the accessory shall be approximately parallel and the chamfer shall be equally divided in both sides.

The force F is slowly increased in such a way that the total force given in Table 105 is exerted after 15 s. After that the full force is applied for 1 min.

When the force is applied, the gauge is not permitted to move more than 4 mm in relation to the shroud of the socket-outlet or connector.

After the test, the socket-outlet of the connector shall not be damaged to the extent of impairing the further use of the accessory.

Second test (holes)

For the second test, the gauge shown in Figure 105 is inserted in each phase hole.

The gauge shall not enter the phase hole by a greater distance than that shown in Table 106 measured from the front of the internal part (see Figure 106).

The same forces and duration and the same method of application are used as for the previous test.

Table 106

Rated current Series I/II	A	16/20	32/30	63/60	125/100
Distance X	mm	11	12,5	15	20

8.3 Addition:

Compliance is checked by manual test and, for accessories with enclosures of resilient or thermoplastic material, by means of the gauge shown in Figure 114.

The gauge is applied with a force of 200 N for 1 min. For accessories with enclosures of thermoplastic material the gauge is applied at a temperature of $(35 \pm 2) ^\circ\text{C}$, both the accessories and the gauge being at this temperature.

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

9 Protection against electric shock

This clause of part 1 is applicable except as follows:

9.1 Addition:

Conformity with the relevant standard sheets ensures compliance with the requirement as far as inaccessibility of contacts during insertion of a plug or connector into the complementary accessories is concerned.

9.2 Addition:

Conformity with the relevant standard sheets ensures compliance with these requirements.

10 Provision for earthing

This clause of part 1 is applicable.

11 Terminals and terminations

This clause of Part 1 is applicable except as follows:

11.2.1 *Addition:*

Screw type terminals may be identified by the terminal sizes given in the Table 107.

NOTE For screw type terminals not identified by terminal sizes given in the Table 107, Part 1 is applicable.

Screw type terminals identified by terminal sizes shall comply with standard sheets as specified in 11.101 of this standard and are not subject to test as in 11.5 of Part 1.

Add the following new subclause:

11.101 Screw type terminals identified by terminal sizes

11.101.1 Terminals shall comply with the standard sheets as specified below, except those for standard sheets 2-X, 2-XI and 2-XII. For these standard sheets, the length of thread in the fixed part or nut and the length of thread on the screw or stud may be reduced, if the mechanical strength of the terminal is adequate and at least two full threads of every clamping screw are in engagement when a conductor of the most unfavourable cross-sectional area is clamped.

Standard sheet 2-X applies to pillar terminals.

Standard sheet 2-XI applies to screw terminals and stud terminals.

Standard sheet 2-XII applies to saddle terminals.

Standard sheet 2-XIII applies to lug terminals.

Mantle terminals shall comply with standard sheet 2-X with regard to the dimensions D and e. Terminals which are essentially of the pillar type, but with the part with the hole for the conductor slotted to enable the conductor to be moved laterally into position, shall comply with standard sheet 2-X. Anyhow, the maximum gap between the conductor restraining parts on the side where the slot is located shall comply with standard sheet 2-XI.

If the required length of thread in a terminal screw hole is obtained by plunging, the edge of the extrusion shall be reasonably smooth and the length of the thread shall exceed the specified minimum value by at least 0,5 mm.

Compliance is checked by inspection, by measurement and, for terminals with a reduced length of thread, by test of 11.101.2.

The maximum gap between the conductor restraining parts is checked by means of a steel gauge pin with a diameter equal to $e \pm 0,05$ mm.

For terminals without pressure plate(s) or the like, complying with standard sheet 2-X, the clamping screw is screwed fully home without a conductor in position. It shall not then be possible to insert the gauge pin between the threaded part of the screw and the wall of the conductor space.

For terminals complying with standard sheet 2-XI, and for terminals with a pressure plate or the like complying with standard sheet 2-X, where it is not appropriate to insert the gauge pin in all positions, a conductor is clamped in the terminal.

For terminals complying with standard sheet 2-X, the conductor is in the form of a rod with a diameter equal to that corresponding to the middle cross-sectional area of the range specified for the particular terminal, and having a flat end perpendicular to the axis.

For terminals complying with standard sheet 2-XI, the conductor is solid and has a diameter D as specified in this standard sheet.

With this conductor in position, it shall not be possible to insert the gauge pin, applied in a direction parallel to the axis of the conductor, into any gap through which a wire of a stranded conductor might escape.

The minimum distance between the clamping screw and the end of the conductor, when fully inserted, is specified in standard sheet 2-X. It is checked by means of the rod conductor specified above, which shall pass into the conductor space for a distance, beyond the threaded hole, at least equal to the minimum distance specified. 

A₁ For terminals with pressure plate(s) complying with standard sheet 2-X, the gauge pin is applied to the gap between the pressure plate and the wall of the conductor space. The following negative deviations from the specified values are allowed for the minimum nominal thread diameter of the screw:

- 0,15 mm for screws with a nominal diameter not exceeding 5 mm;
- 0,22 mm for screws with a nominal diameter over 5 mm but not exceeding 10 mm;
- 0,27 mm for screws with a nominal diameter of over 10 mm.

This subclause does not exclude terminals of types other than those shown in the standard sheets. Such terminals shall, however, comply with the other requirements of this clause as far as is reasonable, and it may be necessary to formulate additional requirements.

If the thread in the fixed part or nut is recessed, the total length of the shank of headed screws shall be increased accordingly.

If one or more of the dimensions are larger than the minimum values specified in the standard sheets, the other dimensions need not be correspondingly increased, but departures from the specified values shall not impair the function of the terminal.

11.101.2 *Terminals complying with standard sheet 2-X, but with a reduced length of thread, are fitted with a conductor of the smallest cross-sectional area specified in Table 107, tightly clamped, or a conductor of the largest cross-sectional area specified in this table, lightly clamped, whichever is the most unfavourable.*

Table 107 — Size of connectable conductors

Rating of the accessory			Internal connection ^a						External earthing connection if any		
Voltage	Current		Flexible cables for plugs and connectors ^b			Solid or stranded cables for socket-outlets ^{bf}					
	A		Solid or stranded cables for appliance inlets ^b								
V	Series I	Series II	Series I mm ²	Series II AWG/MCM ^c	Terminal size	Series I mm ²	Series II AWG/MCM ^c	Terminal size	Series I mm ²	Series II AWG/MCM ^c	Terminal size
Not exceeding 50	16	20	4 to 10	12 to 8	6	4 to 10	12 to 8	5			
	32	30	4 to 10	12 to 8	6	4 to 10	12 to 8	5			
Exceeding 50	16	20	1 to 2,5	16 to 12	2	1,5 to 4	16 to 12	3 ^d	6	10	4
	32	30	2,5 to 6	14 to 10	5	2,5 to 10	14 to 8	5	10	8	5
	63	60	6 to 16	10 to 6	7	6 to 25	10 to 4	7	25	4	7
	125	100	16 to 50	6 to 2	9 ^e	25 to 70	4 to 0	9 ^e	25	4	7

^a Terminals for pilot conductors, if any, shall allow the connection of conductors having the same nominal cross-sectional areas as the terminals of 16 A accessories having rated operating voltages exceeding 50 V.

^b Classification of conductors: according to IEC 60228, Clause 2, solid (Class 1); stranded (Class 2); flexible (Class 5).

^c The nominal cross-sectional areas of conductors are given in square millimetres (mm²). AWG/MCM values are considered as equivalent to mm² for the purpose of this standard.

AWG: American Wire Gauge is a system of identifying wires in which the diameters are in geometric progression between size 36 and size 0000.

MCM: Mille Circular Mills denotes circle surface unit. 1 MCM = 0,5067 mm².

^d For pillar terminals, size 2.

^e Compliance with terminal size 9 is provisionally not required.

^f For socket-outlets declared for flexible conductors only, these values apply.

Terminals complying with standard sheets 2-XI or 2-XII, but with a reduced length of thread, are fitted with a conductor of the largest cross-sectional area specified in Table 107, lightly clamped.

At least two threads shall be in full engagement.

*The terminals are then fitted with conductors of the smallest and largest cross-sectional areas specified in Table 107, rigid (solid or stranded) for socket-outlets and appliance inlets, and flexible for plugs and connectors, and the terminal screws are tightened, the maximum torque applied being equal to two-thirds of the torque specified in Table 15 of IEC 60309-1. Each conductor is subjected to a pull force N of the value, in Newton, shown in Table 108; the pull is applied without jerks, for 1 min, in the direction of the axis of the conductor space. **A₁***

Ⓐ

Table 108

Terminal size	2	3	4	5	6	7	8	9	10
Pulling force N	50	50	60	80	90	100	120	150	200

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

NOTE For terminals with sizes from 8 to 10, the value of the pulling force N is provisional. Ⓐ

12 Interlocks and retaining devices

This clause of part 1 is applicable except as follows:

12.1 Addition:

If an accessory having a rated operating voltage exceeding 50 V is provided with a mechanical interlock, this shall comply with standard sheet 2-V.

It shall not be possible to operate the mechanical switching device of a mechanically interlocked switched socket-outlet or switched connector, except after the insertion of an appropriate plug.

NOTE Tools are not considered as appropriate plugs.

It is accepted that tools may be used to override interlock for circuit testing purposes.

12.3 Addition:

Accessories shall be provided with a retaining device as indicated in Table 109.

Table 109

Rated current of the accessory A	Classification according to degree of protection against moisture	Socket-outlets and connectors			Plugs and appliance inlets		
		Retaining means	Standard sheet		Retaining means	Standard sheet	
			Rated operating voltage exceeding 50 V	Rated operating voltage not exceeding 50 V		Rated operating voltage exceeding 50 V	Rated operating voltage not exceeding 50 V
16/20 and 32/30	Ⓐ IP44 Ⓐ	Lid	2-I (continuation 1)	2-VIII (continuation 1)	Lug or cavity	2-II (continuation 1)	2-IX (continuation 1)
	Ⓐ IP66/IP67 and IP67 Ⓐ	Two-ramp system	2-I (continuation 2)	2-VIII (continuation 2)	Lug or cavity and bayonet ring	2-II (continuation 2)	2-IX (continuation 2)
63/60	Ⓐ IP44 Ⓐ	Lid and two-ramp system	2-III (continuation 1)	—	Lug or cavity	2-IV (continuation 1)	—
	Ⓐ IP66/IP67 and IP67 Ⓐ	Two-ramp system	2-III (continuation 2)	—	Bayonet ring	2-IV (continuation 2)	—
125/100	Ⓐ IP66/IP67 and IP67 ^a Ⓐ	Two-ramp system	2-III (continuation 2)	—	Bayonet ring	2-IV (continuation 2)	—

^a When 125/100 A socket-outlets are mounted on or integrated with enclosures, the whole unit can also be IP44.

13 Resistance to ageing of rubber and thermoplastic material

This clause of part 1 is applicable.

14 General construction

This clause of part 1 is applicable except as follows:

Addition:

Accessories having a rated current of 63/60 A shall be Ⓐ IP44 Ⓐ or Ⓐ IP66/IP67 and IP67 Ⓐ.

Accessories having a rated current of 125/100 A shall be Ⓐ IP66/IP67 and IP67 Ⓐ.

When 125/100 A socket-outlets are mounted on or integrated with enclosures, the whole unit can be IP44.

14.101 Additional subclause:

It shall not be possible to operate the phase inverting means unintentionally or to operate the phase inverting means when the phase inverter is inserted in the complementary accessory.

The phase inverting means shall incorporate a latching means to retain it in its defined position.

Compliance is checked by inspection and manual test.

The operation of the phase inverting means shall not damage the cable or wiring.

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

15 Construction of socket-outlets

This clause of part 1 is applicable except as follows:

15.1 Addition:

Contact tubes shall be self-adjusting and so designed as to ensure adequate contact continuity before and after a number of operations corresponding to their operational life.

Contact tubes other than the earth-contact shall be floating.

Earth contact tubes need not be floating, provided that they have the necessary resilience in all directions.

Compliance is checked by inspection and by the following test:

The sample is mounted so that the axes of the contact tubes are vertical with the contact openings downwards.

A gauge of hardened steel, with a finish of 0,002 mm and free from grease, having the dimensions shown in Table 110, is inserted into each contact tube, also free from grease, and the force necessary to withdraw the gauge is measured.

The sum of the force and the weight of the gauge shall exceed the minimum total force shown in Table 110.

Table 110

Nominal pin diameter mm	Gauge	
	Diameter of gauge mm +0 -0,01	Minimum total force N
5	4,80	2,5
6	5,80	5
7	6,80	5
8	7,80	10
10	9,80	15
12	11,80	20

This test shall be made after that of 15.2.

15.2 Replacement:

The pressure exerted by the contact tubes on the pins of a plug shall not be so great as to prevent easy insertion and withdrawal of the plug.

Compliance is checked by determining the force necessary to withdraw the test plug from the sample, this being mounted so that the axes of the contact tubes are vertical with the contact opening downwards, as shown in Figure 115.

A test plug provided with pins having the dimensions shown in Table 111 is inserted into the sample.

Table 111

Nominal pin diameter mm	Diameter of pins of the test plug mm $\begin{smallmatrix} +0,01 \\ 0 \end{smallmatrix}$
5	5,00
6	6,00
7	7,00
8	8,00
10	10,00
12	12,00

The principal weight, together with the supplementary weight (the latter being such that it exerts a force equal to one-tenth of the force exerted by the principal weight) and the test plug, exert a force equal to the maximum withdrawal force shown in Table 112.

The principal weight is hung without jolting on the test plug, and the supplementary weight is allowed to fall from a height of 5 cm onto the principal weight.

The plug shall not remain in the sample.

Table 112

Rated current A		Maximum withdrawal force
Series I	Series II	N
16	20	150
32	30	150
63	60	275
125	100	400

NOTE Details of the test plugs are under consideration.

15.7 Modification:

Instead of the third paragraph of the requirements, the following applies:

Socket-outlets, splash-proof or up to and including IP44, designed for only one mounting position, shall have provision for opening a drain hole at least 5 mm in diameter, or 20 mm² in area with a width of at least 3 mm, which is effective when the socket-outlet is in the mounting position.

16 Construction of plugs and connectors

This clause of part 1 is applicable except as follows:

16.1 Replacement of the third paragraph by the following:

Accessories shall be so designed that they can only be reassembled so as to ensure the correct angular relationship between key(s), keyway(s), the earthing pin and the earthing-contact tube, as originally assembled.

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

Tests to be carried out are those described in 15.1 and 15.2.

16.101 Additional subclause:

A2 Pins shall be solid, i.e. made of a single homogenous material without any intentional hole, slot, slit or the like.

This requirement is applicable for the pin parts described by:

- h2 and h3 of standard sheet 2-II;
- h2 of standard sheet 2-IV;
- h2 and h5 of standard sheet 2-IVa;
- dimension of the pin 20,5 (0, -1) of standard sheets 2-IX and 2-IXa.

Compliance is checked by inspection. **A2**

16.102 Additional subclause:

Plugs rated up to 32 A may incorporate a phase inverting means. These plugs shall comply with the general requirements for plugs and with Clause 21 for phase inverters. They shall be delivered with an instruction sheet with the following information:

Use class 5 or class 6 flexible conductors only and make sure that the conductors can move to permit operation of the phase inverting means.

An integral switching device shall not be used as a phase inverting means.

The phase inverting means shall be preconditioned when wired with class 5 cables according to Clause 23 by carrying out 1 000 position changing operations.

17 Construction of appliance inlets

This clause of part 1 is applicable except as follows:

Additional subclauses:

17.101 Pins shall be solid.

Compliance is checked by inspection.

17.102 Appliance inlets rated up to 32 A may incorporate a phase inverting means. These inlets shall comply with the general requirements for inlets and Clause 21 for phase inverters. They shall be delivered with an instructions sheet with the following information:

Use class 5 or class 6 flexible conductors only and make sure that the conductors can move to permit operation of the phase inverting means.

For appliance inlets, switches can be used as phase inverting means.

Switches shall comply with IEC 60947-3 in a utilisation category of at least AC 22A.

The phase inverting means shall be preconditioned when wired with class 5 cables according to Clause 23, by carrying out 1 000 position changing operations.

18 Degrees of protection

This clause of part 1 is applicable.

19 Insulation resistance and dielectric strength

This clause of part 1 is applicable except as follows:

19.1 *Add before the note:*

For phase inverters, the testing is carried out with the phase inverting means in each of the end positions.

19.4 *Replacement:*

Immediately after the test of 19.3 it shall not be possible to engage accessories with enclosures of thermoplastic material with gauges having an earthing-contact position or a minor key or keyway position different from that of the sample.

For socket-outlets and connector having rated operating voltages exceeding 50 V, the gauges shown in Figure 104 are used. For plugs and appliance inlets having rated operating voltages exceeding 50 V, the gauges shown in Figure 109 are used.

For 16/20 A and 32/30 A socket-outlets and connectors having rated operating voltages not exceeding 50 V, the gauges shown in Figure 111 are used. For plugs and appliance inlets having rated operating voltages not exceeding 50 V, the gauges shown in Figure 113 are used.

The gauges are applied with a force of 200 N applied for 1 min.

20 Breaking capacity

This clause of part 1 is applicable except as follows:

Addition:

Plugs and appliance inlets complying with this standard are not to be tested.