

Plugs, socket-outlets and couplers for industrial purposes —

Part 1: General requirements

ICS 29.120.30

National foreword

This British Standard is the UK implementation of EN 60309-1:1999+A2:2012, incorporating amendment A11:2004. It is identical to IEC 60309-1:1999, incorporating IEC amendments 1:2005, 2:2012 and corrigendum May 2014. It supersedes BS EN 60309-1:1999 which will be withdrawn on 13 July 2015.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 **A1** **A1**. 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 common modifications introduced by CENELEC amendment A1 are indicated by **C1** **C1**.

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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	31 July 2014	Implementation of IEC corrigendum May 2014: Series I column within the Current A group column in Table 3 updated

**Plugs, socket-outlets and couplers for industrial purposes
Part 1: General requirements**

Prises de courant pour usages industriels
Partie 1: Règles générales

Stecker, Steckdosen und Kupplungen
für industrielle Anwendungen
Teil 1: Allgemeine Anforderungen

This European Standard was approved by CENELEC on 1999-04-01. 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 amendment 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, Malta, 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

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The text of document 23H/88/FDIS, future edition 4 of IEC 60309-1, 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 60309-1 on 1999-04-01.

This European Standard supersedes EN 60309-1:1997.

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) 2000-01-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2002-04-01

Annexes designated "normative" are part of the body of the standard.
In this standard, annexes A and ZA are normative.
Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60309-1:1999 was approved by CENELEC as a European Standard without any modification.

Foreword to amendment A11

This amendment to the European Standard EN 60309-1:1999 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 60309-1:1999 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/174/FDIS, future amendment 1 to IEC60309-1:1999, prepared by SC23H, Industrial plugs and socket-outlets, of IECTC23, Electrical accessories, was submitted to the IEC-CENELEC parallel vote.

A draft amendment, containing common modifications to IEC 60309-1:1999 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 60309-1:1999 on 2006-11-01.

This amendment supersedes EN 60309-1:1999/A11:2004.

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

Annexes ZA and ZB have been added by CENELEC.

Endorsement notice

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

Foreword to amendment A2

The text of document 23H/282/FDIS, future edition 1 of IEC 60309-1:1999/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 60309-1:1999/A2:2012.

The following dates are fixed:

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- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2015-07-13

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.

Endorsement notice

The text of the International Standard IEC 60309-1:1999/A2:2012 was approved by CENELEC as a European Standard without any modification.

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INTRODUCTION

International Standard IEC 60309 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.

PLUGS, SOCKET-OUTLETS AND COUPLERS FOR INDUSTRIAL PURPOSES –

Part 1: General requirements

1 Scope

A2 This standard applies to plugs and socket-outlets, cable couplers and appliance couplers, with a rated operating voltage not exceeding 1 000 V d.c. or a.c. and 500 Hz a.c., and a rated current not exceeding 800 A, primarily intended for industrial use, either indoors or outdoors.

These accessories are intended to be installed by instructed persons (IEC 60050-195:1998, Amendment 1:2001, 195-04-02) or skilled persons (IEC 60050-195:1998, Amendment 1:2001, 195-04-01) only. **A2**

A1 The list of preferred ratings is not intended to exclude other ratings. **A1**

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 of –25 °C to +40 °C. These accessories are intended to be connected to cables of copper or copper alloy only.

A2 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. **A2**

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

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.

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.

C1 This European Standard applies to products intended to be used with cable with metric sizes (mm²) only.

Reference and requirements to AWG and MCM cables and voltages not used in Europe are present in the relevant IEC publication and they are reported in this standard for information only.

See Annex ZB for a list of references to AWG/MCM cables or non-European voltages which are excluded from this standard.

In this standard delete all reference to products of Series II. Values and corresponding requirements listed as Series II ratings are to be considered as “Other ratings”. **C1**

2 Definitions

Where the terms voltage and current are used, they imply the d.c. or the a.c. r.m.s. values.

For the purpose of this part of IEC 60309, the following definitions apply.

The application of accessories is shown in Figure 1.

2.1

plug and socket-outlet

a means enabling the connection at will of a flexible cable to fixed wiring. It consists of two parts:

2.1.1

socket-outlet

the part intended to be installed with the fixed wiring or incorporated in equipment.

A socket-outlet may also be incorporated in the output circuit of an isolating transformer

2.1.2

plug

the part integral with or intended to be attached directly to one flexible cable connected to the equipment or to a connector

2.2

cable coupler

a means enabling the connection at will of two flexible cables. It consists of two parts:

2.2.1

connector

the part integral with or intended to be attached to one flexible cable connected to the supply

NOTE In general, a connector has the same contact arrangement as a socket-outlet.

2.2.2

plug

the part integral with or intended to be attached to one flexible cable connected to the equipment or to a connector

NOTE The plug of a cable coupler is identical to the plug of a "plug and socket-outlet".

2.3

appliance coupler

a means enabling the connection at will of a flexible cable to the equipment. It consists of two parts:

2.3.1

connector

the part integral with, or intended to be attached to, one flexible cable connected to the supply

NOTE In general, the connector of an appliance coupler is identical to the connector of a cable coupler.

2.3.2

appliance inlet

the part incorporated in, or fixed to, the equipment or intended to be fixed to it

NOTE In general, an appliance inlet has the same contact arrangement as a plug.

2.4

rewirable plug or connector

an accessory so constructed that the flexible cable can be replaced

2.5

non-rewirable plug or connector

an accessory so constructed that the flexible cable cannot be separated from the accessory without making it permanently useless

2.6

mechanical switching device

a switching device designed to close and open one or more electric circuits by means of separable contacts

2.7

switched socket-outlet

a socket-outlet with an associated switching device to disconnect the supply from the socket-outlet contacts

2.8

integral switching device

a mechanical switching device constructed as a part of an accessory covered by this standard

2.9

interlock

a device, either electrical or mechanical, which prevents the contacts of a plug from becoming live before it is in proper engagement with a socket-outlet or connector, and which either prevents the plug from being withdrawn while its contacts are live or makes the contacts dead before separation

2.10

retaining device

a mechanical arrangement which holds a plug or connector in position when it is in proper engagement, and prevents its unintentional withdrawal

2.11

rated current

the current assigned to the accessory by the manufacturer

2.12

insulation voltage

the voltage assigned to the accessory by the manufacturer and to which dielectric tests, clearances and creepage distances are referred

2.13

rated operating voltage

the nominal voltage of the supply for which the accessory is intended to be used

2.14

basic insulation

the insulation necessary for the proper functioning of the accessory and for basic protection against electric shock

2.15

supplementary insulation (protective insulation)

an independent insulation provided in addition to the basic insulation, in order to ensure protection against electric shock in the event of a failure of the basic insulation

2.16

double insulation

insulation comprising both basic insulation and supplementary insulation

2.17

reinforced insulation

an improved basic insulation with such mechanical and electrical qualities that it provides the same degree of protection against electric shock as double insulation

2.18

terminal

a conductive part provided for the connection of a conductor to an accessory

2.18.1

pillar terminal

a terminal in which the conductor is inserted into a hole or cavity, where it is clamped under the shank of the screw or screws. The clamping pressure may be applied directly by the shank of the screw or through an intermediate clamping member to which pressure is applied by the shank of the screw (see Figure 14a)

2.18.2

screw terminal

a terminal in which the conductor is clamped under the head of the screw. The clamping pressure may be applied directly by the head of the screw or through an intermediate part, such as a washer, clamping plate or anti-spread device (see Figures 14b and 14c)

2.18.3

stud terminal

a terminal in which the conductor is clamped under a nut. The clamping pressure may be applied directly by a suitably shaped nut or through an intermediate part, such as a washer, clamping plate or anti-spread device (see Figure 14d)

2.18.4

saddle terminal

a terminal in which the conductor is clamped under a saddle by means of two or more screws or nuts (see Figure 14e)

2.18.5

lug terminal

a screw terminal or a stud terminal, designed for clamping a cable lug or bar by means of a screw or nut (see Figure 14f)

2.18.6

mantle terminal

a terminal in which the conductor is clamped against the base of a slot in a threaded stud by means of a nut. The conductor is clamped against the base of the slot by a suitably shaped washer under the nut, by a central peg if the nut is a cap nut, or by equally effective means for transmitting the pressure from the nut to the conductor within the slot (see Figure 14g)

2.18.7

screwless type terminal

a terminal for the connection and subsequent disconnection of one or more conductors, the connection being made, directly or indirectly, by other means than screws

NOTE Examples of screwless type terminals are given in Figure 14h. 

A₁ 2.18.8

**insulation piercing terminal
IPT**

a terminal for the connection and subsequent disconnection of one or more conductors, the connection being made by piercing, boring through, cutting through, removing, displacing or making ineffective in some other manner the insulation of the conductor(s) without previous stripping

NOTE 1 The removal of the sheath of the cable, if necessary, is not considered as a previous stripping.

NOTE 2 Examples of IPT are given in Figure 14i. **A₁**

2.19

clamping unit

the part of a terminal necessary for the clamping and the electrical connection of the conductor

2.20

conditional short-circuit current

the prospective current that an accessory, protected by a specified short-circuit protective device, can satisfactorily withstand for the total operating time of that device under specified conditions of use and behaviour

NOTE This definition differs from IEC 441-17-20 by broadening the concept of current-limiting device into a short-circuit protective device, the function of which is not only to limit the current.

2.21

cap

a part separated or attached, which may be used to provide the degree of protection of a plug or appliance inlet when it is not engaged with a socket-outlet or connector

2.22

lid

a means to ensure the degree of protection on a socket-outlet or a connector

3 Normative references

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

IEC 60050-441:1984, *International Electrotechnical Vocabulary (IEV) – Chapter 441: Switchgear, controlgear and fuses*

IEC 60083:1997, *Plugs and socket-outlets for domestic and similar general use standardized in member countries of IEC*

IEC 60112:1979, *Method for determining the comparative and the proof tracking indices of solid insulating materials under moist conditions*

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

IEC 60228:1978, *Conductors of insulated cables*

IEC 60245-4:1994, *Rubber insulated cables – Rated voltages up to and including 450/750 V – Part 4: Cords and flexible cables*

IEC 60269-1:1986, *Low-voltage fuses – Part 1: General requirements*

IEC 60269-2:1986, *Low-voltage fuses – Part 2: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) – Sections I to III*

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

IEC 60529:1989, *Degrees of protection provided by enclosures (IP code)*

IEC 60664-1:1992, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

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

IEC 60947-3:1990, *Low-voltage switchgear and controlgear – Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units*

Ⓐ₁ ISO 2081, *Metallic coatings – Electroplated coatings of zinc on iron or steel*

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

ISO 1456, *Metallic coatings – Electrodeposited coatings of nickel plus chromium and of copper plus nickel plus chromium* Ⓐ₁

Ⓐ₂ IEC 60309-4, *Plugs, socket-outlets and couplers for industrial purposes – Part 4: Switched socket-outlets and connectors with or without interlock*

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

4 General

4.1 General requirements

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

Unless otherwise stated, the normal use environment in which the devices complying with this standard are normally used is pollution degree 3 according to IEC 60664-1.

If other pollution degrees are needed, creepage and clearance distances have to be in accordance with IEC 60664-1. The comparative tracking index (CTI) value shall be evaluated in accordance with IEC 60112.

Ⓐ₂ Accessories shall have a minimum degree of protection IP23 according to IEC 60529. Ⓐ₂

Ⓐ₁ Combinations of plugs, socket-outlets, appliance inlets and connectors that are intended for use together shall comply with the requirements of this standard and the relevant standard sheet, if any. Ⓐ₁

In general, compliance is checked by carrying out all the tests specified.

4.2 General notes on tests

4.2.1 Tests according to this standard are type tests. If a part of an accessory has previously passed tests for a given degree of severity, the relevant type tests shall not be repeated if the severity is not greater. Ⓐ₁ When a part or a component is incorporated in a device or accessory according to IEC 60309 standard, and if this part or component meets an appropriate IEC standard, then no further test(s) or requirement(s) shall be required for this part or component, unless it is being used in a way significantly different from the intent of its own standard. Ⓐ₁

4.2.2 Unless otherwise specified, the samples are tested as delivered and under normal conditions of use, at an ambient temperature of $(20 \pm 5) ^\circ\text{C}$; the tests are made at rated frequency.

4.2.3 Unless otherwise specified, the tests are carried out in the order of the clauses of this standard.

A1 **4.2.4** Three samples are subjected to all the tests, except if necessary for the tests of 11.1.4 and Clause 29 where, for each clause, one new set of samples is tested. If, however, the tests of Clauses 20, 21 and 22 have to be made with both d.c. and a.c., the tests with a.c. are made on three additional samples. **A1**

4.2.5 Accessories are deemed to comply with this standard if no sample fails in the complete series of appropriate tests. If one sample fails in a test, that test and those preceding which may have influenced the test result are repeated on another set of three samples, all of which shall then pass the repeated tests.

NOTE In general, it will only be necessary to repeat the test which caused the failure, unless the sample fails in one of the tests of clauses 21 and 22, in which case the tests are repeated from that of clause 20 onwards.

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

4.2.6 When the tests are carried out with conductors, they shall be copper and comply with IEC 60227, IEC 60228 [clause 2, solid (class 1), stranded (class 2), flexible (class 5)] and IEC 60245-4, as accessories according to this standard are intended to be connected to cables with copper or copper-alloy conductors only.

5 Standard ratings

5.1 Preferred rated operating voltage ranges and voltages are:

20 V to 25 V	380 V to 415 V
40 V to 50 V	440 V to 460 V
100 V to 130 V	480 V to 500 V
200 V to 250 V	600 V to 690 V
277 V	A2 750 V
	1 000 V A2

5.2 Preferred rated currents are given in the following table:

Table 1

Series I A	Series II A
16	20
32	30
63	60
125	100
250	200
A2 315	300
400	350
630	500
800	600 A2

A1 NOTE 1 Ratings referred as "Other ratings" in this standard are given for test purpose only, when the manufacturer has not used the preferred ratings. **A1**

A2 NOTE 2 This table does not provide correspondence between series I and series II values. It is only a list of preferred ratings. **A2**

6 Classification

6.1 Accessories are classified:

6.1.1 according to purpose: plugs, socket-outlets, connectors, appliance inlets;

  6.1.2 according to degrees of protection in accordance with IEC 60529 (with a minimum IP23, see 4.1) 

NOTE According to IEC 60529, an accessory designated with second characteristic numeral 7 or 8 is only suitable for immersion. For protection against exposure to water jets, additional testing is required according to second characteristic numeral 5 or 6 and then the product should be marked accordingly. 

6.1.3 according to earthing facilities:

- accessories without earthing contact;
- accessories with earthing contact;

6.1.4 according to the method of connecting the cable:

- rewirable plugs and connectors;
- non-rewirable plugs and connectors;

6.1.5 according to interlocking facilities:

- accessories without interlock, with or without integral switching device;
- accessories with mechanical interlock;
- accessories with electrical interlock.

 6.1.6 according to the type of terminals

- with screw type terminals;
- with screwless type terminals;
- with insulation piercing terminals.

6.1.7 according to the type of conductors for screwless type and insulation piercing terminals

- for solid conductors only;
- for rigid (both solid and stranded) conductors only;
- for flexible conductors only;
- for rigid (both solid and stranded) and flexible conductors. 

 6.1.8 according to accessibility to live parts:

- accessories providing for IPXXB
- accessories providing for IP2X
- accessories providing for IPXXD
- accessories providing for IP4X 

7 Marking

7.1 Accessories shall be marked with:

- rated current(s) in amperes;
- rated operating voltage(s) or range(s) in volts;
- symbol for nature of supply, if the accessory is not intended for both a.c. and d.c., or is intended for a.c. with frequencies other than 50 Hz or 60 Hz, or if the rating is different for A_2 alternating A_1 current and direct current;
- rated frequency if exceeding 60 Hz;
- either the name or trade mark of the manufacturer or of the responsible vendor;
- type reference, which may be a catalogue number;
- A_2 degree of protection A_2 ;
- symbol indicating the position of the earthing contact or the means used for interchangeability, if any.

NOTE Optionally, the insulation voltage may be marked.

Compliance is checked by inspection.

7.2 When symbols are used, they shall be as follows:

A		amperes
V		volts
Hz		hertz
~		alternating current
==		direct current
	(preferred) or $\perp$	earth

A_1 Text deleted A_1

IPXX (relevant figures) degree of protection according to IEC 60529

A_1 For IP codes, the two characteristic numerals (XX) shall be specified. A_1

A_2 Marking of degree(s) of protection on plugs and appliance inlets is only valid when those are in engagement with a complementary accessory or with an attached cap, if any. A_2

For the marking of rated current(s) and rated operating voltage(s) or range(s), figures may be used alone.

The figure for d.c. rated operating voltage, if any, shall then be placed before the figure for the a.c. rated operating voltage, and separated from it by a line or a dash.

Compliance is checked by inspection.

7.3 For socket-outlets and appliance inlets, the marking for rated current, nature of supply, if necessary, and either the name or trade mark of the manufacturer or the responsible vendor shall be on the main part, on the outside of the enclosure, or on the lid, if any, if the latter cannot be removed without the aid of a tool.

Except for flush-type socket-outlets and appliance inlets, these markings shall be easily discernible when the accessory is mounted and wired as in normal use, if necessary after it has been removed from the enclosure. The marking, if any, for the insulation voltage shall be on the main part; it shall not be visible when the accessory is mounted and wired as in normal use.

The marking for rated operating voltage, type reference, A_2 the degree of protection A_2 and the symbol indicating the position of the earthing contact or the means used for interchangeability, if any, shall be on a place which is visible after installation of the accessory, on the outside of enclosure or on the lid, if any, if the latter cannot be removed without the aid of a tool.

With the exception of the type reference, these markings shall be easily discernible when the accessory is mounted and wired as in normal use.

Compliance is checked by inspection.

NOTE The term "main part" of a socket-outlet or an appliance inlet means the part carrying the contacts.

The type reference may be marked on the main part.

The marking for rated current, nature of supply, rated operating voltage and the name or trade mark of the manufacturer or the responsible vendor, may be repeated on the lid, if any.

7.4 For plugs and connectors, the marking specified in 7.1, with the exception of the marking for insulation voltage, if any, shall be easily discernible when the accessory is wired ready for use.

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

NOTE The term "ready for use" does not imply that the plug or connector is in engagement with its complementary accessory.

NOTE The term "main part" of a plug or a connector means the part carrying the contacts.

Compliance is checked by inspection.

7.5 For rewirable accessories, the contacts shall be indicated by the symbols:

- for three-phase, the symbols L1, L2, L3, or 1, 2, 3 for the phases, N for neutral, if any, and the symbol ⏏ or ⏏ for earth;
- for two-pole, which may be used for both a.c. and d.c., one symbol for one of the live poles and the symbol ⏏ or ⏏ for earth, if any;
- for a period of time the marking R1, S2, T3 may be used instead of L1, L2, L3.

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

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 $\textcircled{\perp}$, should be used.

Compliance is checked by inspection.

7.6 Marking shall be indelible and easily legible.

Compliance is checked by inspection and by the following test:

A₂ After the humidity treatment of Clause 18, the marking is rubbed by hand for 15 s with a piece of cloth soaked in water and again for 15 s with a piece of cloth soaked in petroleum spirit.

*It is recommended that the petroleum spirit used consist of a solvent hexane with an aromatic content of maximum 0,1 volume percentage, a Kauri-Butanol value of approximately 29, an initial boiling point of approximately 65 °C, a dry point of approximately 69 °C and a density of approximately 0,68 g/ cm³. **A₂***

Special attention is paid to the marking of the name or trade mark of the manufacturer or the responsible vendor and to that of the nature of supply, if any.

NOTE A special test for checking the indelibility of these markings is under consideration.

7.7 If, in addition to the marking prescribed, the rated operating voltage is indicated by means of a colour, the colour code shall be as shown in Table 2. An indicating colour, if different from that of the enclosure, shall be used only if it can be easily distinguished.

Table 2

Rated operating voltage V	Colour ^{1) 2)}
20 to 25 40 to 50 100 to 130 200 to 250 380 to 480 500 to A₂ 1000 A₂	Violet White Yellow Blue Red Black
1) For frequencies over 60 Hz up to and including 500 Hz, the colour green may be used, if necessary, in combination with the colour for the rated operating voltage. 2) In countries where accessories of series II current ratings are used, the colour orange is reserved for 125/250 V a.c. and the colour grey is reserved for 277 V a.c. accessories.	

A₁ **7.8** Accessories with screwless type terminals shall be marked with the length of insulation to be removed before insertion of the conductor into the terminal.

7.9 Terminals according to 6.1.7 shall be marked as follows:

- terminals declared for solid conductors only with the letter(s) “s” or “sol”;
- terminals declared for rigid conductors only (both solid and stranded) with the letter “r”
- terminals declared for flexible conductors only with the letter “f”; **A₁**

Ⓐ₁ – terminals declared for rigid (both solid and stranded) and flexible conductors need not be marked. Ⓐ₁

Ⓐ₂ This marking shall appear on the accessory. It may also appear on the accompanying instruction sheet, the smallest package unit or the manufacturer's documentation, if any. Ⓐ₂

7.10 Ⓐ₂ For terminals, the connection and disconnection procedures shall, if necessary, be indicated on the product, on the smallest package unit or on the manufacturer's documentation. Ⓐ₂

8 Dimensions

Ⓐ₁ **8.1** Accessories shall comply with the appropriate standard sheets, if any. When standard sheets do not exist, accessories shall comply with manufacturer's specifications.

8.2 It shall not be possible to engage plugs or connectors with socket-outlets or appliance inlets having different ratings, or having contact combinations allowing improper connection.

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

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

Connection of single-phase or three-phase plugs into three-phase + neutral socket-outlets are permitted where the above conditions are met.

Compliance is checked by inspection. Ⓐ₁

8.3 It shall not be possible to make single-pole connections between plugs and socket-outlets or connectors, or between appliance inlets and connectors or socket-outlets.

Plugs and appliance inlets shall not allow improper connections with socket-outlets complying with IEC 60083 or with connectors complying with IEC 60320.

Socket-outlets and connectors shall not allow improper connections with plugs complying with IEC 60083 or with appliance inlets complying with IEC 60320.

Improper connections include single-pole connections and other connections which do not comply with the requirements for protection against electric shock.

Compliance is checked by inspection.

9 Protection against electric shock

9.1 Accessories shall be so designed that live parts of socket-outlets and connectors, when they are wired as in normal use, and live parts of plugs and appliance inlets, when they are in partial or complete engagement with the complementary accessories, are not accessible.

In addition, it shall not be possible to make contact between a contact of a plug or appliance inlet and a contact of a socket-outlet or connector while any contact is accessible.

Compliance is checked by inspection and, if necessary, by a test on the sample wired as in normal use.

The standard test finger shown in Figure 2 is applied in every possible position, an electrical indicator, with a voltage not less than 40 V, being used to show contact with the relevant part.

NOTE The neutral contact and pilot contacts of socket-outlets and connectors are deemed to be live parts.

9.2 Accessories with earthing contact shall be so designed that:

- when inserting the plug or connector, the earth connection is made before the phase connections and neutral, if any, are made;
- when withdrawing the plug or connector, the phase connections and neutral, if any, are broken before the earth connection is broken.

9.3 It shall not be possible to inadvertently assemble the part carrying plug contacts into the enclosure of a socket-outlet or connector.

Compliance is checked by manual test.

10 Provision for earthing

10.1 Accessories with earthing contact shall be provided with an earthing terminal. Metal-clad fixed accessories with an internal earthing terminal can, in addition, be provided with an external earthing terminal, which, except for flush type socket-outlets, shall be visible from the outside.

Earthing contacts shall be directly and reliably connected to the earthing terminals, except that the earthing terminal of socket-outlets incorporated in the output circuit of an isolating transformer shall not be connected.

Compliance is checked by inspection.

10.2 Accessible metal parts of accessories with earthing contact, which may become live in the event of an insulation fault, shall be reliably connected to the internal earthing terminal(s) by construction.

NOTE For the purpose of this requirement, screws for fixing bases, covers and the like are not deemed to be accessible parts which may become live in the event of an insulation fault.

If accessible metal parts are screened from live parts by metal parts which are connected to an earthing terminal or earthing contact, or if they are separated from live parts by double insulation or reinforced insulation, they are not, for the purpose of this requirement, regarded as likely to become live in the event of an insulation fault.

Compliance is checked by inspection and by the following test:

A current of 25 A derived from an a.c. source having a no-load voltage not exceeding 12 V 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 .

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

10.3 Earthing contacts shall be capable of carrying a current equal to that specified for the phase contacts without overheating.

Compliance is checked by the test of clause 22.

10.4 Earthing contacts shall be so shrouded or guarded that they are protected against mechanical damage.

Compliance is checked by inspection.

NOTE This requirement precludes the use of side earthing contacts.

Table 3 – Size for connectable conductors

Rating of the accessory				Internal connection ^{1) 5)}				External earthing connection if any	
Voltage V	Current A			Flexible cables for plugs and connectors		Solid or stranded cables for socket-outlets ^{2) 6)}			
				Solid or stranded cables for appliance inlets ²⁾					
	Series I	Series II	Other ratings	Series I mm ²	Series II AWG/MCM ³⁾	Series I mm ²	Series II AWG/MCM ³⁾	Series I mm ²	Series II AWG/MCM ³⁾
Not exceeding 50	16 32	20 30		4 to 10 4 to 10	12 to 8 12 to 8	4 to 10 4 to 10	12 to 8 12 to 8		
Exceeding 50	16	20	6	0,75 to 1	18 to -	0,75 to 1,5	18 to 16	2,5	14
			10	1 to 1,5	- to 16	1 to 1,5	- to 16	2,5	14
				1 to 2,5	16 to 12	1,5 to 4	16 to 12	6	10
			25	1,5 to 4	16 to 12	2,5 to 6	14 to 10	6	10
				2,5 to 6	14 to 10	2,5 to 10	14 to 8	10	8
	63	60	40	4 to 10	12 to 8	4 to 16	12 to 6	10	8
			50	4 to 10	12 to 8	4 to 16	12 to 6	16	6
				6 to 16	10 to 6	6 to 25	10 to 4	25	4
			80	10 to 25	8 to 4	16 to 35	6 to 2	25	4
			90	10 to 25	8 to 4	16 to 35	6 to 2	25	4
Exceeding 50	125	100		16 to 50	6 to 0	25 to 70	4 to 00	25	4
			150	25 to 70	4 to 00	35 to 95	2 to000	25	4
			160	25 to 70	4 to 00	35 to 95	2 to000	25	4
				70 to 150	00 to 0000	70 to 185 ⁴⁾	00 to 250	25	4
				95 to 150	000 to 300	120 to 185	250 to 350	25	4
	400	500		120 to 185	250 to 350	150 to 240	300 to 500	35	3
				150 to 240	300 to 500	185 to 300	350 to 600	35	3
				185 to 300	350 to 600	240 to 400	500 to 800	35	2
				240 to 400	500 to 800	300 to 500	600 to 1 000	50	1
				300 to 500	600 to 1 000	400 to 630	800 to 1 250	50	0

¹⁾ Terminal for pilot conductors, if any, shall allow the connection of conductors having a cross-sectional area of 1 mm².

²⁾ Classification of conductors: according to IEC 60228.

³⁾ 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 Mils denotes circle surface area. 1 MCM = 0,5067 mm².

⁴⁾ 150 mm² for 200 A accessories of series II.

⁵⁾ For ratings other than those above, the cross-sectional area(s) of the conductors may be that specified by the manufacturer.

⁶⁾ For socket-outlets declared for flexible conductors only, these values apply.

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A1 11 Terminals and terminations

11.1 Common requirements for terminals and terminations

11.1.1 Rewirable accessories shall be provided with terminals.

Rewirable plugs and connectors shall be provided with terminals that accept flexible conductors.

A2 *Compliance is checked by inspection.* **A2**

11.1.2 Non-rewirable accessories shall be provided with soldered, welded, crimped or equally effective permanent connections (terminations).

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.

11.1.3 Terminals shall allow the conductor to be connected without special preparation.

NOTE 1 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.

NOTE 2 This requirement is not applicable to lug terminals

Compliance is checked by inspection.

11.1.4 Parts of terminals shall be of a metal having, under conditions occurring in the equipment, mechanical strength, electrical conductivity and resistance to corrosion adequate to intended use.

Examples of suitable metals, when used within a permissible temperature range and under normal conditions of chemical pollution, are:

- copper;
- an alloy containing at least 58 % copper for parts that are worked cold or at least 50 % copper for other parts;
- stainless steel containing at least 13 % chromium and not more than 0,09 % carbon;
- steel provided with an electroplated coating of zinc according to ISO 2081, the coating having a thickness of at least:
 - 8 µm (ISO service condition 2) for $IP \leq X4$ accessories;
 - 12 µm (ISO service condition 3) $IP \geq X5$ accessories;
- steel provided with an electroplated coating of nickel and chromium according to ISO 1456, the coating having a thickness of at least:
 - 20 µm (ISO service condition 2) for $IP \leq X4$ accessories;
 - 30 µm (ISO service condition 3) for $IP \geq X5$ accessories;
- steel provided with an electroplated coating of tin according to ISO 2093, the coating having a thickness equal to at least that specified for:
 - 20 µm (ISO service condition 2) for $IP \leq X4$ accessories;
 - 30 µm (ISO service condition 3) for $IP \geq X5$ accessories. **A1**

A1 Current-carrying parts, which may be subjected to mechanical wear, shall not be made of steel provided with an electroplated coating.

Compliance is checked by inspection and by chemical analysis.

11.1.5 If the body of an earthing terminal is not part of the metal frame or housing of the accessory, the body shall be of material as prescribed in 11.1.4 for parts of terminals. If the body is part of the metal frame or housing, the clamping means shall be of such material.

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

NOTE The requirement regarding the avoidance of the risk of corrosion does not preclude the use of adequately coated metal screws or nuts.

Compliance is checked by inspection and by chemical analysis.

11.1.6 Terminals shall be properly fixed to the accessory and shall not loosen when connecting and disconnecting the conductors.

Clamping means shall not serve to fix any other component.

NOTE The clamping means for the conductor may be used to stop rotation or displacement of the plug or socket contacts.

Compliance is checked by inspection and, if necessary, by test of 25.1.

NOTE These requirements do not preclude terminals that are floating or terminals so designed that rotation or displacement of the terminal is prevented by the clamping screw or nut, provided that their movement is appropriately limited and does not impair the correct operation of the accessory.

Terminals may be prevented from working loose by fixing with two screws, by fixing with one screw in a recess such that there is no appreciable play, or by other suitable means.

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

11.1.7 Each terminal shall be located in proximity to the other terminals, as well as to the internal earthing terminal, if any, unless there is a sound technical reason to the contrary.

Compliance is checked by inspection.

11.1.8 Terminals shall be so located or shielded that:

- screws or other parts becoming loose from the terminals, cannot establish any electrical connection between live parts and metal parts connected to the earthing terminal;
- conductors becoming detached from live terminals cannot touch metal parts connected to the earthing terminal;
- conductors becoming detached from the earthing terminal cannot touch live parts.

This requirement applies also to terminals for pilot conductors.

*Compliance is checked by inspection and by manual test. **A1***

A1 11.1.9 When the conductors have been correctly fitted, there shall be no risk of accidental contact between live parts of different polarity or between such parts and accessible metal parts, and, should a wire of a stranded conductor escape from a terminal, there shall be no risk that such a wire emerges from the enclosure.

The requirement with regard to the risk of accidental contact between live parts and accessible metal parts does not apply to accessories having rated voltages not exceeding 50 V.

Compliance is checked by inspection and, where the risk of accidental contact between live parts and other metal parts is concerned, by the following test:

An 8 mm length of insulation is removed from the end of a flexible conductor having a cross-sectional area in the middle of the range specified in Table 3. One wire of the stranded conductor is left free and the other wires are fully inserted and clamped into the terminal. The free wire is bent back, without tearing the insulation, in every possible direction, but without making sharp bends around barriers.

The free wire of a conductor connected to a live terminal shall neither touch any metal part which is not a live part nor emerge from the enclosure. The free wire of a conductor connected to the earthing terminal shall not touch any live part.

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

11.2 Screw type terminals

11.2.1 Screw type terminals shall allow the proper connection of copper or copper-alloy conductors having nominal cross-sectional areas as shown in Table 3.

For terminals other than lug terminals, compliance is checked by the following test and by tests of 11.5.

Gauges as specified in Figure 13, having a measuring section for testing the insertability of the maximum specified cross-sectional area of Table 3, shall be able to penetrate into the terminal aperture, down to the designated depth of the terminal, under their own weight.

Screw type terminals that cannot be checked with the gauges specified in Figure 13, shall be tested by suitably shaped gauges, having the same cross-section as those of the appropriate gauges given in Figure 13.

For pillar terminals in which the end of a conductor is not visible, the hole to accommodate the conductor shall have a depth such that the distance between the bottom of the hole and the last screw will be equal to at least half the diameter of the screw, and in any case not less than 1,5 mm.

Compliance is checked by inspection.

For terminals complying with Figure 14f, the lug shall accept conductors having nominal cross-sectional areas within the appropriate range specified in Table 3.

Compliance is checked by inspection. A1

11.2.2 Screw type terminals shall have appropriate mechanical strength.

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

NOTE Provisionally, SI, BA and UN threads are considered as being comparable in pitch and mechanical strength.

Compliance is checked by inspection, measurement and the test of 25.1. In addition to the requirements of 25.1, the terminals shall not have undergone changes after the test, that would adversely affect their future use.

11.2.3 Screw type terminals shall be so designed that they clamp the conductor between metal surfaces with sufficient contact pressure and without damaging the conductor.

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

11.2.4 Lug terminals shall be used only for accessories having a rated current of at least 60 A; if such terminals are provided, they shall be fitted with spring washers or equally effective locking means.

Compliance is checked by inspection.

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

Compliance is checked by inspection, by manual test and by the relevant test of Clause 11.

11.3 Screwless type terminals

11.3.1 Screwless type terminals shall allow the proper connection of copper or copper-alloy conductors having nominal cross-sectional areas as shown in Table 3.

Gauges as specified in Figure 13, having a measuring section for testing the insertability of the maximum specified cross-sectional area of Table 3, shall be able to penetrate into the terminal aperture to the designated depth of the terminal.

Screwless type terminals that cannot be checked with the gauges specified in Figure 13, shall be tested by suitably shaped gauges, having the same cross-section as those of the appropriate gauges given in Figure 13.

Compliance is checked by inspection.

11.3.2 Screwless type terminals shall be so designed that they clamp the conductor(s) between metal surfaces, with sufficient contact pressure and without damaging the conductor(s).

Compliance is checked by inspection and the type tests of 11.5 and 11.6. 

11.3.3 Screwless type terminals shall have appropriate mechanical strength.

Compliance is checked by the following test:

Five insertions and disconnections are made with each type of conductor for which the terminal is intended to be used, with conductors having the largest diameter according to Table 3 and Table 10.

The insertion and disconnection of the conductors shall be made in accordance with manufacturer's instructions.

New conductors are used each time, except for the fifth time, when the conductor used for the fourth insertion is clamped at the same place. For each insertion, the conductors are either pushed as far as possible into the clamping unit or are inserted so that adequate connection is obvious. After each insertion the conductor is twisted through 90° and subsequently disconnected.

After these tests, the terminals shall not be damaged in such a way as to impair their further use with the smallest and the largest conductors.

11.3.4 The connection or disconnection of conductors shall be made:

- either by the use of a general purpose tool or a convenient integrated device in the terminal, to open it and to assist the insertion or the withdrawal of the conductor(s);
- or by simple insertion.

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

Compliance is checked by inspection.

11.3.5 Opening for a tool intended to assist the insertion or disconnection of the conductors, if needed, shall be clearly distinguishable from the opening intended for the conductor.

Compliance is checked by inspection.

11.3.6 Terminals shall be so designed and constructed that:

- each conductor is clamped individually in a separate independent clamping unit (not necessarily in separate holes);
- during the connection or disconnection, the conductors can be connected or disconnected either at the same time or separately.

It shall be possible to clamp securely any number of conductors up to the maximum provided for.

Compliance is checked by inspection and by tests of 11.5.

11.3.7 Terminals shall be so designed and constructed that inadequate insertion of the conductor is avoided.

Compliance is checked by inspection. 

11.3.8 Screwless terminals shall be so designed that the connected conductor remains clamped, even if it has been bent during normal installation.

NOTE This test is intended to simulate the bending forces on the conductor being transferred to the terminal during installation.

Compliance is checked by the following test:

For the bending test, three new specimens shall be used.

The test apparatus, the principle of which is shown in Figure 19, shall be constructed so that:

- *the test conductor, properly inserted into a clamping unit of the connecting devices, shall be allowed to be bent (deflected) in any of the 12 directions differing from each other by $30^\circ \pm 5^\circ$;*
- *the starting point can be varied by 10° and 20° from the original point.*

NOTE A reference direction and starting point is not specified.

The bending of the conductor from its straight position to the testing positions shall be effected by means of a suitable device applying a force as specified in Table 4-1 to the conductor, at a certain distance from the clamping unit of the connecting device.

The bending apparatus shall be so designed that:

- *the force is applied in the direction perpendicular to the conductor;*
- *the bending is attained without rotation of the conductor within the clamping unit;*
- *the force remains applied while the prescribed voltage drop measurement is made.*

The force for bending the conductor is specified in Table 4-1. The distance “D” shall be measured from the extremity of the connecting device, including the guidance for the conductor, if any, to the point of application of the force to the conductor.

Table 4-1 – Deflection test forces

Cross-section of the test conductor		Deflection test force ¹⁾	Distance <i>D</i>
mm ²	AWG	N	mm
1,0	--	0,25 ²⁾	100
1,5	16	0,5 ²⁾	100
2,5	14	1,0 ²⁾	100
4	12	2,0 ²⁾	100
6	10	3,5 ³⁾	100
10	8	7,0 ³⁾	100

¹⁾ The forces are chosen so that they stress the conductors close to the limit of elasticity.

²⁾ These values are based on IEC 60998-2-2.

³⁾ These values are based on IEC 60352-7.

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A1 Provisions shall be made so that the voltage drop across the clamping units under test can be measured when the conductor is connected, as shown for example in Figure 19 b).

The specimen is mounted on the fixed part of the test apparatus in such a way that the test conductor can be freely bent.

The surface of the test conductor shall be free of detrimental contamination or corrosion.

A clamping terminal is fitted, as for normal use, with a rigid solid copper conductor having the smallest cross-sectional area specified in Table 3 and is submitted to a first test sequence; the same clamping terminal is submitted to a second test sequence using the conductor having the largest cross-sectional area, unless the first test sequence has failed.

The test shall be made with the current flowing (i.e. the current is not switched on and off during the test). A suitable power supply shall be used so that the current variations are kept with $\pm 5\%$.

A tenth of the test current assigned to the connected conductor, according to Table 4-4, shall flow through the connecting devices. A bending force shall be applied as shown in Figure 19 a), in one of the 12 directions and the voltage drop across this clamping unit shall be measured.

The force shall then be applied successively on each one of the remaining 11 directions shown in Figure 19 a) following the same test procedure.

If at any of the 12 test directions the voltage drop is greater than 2,5 mV, the force shall be maintained in this direction until the voltage drop is reduced to a value below 2,5 mV, but for not more than 1 min. After the voltage drop has reached a value below 2,5 mV, the force shall be 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 specimens of the test set shall be tested according to 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 shall be repeated on another set of specimens, all of which shall comply with the repeated tests.

11.4 Insulation piercing terminals (IPT)

11.4.1 Insulation piercing terminals shall allow the proper connection of copper or copper-alloy conductors having nominal cross-sectional areas as shown in Table 3.

Compliance is checked by inspection and by introducing the largest insulated conductor according to Table 3 and Table 10.

11.4.2 Insulation piercing terminals shall be so designed that they clamp the conductor between metal surfaces with sufficient contact pressure and without damaging the conductor.

Compliance is checked by inspection and tests of 11.5 and 11.6. **A1**