BS EN 61984:2009

BSI British Standards

Connectors — Safety requirements and tests

raising standards worldwide™

BSI British Standards

National foreword

This British Standard is the UK implementation of EN 61984:2009. It is identical to IEC 61984:2008. It supersedes BS EN 61984:2001 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee EPL/48, Electromechanical components and mechanical structures for electronic equipment.

A list of organizations represented on this committee 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.

ISBN 978 0 580 55007 2

ICS 31.220.10

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

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 July 2009

Amendments issued since publication

Amd. No.	Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 61984

June 2009

ICS 31.220.10

Supersedes EN 61984:2001

English version

Connectors - Safety requirements and tests
(IEC 61984:2008)

Connecteurs -
Exigences de sécurité et essais
(CEI 61984:2008)

Steckverbinder -
Sicherheitsanforderungen und Prüfungen
(IEC 61984:2008)

This European Standard was approved by CENELEC on 2009-06-01. 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, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

CENELEC

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

Central Secretariat: Avenue Marnix 17, B - 1000 Brussels

Ref. No. EN 61984:2009 E

Foreword

The text of document 48B/1927/FDIS, future edition 2 of IEC 61984, prepared by SC 48B, Connectors, of IEC TC 48, Electromechanical components and mechanical structures for electronic equipment, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61984 on 2009-06-01.

This European Standard supersedes EN 61984:2001.

EN 61984:2009 includes the following significant technical changes with respect to EN 61984:2001:

– addition in the scope of the statement that this standard may be used as a guide for connectors with rated current higher than 125 A per pole;

– new definitions added and improvement of existing definitions;

– in Clause 5, the classification referred to protection against electric shock and that of connector for class II equipment were added;

– in 6.4 (Protection against electric shock), it is clarified that all parts which are necessary to ensure protection against electric shock shall only be removable by the aid of a tool;

– Table 2 and Table 3 are added for better readability and connecting methods updated to current status of standardization;

– values for cable clamp testing in Table 6 are adopted according to EN 50262 and no tests are required if metric cable glands according to this standard are used;

– tables in 6.19 are deleted and the text refers to EN 60664;

– Table 7 (Values for torque for screw-type clamping units) in 7.1.4 of EN 61984:2001 is deleted and the text refers to the relevant standards;

– Subclause 7.3.7 of EN 61984:2001 is modified. In 7.3.8 of EN 61984:2009, the length of the connecting cable and conductor loops are added. Test arrangements for temperature rise test for two-part printed board connectors are fixed;

– Figure 2 (Device for bending test) transferred from 7.3.8 (Mechanical operation) of EN 61984:2001 to 7.3.10 (Bending (flexing) test) of EN 61984:2009;

– in Table 10 (Mechanical test group A) test phase A3, the severity or conditions for unenclosed and enclosed connectors are specified;

– the informative Annex B (Additional information on connector classification) with its Tables B.1 (Scheme of connectors) and B.2 (Help for the classification of connectors) are added for better readability of the standard.

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)	2010-03-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2012-06-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61984:2008 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60068-2-20 + A2	NOTE Harmonized as HD 323.2.20 S3:1988 (not modified).
IEC 60112	NOTE Harmonized as EN 60112:2003 (not modified).
IEC 60364-5-54	NOTE Harmonized as HD 60364-5-54:2007 (modified).
IEC 60423	NOTE Harmonized as EN 60423:2007 (not modified).
IEC 60695-2-12	NOTE Harmonized as EN 60695-2-12:2001 (not modified).
IEC 60695-10-2	NOTE Harmonized as EN 60695-10-2:2003 (not modified).
IEC 60695-11-5	NOTE Harmonized as EN 60695-11-5:2005 (not modified).
IEC 60998-2-1	NOTE Harmonized as EN 60998-2-1:2002 (modified).
IEC 60998-2-2	NOTE Harmonized as EN 60998-2-2:2002 (modified).

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
-	-	Cable glands for electrical installations	EN 50262 + corr. October A1 A2	1998 1998 2001 2004
IEC 60050-581	- [1)]	International Electrotechnical Vocabulary (IEV) - Part 581: Electromechanical components for electronic equipment	-	-
IEC 60050-826	- [1)]	International Electrotechnical Vocabulary (IEV) - Part 826: Electrical installations	-	-
IEC 60060-1	- [1)]	High-voltage test techniques - Part 1: General definitions and test requirements	HD 588.1 S1	1991 [2)]
IEC 60068-1	- [1)]	Environmental testing - Part 1: General and guidance	EN 60068-1	1994 [2)]
IEC 60068-2-70	- [1)]	Environmental testing - Part 2: Tests - Test Xb: Abrasion of markings and letterings caused by rubbing of fingers and hands	EN 60068-2-70	1996 [2)]
IEC 60228	2004	Conductors of insulated cables	EN 60228 + corr. May	2005 2005
IEC 60309-1 A1 (mod)	1999 2005	Plugs, socket-outlets and couplers for industrial purposes - Part 1: General requirements	EN 60309-1 A1	1999 2007
IEC 60352-1	- [1)]	Solderless connections - Part 1: Wrapped connections - General requirements, test methods and practical guidance	EN 60352-1	1997 [2)]
IEC 60352-2	- [1)]	Solderless connections - Part 2: Crimped connections - General requirements, test methods and practical guidance	EN 60352-2	2006 [2)]
IEC 60352-3	1993	Solderless connections - Part 3: Solderless accessible insulation displacement connections - General requirements, test methods and practical guidance	EN 60352-3	1994

[1)] Undated reference.

[2)] Valid edition at date of issue.

Publication	Year	Title	EN/HD	Year
IEC 60352-4	1994	Solderless connections - Part 4: Solderless non-accessible insulation displacement connections - General requirements, test methods and practical guidance	EN 60352-4	1994
IEC 60352-5	- [1)]	Solderless connections - Part 5: Press-in connections - General requirements, test methods and practical guidance	EN 60352-5	2008 [2)]
IEC 60352-6	- [1)]	Solderless connections - Part 6: Insulation piercing connections - General requirements, test methods and practical guidance	EN 60352-6	1997 [2)]
IEC 60352-7	- [1)]	Solderless connections - Part 7: Spring clamp connections - General requirements, test methods and practical guidance	EN 60352-7	2002 [2)]
IEC 60364-4-41 (mod)	- [1)]	Low-voltage electrical installations - Part 4-41: Protection for safety - Protection against electric shock	HD 60364-4-41 + corr. July	2007 [2)] 2007
IEC 60417	Data-base	Graphical symbols for use on equipment	-	-
IEC 60512	Series	Connectors for electronic equipment - Tests and measurements	EN 60512	Series
IEC 60512-1-100	- [1)]	Connectors for electronic equipment - Tests and measurements - Part 1-100: General - Applicable publications	EN 60512-1-100	2006 [2)]
IEC 60529	1989	Degrees of protection provided by enclosures (IP Code)	EN 60529 + corr. May	1991 1993
A1	1999		A1	2000
IEC 60664-1	2007	Insulation coordination for equipment within low-voltage systems - Part 1: Principles, requirements and tests	EN 60664-1	2007
IEC 60664-5	2007	Insulation coordination for equipment within low-voltage systems - Part 5: Comprehensive method for determining clearances and creepage distances equal to or less than 2 mm	EN 60664-5	2007
IEC 60760	- [1)]	Flat, quick-connect terminations	-	-
IEC 60998-2-3 (mod)	2002	Connecting devices for low-voltage circuits for household and similar purposes - Part 2-3: Particular requirements for connecting devices as separate entities with insulation-piercing clamping units	EN 60998-2-3	2004
IEC 60999-1	1999	Connecting devices - Electrical copper conductors - Safety requirements for screw-type and screwless-type clamping units - Part 1: General requirements and particular requirements for clamping units for conductors from 0,2 mm² up to 35 mm² (included)	EN 60999-1	2000

Publication	Year	Title	EN/HD	Year
IEC 60999-2	2003	Connecting devices - Electrical copper conductors - Safety requirements for screw-type and screwless-type clamping units - Part 2: Particular requirements for clamping units for conductors above 35 mm² up to 300 mm² (included)	EN 60999-2	2003
IEC 61032	- [1)]	Protection of persons and equipment by enclosures - Probes for verification	EN 61032	1998 [2)]
IEC 61140	- [1)]	Protection against electric shock - Common aspects for installation and equipment	EN 61140	2002 [2)]
IEC 61210 (mod)	- [1)]	Connecting devices - Flat quick-connect terminations for electrical copper conductors - Safety requirements	EN 61210	1995 [2)]
ISO 6988	1985	Metallic and other non-organic coatings - Sulfur dioxide test with general condensation of moisture	EN ISO 6988	1994

CONTENTS

CONNECTORS – SAFETY REQUIREMENTS AND TESTS

1 Scope

This International Standard applies to connectors with rated voltages above 50 V and up to 1000 V a.c. and d.c. and rated currents up to 125 A per contact, for which either no detail specification (DS) exists or the DS calls up this standard for safety aspects.

For connectors with rated voltage up to 50 V, this standard may be used as a guide. In this case, reference is made to IEC 60664-1 for clearance and creepage distances.

This standard may also be used as a guide for connectors with rated current higher than 125 A per pole.

This standard does not apply to connectors in or on equipment where application specific safety requirements for connectors exist.

2 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 60050-581, *International Electrotechnical Vocabulary (IEV) – Chapter 581: Electromechanical components for electronic equipment*

IEC 60050-826, *International Electrotechnical Vocabulary (IEV) – Chapter 826: Electrical installations*

IEC 60060-1, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60068-1, *Environmental testing – Part 1: General and guidance*

IEC 60068-2-70, *Environmental testing – Part 2: Tests – Test Xb: Abrasion of marking and letterings caused by rubbing of fingers and hands*

IEC 60228: 2004*, Conductors of insulated cables*

IEC 60309-1:1999, *Plugs, socket-outlets and couplers for industrial purposes – Part 1: General requirements*
Amendment 1 (2005)

IEC 60352-1, *Solderless connections – Part 1: Wrapped connections – General requirements, test methods and practical guidance*

IEC 60352-2, *Solderless connections – Part 2: Crimped connections – General requirements, test methods and practical guidance*

IEC 60352-3:1993, *Solderless connections – Part 3: Solderless accessible insulation displacement connections – General requirements, test methods and practical guidance*

IEC 60352-4:1994, *Solderless connections – Part 4: Solderless non-accessible insulation displacement connections – General requirements, test methods and practical guidance*

IEC 60352-5, *Solderless connections – Part 5: Press-in connections – General requirements, test methods and practical guidance*

IEC 60352-6, *Solderless connections – Part 6: Insulation piercing connections – General requirements, test methods and practical guidance*

IEC 60352-7, *Solderless connections – Part 7: Spring-clamp connections – General requirements, test methods and practical guidance*

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

IEC 60417, *Graphical symbols for use on equipment*

IEC 60512 (all parts), *Connectors for electronic equipment – Tests and measurements* [1]

IEC 60512-1-100, *Connectors for electronic equipment – Tests and measurements – Part 1-100: General – Applicable publications*

IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*
Amendment 1 (1999)

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

IEC 60664-5:2007*, Insulation coordination for equipment within low-voltage systems – Part 5: Comprehensive method for determining clearances and creepage distances equal to or less than 2 mm*

IEC 60760, *Flat, quick-connect terminations*

IEC 60998-2-3:2002, *Connecting devices for low-voltage circuits for household and similar purposes – Part 2-3: Particular requirements for connecting devices as separate entities with insulation-piercing clamping units*

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

IEC 60999-2:2003, *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 2: Particular requirements for conductors above 35 up to 300 mm^2* (*included*)

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

IEC 61140, *Protection against electric shock – Common aspects for installation and equipment*

---

1 IEC 60512-1-100 gives the list of tests of the IEC 60512 series and the part of IEC 60512 corresponding to each test.

IEC 61210, *Connecting devices – Flat quick-connect terminations for electrical copper conductors – Safety requirements*

ISO 6988:1985, *Metallic and other non organic coatings – Sulfur dioxide test with general condensation of moisture*

EN 50262:1998, *Cable glands for electrical installations*
Amendment 1 (2001)
Amendment 2 (2004)

3 Terms and definitions

For the purpose of this International Standard, definitions from IEC 60050-581, IEC 60050-826, IEC 60309-1, IEC 60664-1, IEC 60999-1 and IEC 61140, as well as the following, apply.

3.1
connector
component which terminates conductors for the purpose of providing connection to and disconnection from a suitable mating component

[IEV 581-06-01, modified]

3.2
free connector
connector for attachment to the free end of a wire or cable

[IEV 581-06-12]

3.3
fixed connector
connector for attachment to a rigid surface

[IEV 581-06-10]

3.4
rewirable connector
connector so constructed that the cable or wire can be replaced

3.5
non-rewirable connector
connector so constructed that the cable cannot be separated from the connector without making it permanently useless

[IEC 60309-1, 2.5, modified]

3.6
enclosed connector
connector for which the protection against electric shock is ensured by the housing of the connector itself

3.7
unenclosed connector
connector with no protection against electric shock

NOTE The protection against electric shock is provided by e.g. the enclosure of the equipment in which the unenclosed connector is deemed to be mounted, in accordance with the applicable product safety standard.

3.8
connector with breaking capacity
CBC
connector specially designed to be engaged or disengaged in normal use when live or under load

NOTE 1 In this standard, the term “live” is used if contacts are under an applied voltage, but not necessarily carrying current. The term “load” is used if a current is flowing through the contacts.

NOTE 2 In this standard, CBC is used only if requirements refer to connectors with a specified breaking capacity.

3.9
connector without breaking capacity
COC
connector which is not deemed to be engaged or disengaged in normal use when live or under load

3.10
connector for class II equipment
connector in which the protection against indirect contact is realised by double or reinforced insulation

NOTE Class II according to IEC 61140.

3.11
intended use
application conditions of connectors which are included within the permissible rated values and environmental conditions and characteristics assigned by the detail specification (DS) or the manufacturer

3.12
interlock
device, either electrical or mechanical, which prevents the contacts of a connector from becoming live before it is in proper engagement with its counterpart, and which either prevents the connector from being withdrawn while its contacts are live or makes the contacts dead before separation

[IEC 60309-1, 2.9, modified]

3.13
cycle of mechanical operation
one insertion and one withdrawal of the connector with his counterpart

3.14
clamping unit
part(s) of the terminal necessary for the mechanical clamping and the electrical connection of the conductor(s), including the parts which are necessary to ensure the correct contact pressure

[IEC 60999-1, 3.1]

3.15
upper limiting temperature
ULT
maximum temperature in the connector as outcome (sum) of the ambient temperature and the temperature rise due to current flow, at which the connector is intended to be still operable.

NOTE 1 At ambient temperature equal to ULT, the available temperature rise due to current flow is zero, thus the current carrying capacity of the connector is zero.

NOTE 2 The ULT of a connector is covered by the climatic category as defined in IEC 60068-1, together with the LLT and the duration of the damp heat test.

3.16
lower limiting temperature
LLT
minimum temperature of a connector as defined by the climatic category assigned by the manufacturer in which a connector is intended to operate

NOTE The LLT of a connector is covered by the climatic category as defined in IEC 60068-1, together with the ULT and the duration of the damp heat test.

3.17
clearance
shortest distance in air between two conductive parts

[IEC 60664-1:2007, 3.2]

3.18
creepage distance
shortest distance along the surface of the insulating material between two conductive parts

[IEC 60664-1:2007, 3.3]

3.19
overvoltage category
numeral defining a transient overvoltage condition

NOTE Overvoltage categories I, II, III and IV are used.

[IEC 60664-1:2007, 3.10]

3.20
pollution
any addition of foreign matter, solid, liquid, or gaseous that can result in a reduction of electric strength or surface resistivity of the insulation

[IEC 60664-1:2007, 3.11]

3.21
pollution degree
numeral characterizing the expected pollution of the micro-environment

NOTE Pollution degrees 1, 2, 3 and 4 are used.

[IEC 60664-1:2007, 3.13]

3.22
rated voltage
value of voltage assigned by the manufacturer to the connector and to which operation and performance characteristics are referred

NOTE A connector may have more than one rated voltage value.

[IEC 60664-1:2007, 3.9, modified]

3.23
rated insulation voltage
r.m.s. withstand voltage value assigned by the manufacturer to the connector, characterising the specified (long term) withstand capability of its insulation

NOTE The rated insulation voltage is not necessarily equal to the rated voltage, which is primarily related to functional performance.

[IEC 60664-1:2007, 3.9.1, modified]

3.24
rated impulse voltage
impulse withstand voltage value assigned by the manufacturer to the connector, characterising the specified withstand capability of its insulation against transient overvoltages

[IEC 60664-1:2007, 3.9.2, modified]

3.25
impulse withstand voltage
highest peak value of impulse voltage of prescribed form and polarity which does not cause breakdown of insulation under specified conditions

NOTE The impulse withstand voltage is equal to or higher than the rated impulse voltage.

[IEC 60664-1:2007, 3.8.1, modified]

3.26
r.m.s. withstand voltage (power-frequency withstand voltage)
highest r.m.s. value of a voltage which does not cause breakdown of insulation under specified conditions

[IEC 60664-1:2007, 3.8.2, modified]

3.27
rated current
current value assigned by the manufacturer, which the connector can carry continuously (without interruption) and simultaneously through all its contacts wired with the largest specified conductor, preferably at an ambient temperature of 40 °C, without the upper limiting temperature being exceeded

NOTE If other ambient temperature values are used for the definition of the rated current, the manufacturer should state, in the technical documentation, the ambient temperature on which the rating is based, with reference, if appropriate, to the derating curve defined in IEC 60512, test 5b.

3.28
breaking capacity
value of current which the CBC can make and break under specified conditions

3.29
functional insulation
insulation between conductive parts which is necessary only for the proper functioning of the equipment

[IEC 60664-1:2007, 3.17.1]

3.30
basic insulation
insulation of hazardous-live-parts which provides basic protection

NOTE The concept does not apply to insulation used exclusively for functional purposes.

[IEC 60664-1:2007, 3.17.2]

3.31
internal insulation
part of a basic insulation providing the required clearance and creepage distances inside a conductive housing or enclosure

3.32
supplementary insulation
independent insulation applied in addition to basic insulation for fault protection

[IEC 60664-1:2007, 3.17.3]

3.33
double insulation
insulation comprising both basic insulation and supplementary insulation

[IEC 60664-1:2007, 3.17.4]

3.34
reinforced insulation
insulation of hazardous-live-parts, which provides a degree of protection against electric shock equivalent to double insulation

NOTE Reinforced insulation may comprise several layers which cannot be tested singly as basic insulation or supplementary insulation.

[IEC 60664-1:2007, 3.17.5]

3.35
protective conductor (symbol PE)
conductor required by some measures for protection against electric shock for electrically connecting any of the following parts:

- exposed conductive parts,
- extraneous conductive parts,
- main earthing terminal,
- earth electrode,
- earthed point of the source or artificial neutral

3.36
protective earthing contact
contact for earthing a point or points in a system or in an installation or in equipment for purposes of electrical safety

[IEV 195-01-11, modified]

3.37
degree of protection
the extent of protection provided by an enclosure against access to hazardous parts, against ingress of solid foreign objects and/or against ingress of water and verified by standardized test methods

[IEC 60529:1989, 3.3]

3.38
IP Code
a coding system to indicate the degrees of protection provided by an enclosure against access to hazardous parts, ingress of solid foreign objects, ingress of water and to give additional information in connection with such protection

[IEC 60529:1989, 3.4]

3.39
cable clamp
accessory or part of a component to grip the cable or wire to provide strain relief and absorb mechanical stress which would otherwise be transmitted to the termination

[IEV 581-09-03]

3.40
cable gland
device designed to permit the entry of a cable or flexible cable into equipment, and which provides sealing and retention. It may also provide other functions such as earthing, bonding, insulation, cable guarding, strain relief or a combination of these.

3.41
specimen
a mating pair of connectors. In the case of contact elements, a mating pair of the intended coupling elements

3.42
detail specification
part of standard giving requirements and tests relating physical and performance characteristics of a particular connector or connector range

NOTE See Annex A for guidance.

4 Technical information (electrical ratings)

In this standard, no particular values have been specified for electrical ratings such as voltage, current and breaking capacity of connectors. Values for these characteristics shall be specified in conjunction with mechanical and environmental conditions given in the detail specification or in the manufacturer's specification, where no detail specification exists.

5 Classification

5.1 General

Connectors shall be classified by the manufacturer’s specification or the detail specification (DS), if any, according to their characteristics and intended use in accordance with 5.2, 5.3 and 5.4 as appropriate.

5.2 Classification according to protection against electric shock

The classification according to protection against electric shock is as follows:

a) unenclosed connector (as per definition in 3.7),

b) enclosed connector (as per definition in 3.6),

c) connector for class II equipment (as per definition in 3.10).

5.3 Classification according to the style of connector

The classification according to the style of connector is a s follows:

a) fixed connector (as per definition in 3.3),

b) free connector (as per definition in 3.2).

5.4 Classification according to additional characteristics of connectors

The classification according to additional characteristics of connectors is as follows:

a) connector with protective earthing contact,

b) connector without protective earthing contact,

c) connector without breaking capacity (COC) (as defined in 3.9),

NOTE 1 See also Annex B.

1) unprotected (IP0X),

2) with protection against electric shock by back of hand safety (IP1X or IPXXA), when mated,

3) with protection against electric shock by finger safety (IP2X or IPXXB), when mated,

d) connector with breaking capacity (CBC) (as defined in 3.8) for protection against electric shock by finger safety only (IP2X or IPXXB), both in mated and in unmated condition,

NOTE 2 See also Annex B.

e) degree of protection of a connector (IP code),

f) connector with interlock,

g) connector without interlock,

h) non-rewirable connector,

i) rewirable connector,

j) terminations and connection methods.

6 Constructional requirements and performance

6.1 General

Connectors shall be so designed and dimensioned that they can withstand the electrical, mechanical, thermal and corrosive stresses which occur in their intended use and present no danger to the user or the environment.

Compliance with this requirement is verified by the specified tests of this standard.

6.2 Marking and identification

6.2.1 Identification

Connectors shall be identified and characterised by the following markings:

a) manufacturer’s name, trademark or mark of origin;

b) type identification;

NOTE The type identification may be a part number, catalogue number or IEC type designation.

c) rated current in ampere (A);

d) rated voltages or rated insulation voltages between line to earth and line to line in volt (V);

e) rated impulse voltage in kilovolt (kV), if specified;

f) pollution degree;

g) degree of protection by enclosure according to IEC 60529, if applicable;

h) temperature range (°C), (LLT – ULT);

i) type of terminals;

j) connectable conductors;

k) reference to this standard or to the DS, if applicable.

6.2.2 Marking

The marking shall be indelible and easily legible.

The minimum marking on the connector shall be that of item a) of 6.2.1.

Markings a) and b) of 6.2.1 shall be found on the smallest unit of packaging.

All markings of 6.2.1 shall be given in the technical documentation or catalogue of the manufacturer; for the rated values, follow the examples given hereinafter.

Examples of markings for rated current, rated voltages, rated impulse voltage and pollution degree:

a) Example 1

Marking of a connector with rated current 16 A, rated voltage 400 V, rated impulse voltage 6 kV and pollution degree 3, 2 and 1 for use in any system, preferably unearthed or delta-earthed systems:

16 / 400 / 6 / 3 or 16A 400V 6kV 3 or 16A/400V/6kV/3

NOTE For reasons of space such marking may lay on two separate rows, i.e.: 16A 400V on one row and 6kV 3 on a subsequent row.

b) Example 2

Marking of a connector with rated current 16 A, rated insulation voltages line-to-earth 250 V, line-to-line 400 V, rated impulse voltage 4 kV and pollution degree 3, 2 and 1 for use in earthed systems, only:

16 / 250 / 400 / 4 / 3 or 16A 250V 400V 4kV 3

6.2.3 Marking of position for contacts

The positions for the contacts and protective earthing contacts shall be clearly indicated.

Marking of the first contact and first row by a letter, number or another clear symbol is sufficient.

This requirement does not apply to a connector in which contact identification is ensured in the end-use product. Relevant information shall be given in the technical documentation of the manufacturer.

Marking of protective earthing contacts shall apply the symbol ⏚ or PE. This requirement is not necessary for non rewirable connectors.

Marking shall not be applied to screws or other removable parts.

Symbols are given in IEC 60417.

The symbol ⧈ is reserved for end-use-equipment. The protection class of components is dependent upon the equipment in which they are used. Therefore, components shall not be marked with the symbol ⧈. A connector without earth contact may be designated so as to read "Connector for class II equipment", if the connector itself meets the requirements of double and/or reinforced insulation.

6.3 Provision against incorrect mating (non-intermateable)

A multipole connector shall be so designed that contact between protective earthing contacts and live contacts is not possible by engagement.

Compliance is checked by a polarisation test.

6.4 Protection against electric shock

6.4.1 Non accessibility of live parts

A connector shall be so designed that, after mounting, its live parts are not accessible by the IEC test finger in accordance with Clause 5 of IEC 60529:1989 using a test force of 20 N. All parts which are necessary to ensure protection against electric shock shall only be removable by the aid of a tool.

This requirement does not apply to a connector in which protection against electric shock is ensured by its mounting provisions or by the use of safety extra-low voltage (SELV, according to IEC 60364-4-41) in the end-use product.

NOTE For an unenclosed connector, the protection against electric shock is provided by the enclosure of the equipment in which the connector is mounted, in accordance with the applicable product safety standard.

6.4.2 Non applicability of protection requirement to unenclosed connectors

6.4.2.1 General

A connector intended for use inside an enclosure which ensures protection against electric shock is not required to have its own protection against electric shock. If protection is claimed by the manufacturer, the requirements of 6.4.2.2 or 6.4.2.3 apply.

6.4.2.2 Back of hand safety

For a COC with protection against electric shock according to characteristic c2) of 5.4, protective provisions shall be tested by using the access probe – “50 mm sphere” – according to Clause 5 of IEC 60529:1989 with a test force of 20 N, without consideration of clearances and creepage distances.

6.4.2.3 Finger safety

For a COC and a CBC with protection against electric shock respectively according to characteristic c3) and d) of 5.4, protective provision shall be tested according to Clause 5 of IEC 60529:1989 by using the test finger with a test force of 20 N without consideration of clearances and creepage distances.

6.4.3 Protection against electric shock during insertion and withdrawal

For a CBC, protection against electric shock shall be ensured also during insertion and withdrawal.

Compliance is checked in accordance with Clause 5 of IEC 60529:1989 by the IEC test finger with a test force of 20 N with consideration of clearances and creepage distances according to the manufacturer specification.

6.5 Provisions for earthing

6.5.1 First make, last break PE contact

For a CBC with a protective earthing contact according to characteristic a) of 5.4, the earthing contact shall be a “first make, last break” contact.

6.5.2 PE contacts on connector for class II equipment

A connector for class II equipment according to characteristic c) of 5.2 may be equipped with protective earthing contacts, provided that these contacts are considered as live parts and are equally protected against electric shock by double or reinforced insulation.

6.5.3 Reliability of connection to PE contacts

Accessible metal parts of a connector with an earthing contact which may become live in the event of an insulation fault shall be reliably connected to the earthing contact.

In no case shall the resistance of this connection exceed 0,1 Ω.

NOTE 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 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 the test of 7.3.13.

6.5.4 Connection of the protective conductor

6.5.4.1 PE conductor terminal capacity

The protective conductor terminal shall be able to accept a conductor with a minimum cross-sectional area as specified in Table 1, column 2.

Table 1 – Minimum cross-sectional area of the protective conductor or the connection to inactive accessible metal parts

1	2	3
Nominal cross-sectional area of the current carrying conductor mm²	**Minimum cross-sectional area[1)] for the protective conductor and accessible metal parts or covers used as protective conductors** mm²	**Minimum cross-sectional area[1)] for connections between the protective conductor and accessible metal parts or covers not used as protective conductors** mm²
Up to 1,5	Corresponding to the nominal cross-sectional area of the current-carrying conductor	
2,5	2,5	1,5
4	4	2,5
6	6	4
10	10	10
16, 25, 35	16	16
50	25	25
70	35	35
95	50	50
120, 150	70	50
185	95	50
240	120	50
300	150	50
400	185	50

[1)] Relating to the same material as the current-carrying conductor.

6.5.4.2 Design of PE termination

The design and type of construction of the protective conductor terminations shall be at least equivalent in performance to the types of termination given in 6.6.

6.6 Terminations and connection methods

6.6.1 General

The terminations and connection methods listed in Table 2 meet the requirements of this standard.

Other terminations and connection methods shall be tested in accordance with the relevant IEC standards to ensure adequate performance.

Table 2 – Compliant termination and connection methods

Ref.	Terminations and connection methods	Reference standard(s)
a)	Wrapped connections	IEC 60352-1
b)	Crimped connections	IEC 60352-2
c)	Accessible insulation displacement connections	IEC 60352-3 or IEC 60998-2-3
d)	Non-accessible insulation displacement connections	IEC 60352-4 or IEC 60998-2-3
e)	Press-in connections	IEC 60352-5
f)	Insulation piercing connections	IEC 60352-6 or IEC 60998-2-3
g)	Screwless-type clamping units	IEC 60999-1 or IEC 60999-2 or IEC 60352-7
h)	Screw-type clamping units	IEC 60999-1 or IEC 60999-2
i)	Flat, quick-connect terminations	IEC 60760 or IEC 61210

At least the following applicable tests shall be conducted:

Table 3 – Tests on connections and terminations

Ref.	Termination and connection method	Tests
a)	Wrapped connections	Visual and dimensional tests on the wrapped post and stripping force and unwrapping test according to IEC 60352-1
b)	Crimped connections	Visual tests on the crimp barrel and tensile strength test of the crimp connection as specified in IEC 60352-2.
c) d)	Insulation displacement connections	Visual examination is carried out on new parts for accessible insulation displacement terminals according to IEC 60352-3:1993, 12.1 and for non-accessible insulation displacement terminals according to IEC 60352-4:1994, 12.2.4.
e)	Press-in connections	Visual and dimensional tests on the press-in post and test of the push-out force as specified in IEC 60352-5
f)	Insulation piercing connections	According to IEC 60352-6 or IEC 60998-2-3
g)	Screwless-type clamping units	Mechanical tests on the conductor connection as specified in IEC 60999-1 or IEC 60999-2 or IEC 60352-7
h)	Screw-type clamping units	Mechanical tests on the conductor connection as specified in IEC 60999-1 or IEC 60999-2 NOTE For prepared conductors the manufacturer's instructions for the preparation apply
i)	Flat, quick-connect terminations	Dimensional tests and safety tests as specified in IEC 61210 as far as applicable. The dimensional test is carried out according to IEC 61210. The compliance check of dimensions is the verification of the safety of the connection according to IEC 61984. If the dimensions do not comply with the specification, the test is not met. Flat, quick-connect terminations, which are definitely not designed according to IEC 61210 can be used if the test program according to IEC 61984 is met. If deviations from IEC 60352-2 exist, the tensile strength according to IEC 60352-2 and the dimensions according to the manufacturer's specification are tested to fulfil IEC 61984.

Electrical and thermal tests on terminations shall be carried out in conjunction with the test on the connector.

Other terminations and connection methods have to be tested in accordance with the relevant standards.

6.6.2 Type and range of conductor cross-sectional areas

Terminations shall be suitable for the type and range of conductor cross-sectional areas according to the DS or the manufacturer's information.

6.6.3 Design of electrical connections

Electrical connections shall be so designed that the contact pressure is not transmitted through insulating material other than ceramic, pure mica or other material with characteristics not less suitable, unless there is sufficient resiliency in the metallic parts to compensate for any shrinkage or yielding of the insulating material (see 25.3 of IEC 60309-1 or Clause 7 of IEC 60999-1 or IEC 60999-2). On the basis of the tests according to IEC 60352-6 or IEC 60998-2-3 of Table 3, insulation piercing connections are excluded from the above requirement.

6.7 Interlock

A connector with an interlock shall be so designed that it cannot be engaged or disengaged as long as the contacts are live.

NOTE If pilot contacts (last make, first break contacts) are used for the electrical interlock, these can be live when disengaged if the pilot contacts are protected against indirect contact with live parts.

6.8 Resistance to ageing

Parts which, due to ageing, might impair safety shall be so resistant that the specified characteristics such as dielectric strength, contact resistance or degree of protection are maintained.

6.9 General design

6.9.1 Polarisation

Multipole connectors shall be so polarised that improper connection of mating parts is prevented.

This requirement does not apply to connectors (for example two-part connectors for printed boards and rack-and-panel connectors) where mismating is prevented by their mounting provisions or by additional accessories, if necessary and available.

6.9.2 Fixing of live parts

Mechanisms which are used for mounting the connector and/or termination of conductors shall not be used to fix live parts in the connector housing, if it may impair the proper function of the mechanism or reduce the clearance and creepage distances below the requirements according to 6.19.

6.9.3 Connection of conductors

Connectors shall be so designed that connection of conductors of the type and cross-sectional areas as specified by the DS or the manufacturer shall be possible. Besides the termination of the conductor, care shall be taken that no damage of the insulation is possible, e.g. by avoiding of sharp edges.

6.9.4 Design of non rewirable connectors

Non-rewirable connectors shall be so designed that

- the flexible cable cannot be separated from the connector without making it permanently useless;

NOTE 1 A connector becomes useless for further use when, for the re-mounting, other parts than the original ones are necessary.

NOTE 2 Connectors with non-rewirable terminations (e.g. crimped connections) are considered as rewirable, if they can be reconstituted with correct replacement parts and, if so, with the tool designated by the manufacturer.

- the connector cannot be opened by hand or by using a general purpose tool, for example a screwdriver, as intended;
- means are provided to prevent live parts, e.g. free strands of a conductor, from reducing the minimum insulation distance between such live parts and all accessible external surfaces of the connector, with the exception of the engagement face of the male connector.

If this cannot be granted by the design or manufacturing process itself, the in-process test schedule according to 7.4 or another test of the same safety level shall be carried out.

6.10 Design of a CBC

A CBC shall have an adequate breaking capacity.

6.11 Design of a free connector

In a free connector, the wires shall be protected against shear and tensile stress at the termination and be secured to prevent twisting.

This requirement does not apply to

a) free connectors for termination to cables in fixed mountings (plug connection in the sense of a detachable connection);
b) free connectors in which the terminations are protected against pull and twisting by mounting provisions in the end-use product.

6.12 Degree of protection (IP Code)

A connector shall have a degree of protection according to IEC 60529, if specified by the DS or the manufacturer's specification according to classification of 5.4 e).

6.13 Dielectric strength

A connector shall withstand the specified test voltage, preferably the impulse withstand voltage (1,2/50 μs) or the r.m.s. withstand voltage (50/60 Hz) alternatively. The connector shall withstand the test voltage specified in Table 8, in accordance with 7.3.12.

6.14 Mechanical and electrical durability

6.14.1 Mechanical endurance (COC and CBC)

A connector, either COC or CBC, shall meet the mechanical operations without load as specified in the DS or in the manufacturer's specification (preferred numbers of operating cycles are given in Table 4a).

6.14.2 Electrical endurance (CBC)

A CBC shall meet the specified breaking capacity taking into account the severity as specified in the DS or in the manufacturer's specification (preferred numbers of operating cycles are given in Table 4a).

6.14.3 Bendings (non-rewirable connectors)

A non-rewirable connector shall meet the numbers of bendings (flexings) specified in the relevant DS or in the manufacturer's specification (preferred numbers are given in Table 4b).

Table 4 – Mechanical and electrical durability

Table 4a – Operating cycles – Preferred values

Operating cycles - Preferred values
10
50
100
500
1 000
5 000

Table 4b – Bendings –Preferred values

Bendings - Preferred values
100
500
1 000
2 000
5 000
20 000

6.15 Temperature limits

A connector shall comply with the upper and lower values of the temperature range as specified in the DS or in the manufacturer's specification (preferred values of temperature are given in Table 5a and Table 5b).

Table 5 – Temperature limits

Table 5a – Lower limiting temperature (LLT) – Preferred values

Lower limiting temperature (LLT) - Preferred values °C
–10
–25
–40
–55

Table 5b – Upper limiting temperature (ULT) – Preferred values

Upper limiting temperature (ULT) - Preferred values °C
70
85
100
125

6.16 Temperature rise

The sum of the ambient temperature and the temperature rise of a connector shall not exceed the upper limiting temperature given in Table 5b.

Compliance shall be checked by the test of 7.3.8.

6.17 Cable clamp

The cable clamp, if any, shall be suitable for the cable to be connected. The range of acceptable cable diameters shall be specified in the DS or by the manufacturer's specification. Tensile and torsion requirements shall be as specified in Table 6.

Loose parts inserted to obtain clamping of the cable are permitted if they are fixed in the connector in the assembled state.

The cable clamp can be made of insulating material or metal. If it consists of metal, it shall meet one of the following requirements:

a) be provided with an insulating means so as to prevent any accessible metal part becoming live in case of a fault;
b) no contact shall be possible with the test finger according to IEC 60529;
c) be connected to the protective earth.

Table 6 – Values for cable clamp testing

Cable diameter	Tensile requirements			Torsion requirements	
	Tensile force		Permissible displacement	Torque	Permissible angle
	Up to 25 conductors	Over 25 conductors			
mm	N	N	mm	Nm	°
4 up to 9	80	60	3	0,10	±30
>9 up to 12	100	80		0,15	
>12 up to 20	120	100		0,6	
>20 up to 33	150	120		0,8	
>33 up to 42	200	150	5	0,9	±45
>42	250	200		1,2	

If metric cable glands according to EN 50262 are used, the above mentioned tests shall not be performed.

6.18 Mechanical strength

6.18.1 Robustness of connectors

A connector shall show no damage likely to impair safety after exposure to mechanical stress according to the test programme.

6.18.2 Retention of contacts

In a connector assembled for final use, the contacts shall be securely retained in the contact insert.

6.18.3 Integrity of internal insulation

After exposure to the stresses according to the test schedule, the internal insulation shall show no damage which could impair normal use.

6.19 Clearances and creepage distances

Clearances and creepage distances shall be dimensioned according to the following specifications, unless otherwise specified by the application or the manufacturer.

6.19.1 Clearances

6.19.1.1 General

Clearances shall be in accordance with IEC 60664-1 and/or IEC 60664-5.

Clearances through slots and openings in enclosures of insulating material shall meet the values of case A of Table F.2 of IEC 60664-1:2007 and/or Table 2 of IEC 60664-5:2007.

6.19.1.2 Rated impulse voltage

The rated impulse voltage shall be selected according to the nominal voltage of the supply system and the overvoltage category, as specified in table B.2 of IEC 60664-1:2007.

6.19.1.3 Overvoltage category

The assignment of connectors shall be carried out according to the rules as given in IEC 60664-1.

6.19.2 Creepage distances

6.19.2.1 General

Creepage distances shall be dimensioned according to the rated voltage according to IEC 60664-1 and/or Table 4 of IEC 60664-5:2007, the pollution degree and insulating material as specified according to IEC 60664-1 and/or Table 4 of IEC 60664-5:2007. If the rated voltage is not derived from the nominal voltage of the supply system (see Table F.3a and Table F.3b of IEC 60664-1:2007) but from the working voltage, interpolation is permissible. For the relationship between creepage distance and clearances see 5.2.2.6 of IEC 60664-1:2007 and/or 5.3.2.6 of IEC 60664-5:2007.

For a connector with a degree of protection IP54 or higher according to IEC 60529, the insulating parts inside the enclosure may be dimensioned for a lower pollution degree.

This lower pollution degree also applies to mated connectors where the enclosure is ensured by the connector housing and which may only be disengaged for test and maintenance purposes.

6.19.2.2 Pollution degree

The pollution degree shall be specified according to IEC 60664-1.

NOTE The pollution degree strongly influences the rated insulation voltage of a connector. Therefore, the rated insulation voltage for a connector with creepage distances fixed by design should be reconsidered for each pollution degree separately.

6.19.2.3 Dimensioning of creepage distances for connectors with IP54 or higher

For a connector with a degree of protection IP54 or higher according to IEC 60529, the insulating parts inside the enclosure may be dimensioned for a lower pollution degree.

This also applies to mated connectors where the enclosure is ensured by the connector housing and which may only be disengaged for test and maintenance purposes.

6.19.2.4 Shape of insulating surfaces

Insulating surfaces may include transverse ridges and grooves to break the continuity of conductive layers.

a) Ribs shall be dimensioned so that they withstand the mechanical stresses according to the test sequence without damage. If the height of the ribs is at least 2 mm the creepage distances may be dimensioned in accordance with one insulating material group level lower.

b) In the case where there are grooves across the creepage distance, the groove walls shall be included in the creepage distance if the width X of the groove complies with 4.2 of IEC 60664-1:2007.

   If the associated clearance, measured on the component, is less than 3 mm, the minimum groove width may be reduced to one-third of this clearance.

In all other cases, the groove walls shall not be taken into account.

Methods of measuring clearances and creepage distances are given in 6.2 of IEC 60664-1:2007.

6.20 Insulation

6.20.1 Functional and basic insulation

Functional and basic insulation shall be so designed that it withstands the impulse withstand voltage or the r.m.s. withstand voltage as specified in the DS or by the manufacturer's specification, as derived from the rated insulation voltage of the connector.

6.20.2 Supplementary insulation

For the supplementary insulation, the same requirements are valid as for the basic insulation.

6.20.3 Double insulation

Double insulation shall be so designed that the breakdown of one part (basic or supplementary insulation) does not impair the protective function of the other part. It shall not be possible to remove the supplementary insulation without using a tool.

For double insulation, where basic and supplementary insulation cannot be tested separately, the insulation system shall be considered as reinforced insulation.

6.20.4 Reinforced insulation

For the assessment of clearances for reinforced insulation, the rated impulse voltage shall be selected from the next higher overvoltage category in comparison to basic insulation.

The creepage distances shall be doubled in comparison with the basic insulation. Insulation material of group IIIb ($100 \leq CTI < 175$) shall not be used at pollution degrees 3 and 4.

6.21 Protection against corrosion

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

Compliance is checked by the test of 7.3.14.

7 Tests

7.1 General

7.1.1 Test sequence and number of specimens

The tests shall be carried out in the sequence specified for each test group using the number of specimens as given in Table 9. For each test group, a separate set of new specimens shall be used.

NOTE If designs of connectors require special tests or preparations, which are not explicitly indicated in this standard, they are chosen or carried out according to the manufacturer's specification, e.g. mechanical locking during IP-Code testing.

If the testing has to be made on free contacts (e.g. crimp contacts), a minimum of three specimens shall be used.

7.1.2 Specimens condition

Unless otherwise specified, the condition used in the test schedule is unmated.

7.1.3 Atmospheric conditions

The tests shall be made under the standard atmospheric conditions of IEC 60068-1, unless otherwise specified in the test schedule.

7.1.4 Number of specimens for tests on terminations

The tests on the terminations according to the relevant standard shall be made on three terminations per specimen, if available.

NOTE See also 6.6.1.

7.1.5 Failure criteria

The product is deemed not to comply with this standard if the product fails in more than one of the tests of any test group.

If the product fails in only one of the tests, this test and the preceding tests which have affected the result shall be repeated on a new set of specimens. The new set of specimens shall pass the repeated tests, otherwise the product is deemed not to comply.

7.1.6 Visual examination tests

All visual examination tests should be performed with the naked eye, unless otherwise specified.

7.2 Preparation of specimens

7.2.1 Pre-conditioning

Specimens shall be pre-conditioned under standard conditions for testing, for a period of 24 h, in accordance with IEC 60512-1.

7.2.2 Conductors

The tests shall be carried out with copper conductors unless otherwise specified by the manufacturer and with the type of conductor specified for the connector. If terminations are provided for all types of conductors, solid, stranded and flexible, the tests shall be carried out only with flexible conductors according to Class 5 of IEC 60228.

7.2.3 Torque for screw-type clamping units

Screw-type clamping units shall be tightened with the value of the torque stipulated according to IEC 60999-1 and IEC 60999-2, unless otherwise specified by the manufacturer.

7.2.4 Assembly conditions

Unless otherwise specified in the test schedule, all tests shall be made on the specimen completely assembled according to the manufacturer's instructions.

7.3 Performance of tests

7.3.1 General

In accordance with the test schedule given in 7.5, the general test methods specified in Tables 10 to 14, columns 3 and 7, shall be applied according to IEC 60512. Other tests are indicated in column 4.

7.3.2 Durability of marking

The test of the durability of marking shall be done as a wet test according to test Xb (abrasion of marking) of IEC 60068-2-70. For the test piston, size 1 shall be used and the test liquid shall be water. A force of 5 N shall be applied for a duration of 10 cycles.

After the test, the marking shall be still readable.

Markings made by impression, moulding, pressing or engraving or the like are not subjected to this test.

7.3.3 "First make, last break" protective earthing contact

The specimens shall be engaged and disengaged by hand in every possible position.

To indicate contact, an electrical device (for example a lamp) shall be used. It shall be checked that the protective earthing contact will first make and last break relative to any other contact. For this test, all other contacts shall be wired in parallel.

7.3.4 Interlock

The specimens are engaged by hand over their full engagement distance.

The requirement that interlock contacts will make last and break first before any other contact shall be checked. An electric device, i.e. a lamp, shall be used to indicate contact. For this test, all other contacts shall be wired in series.

7.3.5 Breaking capacity of a CBC

The specimens of a CBC shall be electrically operated at the indicated breaking capacity and at the rated voltage for a.c. with $\cos \varphi = (0{,}9 \pm 0{,}05)$ or for d.c. with a time constant of 1 ms ± 15 %, depending on manufacturer's specifications. Any existing protective earthing contact shall not be loaded.

The specimens shall be engaged and disengaged by means of a device simulating normal insertion and withdrawal. The number of operating cycles shall be specified by the DS or by the manufacturer, preferred values being given in Table 4a.

The test position shall be horizontal or, if not possible, as in normal use.

The specimen is inserted into and withdrawn from its counterpart at a rate of three to four cycles per minute. The speed of insertion and withdrawal of the specimen shall be (0,8 ± 0,1) m/s. Electrical contact shall be maintained for no more than 4 s and no less than 2 s.

During the test, no sustained arcing shall occur.

After the test, the samples shall show no damage impairing their further use and the entry holes for the plug contacts shall not show any serious damage.

7.3.6 Protection against electric shock

7.3.6.1 Unenclosed connectors

For unenclosed connectors, with the exception of classification IP00, protection against electric shock shall be tested with the relevant test probe in accordance with the IP code claimed by the manufacturer.

Creepage and clearance distances are not taken into consideration for the test.

7.3.6.2 Enclosed connectors

Enclosed connectors shall be tested with the IEC jointed test finger taking into consideration clearances and creepage distances between live parts and the test finger.

This does not apply to the contact openings (lead-in) in the mating face:

- For a CBC, clearance and creepage distances according to IEC 60664-1 shall be measured through the openings between the live parts and the plane of the mating face.
- For a connector without breaking capacity (COC), clearance and creepage distances through the openings are disregarded.

7.3.6.3 Tests for connectors with IP Code higher than IP2X or IPXXB

If the manufacturer claims a protection against access to hazardous parts higher than IP2X or IPXXB, the relevant tests shall be carried out according to IEC 60529.

7.3.7 Protection against solid foreign objects and against ingress of water

7.3.7.1 General

IP code is measured in mated condition or according to the manufacturer´s specification.

7.3.7.2 Protection against foreign solid objects

If the manufacturer claims a degree of protection against ingress of foreign solid objects, the relevant tests shall be carried out according to IEC 60529.

Compliance is checked according to IEC 60529.

7.3.7.3 Protection against harmful ingress of water

If the manufacturer claims a degree of protection against harmful ingress of water, the relevant tests shall be carried out according to IEC 60529.

Compliance is checked according to IEC 60529. For numeral 3 and 4, unless otherwise specified in the detail specification or by the manufacturer, the oscillating tube, Figure 4 of IEC 60529:1989 is used.

7.3.8 Temperature rise

The object of this test is to assess the ability of a connector to continuously carry its rated current without exceeding the upper limiting temperature. The test shall be carried out according to test 5a of IEC 60512-5-1, unless otherwise specified, under the following test conditions.

Any existing PE contact is not involved in the test.

Test conditions:

Maximum permissible conductor cross-sectional area used for the test shall be in accordance with the detail specification DS or manufacturer's information.

The length of the connecting cable and conductor loops (see Figures 1a, 1b and 1c) is given in Table 7.

Table 7 – Length of the connecting cable and conductor loops

Cross sectional area mm^2	Minimum length mm	Recommended length mm
≤ 10	150	500 ± 50
>10	150	1 000 ± 100

The test shall be carried out with a rated current selected from the current-carrying capacity curve according to IEC 60512-5-2, test 5b depending on the ambient temperature. For this purpose, the test arrangement according to IEC 60512-5-2 shall be used.

NOTE The reduction factor for ascertaining the derating curve is 0,8. In case of deviation, the used factor shall be indicated in the technical documentation.

The test shall be continued until a constant temperature is obtained.

For two-part printed board connectors, the connection on the printed board side is made by wire jumpers corresponding to the cross sectional area of the connecting cable of the connector. According to the agreement with the manufacturer, a printed board can be used for fixing (Figure 1b). For edge-socket connectors, the wire jumpers are soldered as close to the contact zone of the printed board as possible corresponding to the cross sectional area of the connecting cables (Figure 1c). For both conductor versions, the wire jumpers shall be produced as short as possible, i.e. in pitch dimension.

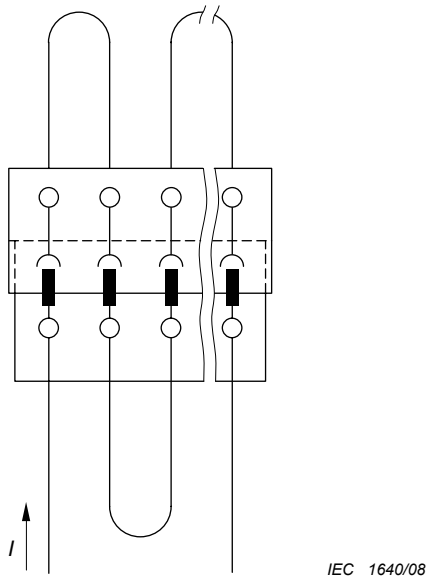

Figure 1a – Test arrangement for temperature rise test of two-part connectors

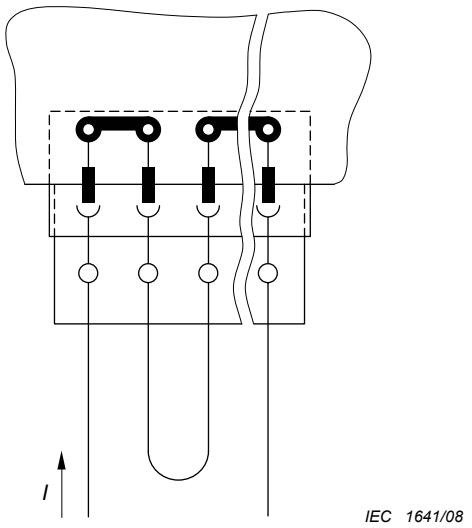

Figure 1b – Test arrangement for temperature rise test of two-part connectors on printed circuit boards

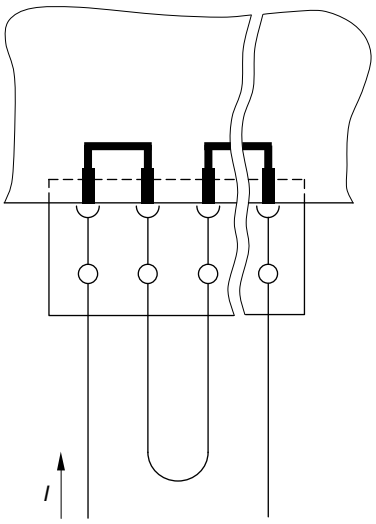

Figure 1c – Test arrangement for temperature rise test of edge-socket connectors

Figure 1 – Test arrangements for temperature rise tests

7.3.9 Mechanical operation

The object of this test is to assess the mechanical operational endurance of a connector either CBC or COC in the normal operational mode without electrical load. The test shall be carried out according to test 9a of IEC 60512, under the following conditions, unless otherwise specified.

Test conditions:

The specimens shall be engaged and disengaged by means of a device simulating normal operating conditions. The preparation and mounting of the specimen shall be as in normal use.

The type and cross sectional area of the cable/wire bundle to be used shall be specified by the manufacturer or by the DS.

The number of operating cycles shall be specified by the manufacturer or by the DS. Preferred values are indicated in Table 4a. The speed of insertion and withdrawal shall be approximately 0,01 m/s with a rest in the unmated position of approximately 30 s.

7.3.10 Bending (flexing) test

Non-rewirable connectors shall be subjected to a bending test in an apparatus similar to that shown in Figure 2.

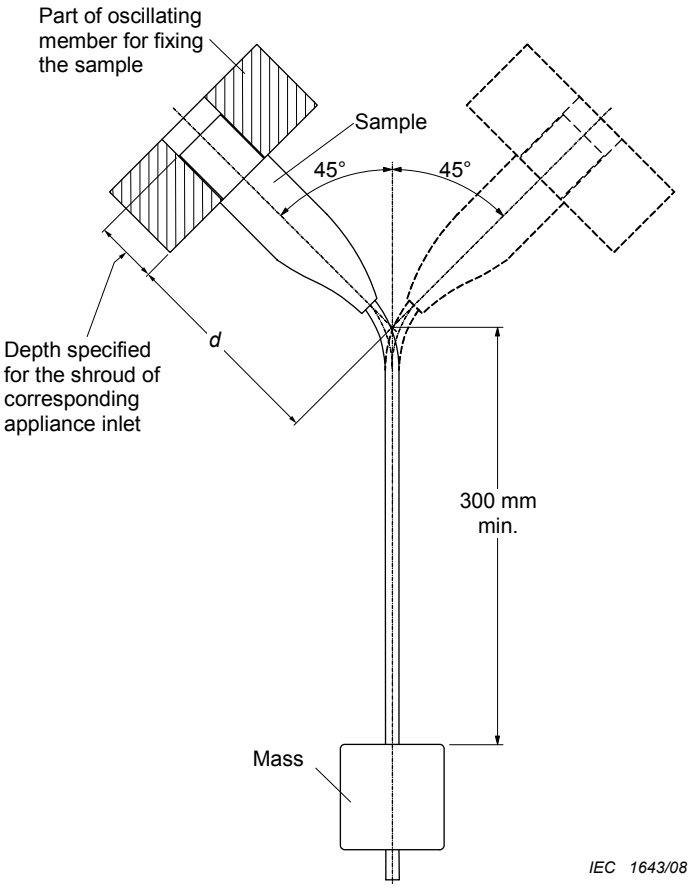

Figure 2 – Device for the bending test

The specimen is fixed to the oscillating member of the apparatus so that, when this is at the midpoint of its travel, the axis of the flexible cable, where it enters the specimen, is vertical and passes through the axis of oscillation.

The oscillating member is, by variation of distance *d* shown in Figure 2, so positioned that the flexible cable makes a minimum lateral movement when the oscillating member of the test apparatus is moved over its full travel.

The cable is loaded with a weight such that the force applied is

- 20 N for non-rewirable connectors with a conductor cross-sectional area > 0,75 mm^2;
- 10 N for non-rewirable connectors with a conductor cross-sectional area ≤ 0,75 mm^2.

A current equal to the rated current of the connector is passed through the conductors, the voltage between them being the rated voltage. The protective conductor, if any, shall be loaded with a sufficient current to perform the continuity test.

The oscillating member is moved backwards and forwards through an angle of 90° (45° on either side of the vertical). The number of bendings shall be specified by the DS or the manufacturer's specification. Preferred values are given in Table 4b. The rate of bendings shall be 60 per minute. One bending is one movement, either backwards or forwards.

Specimens with cables of circular cross-sectional area shall be rotated approximately 90° around the vertical axis within the oscillating part after 50 % of flexings; specimens with flat flexible cables are only bent in a direction perpendicular to the plane containing the axis of the conductor.

During this test, there shall be no interruption of the test current and no short-circuit between the conductors, including the protective conductor, if any.

After the test there shall be no damage; the cable support sleeve shall not be loosened from the body and the insulation shall show no signs of abrasion or of wear and tear. Broken strands shall not pierce the insulation.

7.3.11 Measurement of clearances and creepage distances

Clearances and creepage distances shall be measured according to IEC 60664-1 with the following additional requirements.

For connectors without breaking capacity (COC), clearances and creepage distances to the accessible surface shall be measured only in the mated position.

The surface of an unenclosed connector to be incorporated into an equipment or a device shall not be regarded as accessible, unless otherwise claimed by the manufacturer.

7.3.12 Dielectric strength

If the manufacturer or the DS specifies a value for the rated impulse voltage, test a) shall be conducted. Otherwise, test b) shall be conducted. For the verification of the solid insulation, test b) shall be used.

a) Impulse withstand test
The impulse withstand test shall be carried out with a voltage having a 1,2/50 µs waveform according to IEC 60060-1 with three impulses of each polarity and an interval of at least 1 s between pulses. The output impedance of the impulse generator should not be higher than 500 Ω. The test voltage shall be taken from Table 8.

b) Voltage proof (test 4a of IEC 60512)
The voltage proof test shall be performed by applying a r.m.s. withstand voltage with values as specified in Table 8 according to test 4a of IEC 60512. The test duration shall be 1 min.

Table 8 – Test voltages

Rated impulse voltage U_{imp} kV	Test voltages Impulse withstand voltage[a] kV (1,2/50 µs)		r.m.s. withstand voltage kV (50/60 Hz)
	At 2 000 m	At sea level	
0,5	0,5	0,55	0,37
0,8	0,8	0,91	0,50
1,5	1,5	1,75	0,84
2,5	2,5	2,95	1,39
4	4	4,8	2,21
6	6	7,3	3,31
8	8	9,8	4,26
12	12	14,8	6,60

a If the test laboratory is located between sea level and an altitude of 2 000 m, interpolation of the impulse withstand voltage is allowed.

NOTE This table uses the characteristics of an inhomogeneous field, case A of IEC 60664-1 (worst case).

7.3.13 Resistance between accessible metal parts and the protective earthing contact

A current of 1,5 times the rated current with a maximum of 25 A derived from a source having an open voltage not exceeding 12 V is passed through the protective earthing contact and each of the accessible metal parts in sequence.

The voltage drop between the protective earthing contact and the accessible metal part is measured after steady conditions have been established and the resistance is calculated from the current and this voltage drop.

This test shall be carried out on the engaged specimen only.

In no case shall the resistance exceed the maximum value given in 6.5.3.

7.3.14 Corrosion test

For testing the protection of contacts against the influence of a corrosion atmosphere, one of the two alternative tests shall be selected. In both cases, the specimens shall be mated.

Test 1: Flowing mixed gas corrosion according to test 11g of IEC 60512, with a choice of method 1 or method 4 (see Table 1 of IEC 60512-11-7).

The test duration shall be four days.

Test 2: Sulfur dioxide test with general condensation of moisture according to ISO 6988.

The test duration shall be 24 h (1 test cycle).

7.4 In-process test schedule (routine test) for non-rewirable free connectors

7.4.1 General

For non-rewirable free connectors, it shall be verified that live parts, e.g. free strands, cannot become accessible. If this cannot be ensured by construction or by the production process, the following tests shall be made on 100 % of the production.

7.4.2 Impulse withstand voltage test

The accessible external surface of the connector, with the exception of the engagement face of the male connector, shall be scanned by plane electrodes according to IEC 61032 and each time the specified impulse withstand voltage of the connector shall be applied between all live parts and these electrodes.

Alternatively, the specified r.m.s. withstand voltage according to Table 8 shall be applied for a minimum of three full cycles (i.e. 60 ms at a frequency of 50 Hz).

No breakdown or flashover shall occur.

7.4.3 Continuity of PE path test

For connectors with protective earthing contacts, an electrical continuity test with Safety Extra-Low Voltage (SELV) shall not show any interruption or wrong connection of the protective earth.

7.4.4 AC power-frequency voltage withstand test

A dielectric strength test using the test voltage according to Table 8, applied between all live contacts connected together and the protective earthing contact shall show no breakdown.

7.5 Test schedule

Table 9 – Plan of specimens required for tests

Table	Test group	Number of specimens
10	Group A: mechanical	1
11	Group B: service life	3
12	Group C: thermal	1
13	Group D: climatic	1
14	Group E: degree of protection	2
Sum of test specimens		8
NOTE For a connector family of the same design and comparable size, tests may be made only on that member of the family which represents the worst case for that test.		

Table 10 – Mechanical test group A

1	2	3	4	5	6	7	8
Test phase	**Designation or title**	**IEC 60512 test no.**	**Test accor-ding to**	**Severity or conditions**	**Measurements to be performed**		**Requirements**
					Designation or title	**IEC 60512 test no.**	
A1	Visual and dimensional examination		7.3.11	Any existing cover shall be removed, if required	Visual and dimensional examination	1a, 1b	6.2; 6.9.2; 6.9.3 6.11; 6.19 Dimensions shall comply with the DS or manufacturer's specification
A2	Durability of marking		7.3.2	With the naked eye	Visual examination	1a	Markings according to 6.2
A3	Polarisation and coding	13e		- For unenclosed connectors (internal connections) 20 N - For enclosed connectors (external connections) 1,5 × mating force, but not higher than 80 N			6.3; 6.9.1
					Visual examination	1a	No damage likely to impair function
A4	Provisions for earthing		7.3.3		First make last break		6.5.1
				Any existing covers shall be removed, if required	Visual examination	1a	6.5.4
A5	Interlock		7.3.4				6.7
A6	Terminations						6.6

Table 10 *(continued)*

1	2	3	4	5	6	7	8
Test phase	**Designation or title**	**IEC 60512 test no.**	**Test accor-ding to**	**Severity or conditions**	**Measurements to be performed**		**Requirements**
					Designation or title	**IEC 60512 test no.**	
A7	Contact retention in insert	15a		Test load shall be three times the specified insertion force (mating) of one contact or the specified insertion force of one contact plus 50 N, whichever is less. The minimum test load shall not be less than 20 N.			6.18.2
					Visual examination	1a	No axial displace-ment likely to impair normal operation
A8.1	Cable clamp resistance to cable pull	17c		With cables having the largest and smallest diameter suitable for clamping specified in the DS or by the manufacturer. Any existing covers associated with the cable anchorage shall be mounted as specified.	Visual examination	1a	6.17, Table 6
A8.2	Cable clamp resistance to cable torsion	17d			Visual examination	1a	6.17, Table 6
A9	Mechanical strength impact	7b		Only free connectors and CBCs Dropping height: – 750 mm for specimens of mass ≤250 g – 500 mm for specimens of mass >250 g Dropping cycles: 8 Positions in 45° steps, one cycle per position			6.18.1 6.18.3
					Visual examination	1a	Parts used for protection against electric shock shall not be damaged. A reduction of clearances and creepage distances is not allowed

Table 11 – Service life test group B

1	2	3	4	5	6	7	8
Test phase	**Designation or title**	**IEC 60512 test no.**	**Test according to**	**Severity or conditions**	**Measurements to be performed**		**Requirements**
					Designation or title	**IEC 60512 test no.**	
B1	Initial measure-ment			Test current: 1 A or the rated current. Measuring points[b]: At the end of the termination. Maximum three contacts per specimen plus protective earthing contact, if any.	Contact resistance	2b	Reference value for subsequent measurement
B2	Breaking capacity		7.3.5	For CBCs only			6.14.2
				Breaking capacity with operating cycles according to manufacturer's specification	Visual examination	1a	No damage shall occur which could impair normal use
B3	Mechanical operation	9a	7.3.9				6.14.1
				Number of operating cycles according to manufacturer's specification	Visual examination	1a	No damage shall occur which could impair normal use
B4	Final measure-ment			Same conditions as for test phase B1	Contact resistance	2b	The change of contact resistance shall be no more than 50 % of the reference value or ≤5 mΩ. The higher value is permissible
			7.3.12 b) or a) and b)	Same conditions as for test phase D6	a) Impulse withstand voltage		6.13 There shall be no breakdown or flashover
					b) Voltage proof	4a	
B5	Bending test[a]		7.3.10	Only non-rewirable connectors	Visual examination	1a	6.14.3 No damage shall occur which could impair normal use

[a] The bending test is performed on new specimen.

[b] Measuring points: At the conductors as close as possible to the termination. If this is not possible, the conductor resistance shall be recalculated.

Table 12 – Thermal test group C

1	2	3	4	5	6	7	8
Test phase	**Designation or title**	**IEC 60512 test no.**	**Test accor-ding to**	**Severity or conditions**	**Measurements to be performed**		**Requirements**
					Designation or title	**IEC 60512 test no.**	
C1	Temperature rise	5a	7.3.8	Mated specimen			6.16 The specified upper limiting temperature (ULT) shall not be exceeded

Table 13 – Climatic test group D

1	2	3	4	5	6	7	8
Test phase	**Designation or title**	**IEC 60512 test no.**	**Test according to**	**Severity or conditions**	**Measurements to be performed**		**Requirements**
					Designation or title	**IEC 60512 test no.**	
D1	Initial measurement			Mated specimen Test current: 1 A or the rated current Measuring points[b]: At the end of the termination Maximum three contacts per specimen plus protective earth contact, if any	Contact resistance	2b	Reference value for subsequent measurement
D2	Cold	11j		Mated specimen Test temperature: lower limiting temperature specified for the specimen Test duration 2 h			6.6.3, 6.8; 6.15; 6.18.3
					Visual examination	1a	No damage shall occur which could impair normal use
D3	Dry heat	11i		Mated specimen Test temperature: Upper limiting temperature specified for the specimen Test duration: 7 days			6.6.3, 6.8; 6.15; 6.18.3
					Visual examination	1a	No damage shall occur which could impair normal use
D4	Flowing mixed gas corrosion	11g	7.3.14	Test 1 – Specimen mated			6.21
	Alternative: Corrosion test according to ISO 6988		7.3.14	Test 2 – Specimen mated	Visual examination	1a	No damage shall occur which could impair normal use
D5	Final measurement			Same conditions as for test phase D1	Contact resistance		No damage shall occur which could impair normal use
						2b	The contact resistance rise shall be no more than 50 % of the reference value or ≤5 mΩ. The higher value is permissible
D6	Dielectric strength		7.3.12 b)	Mated specimen Measuring points[b]: contact/contact contact/earth[a]	a) Impulse withstand voltage		6.13 There shall be no breakdown or flashover
				Test voltage (impulse withstand voltage or the r.m.s. withstand voltage) according to Table 7 shall be applied	b) Voltage proof	4a	

a Earth in the sense of non live metal parts (e.g. fixing devices/housings/accessible surfaces).

b Measuring points: At the conductors, as close as possible to the termination. If this is not possible, the conductor resistance shall be recalculated.

Table 14 – Degree of protection, test group E

1	2	3	4	5	6	7	8
Test phase	**Designation or title**	**IEC 60512 test no.**	**Test accor-ding to**	**Severity or conditions**	**Measurements to be performed**		**Requirements**
					Designation or title	**IEC 60512 test no.**	
E1	Protection against electric shock (for clarification)		7.3.6.1	Unenclosed connectors. Test finger or 50 mm sphere pressed with 20 N against the surfaces as specified by the manufacturer. Mated specimen			No live part shall be accessible 6.4.2.2 or 6.4.2.3
			7.3.6.2	Enclosed connectors. Mated and unmated specimen. Test finger pressed with 20 N against the surfaces except the mating face of the male part of the connector.	Visual examination	1a	Required clearances and creepage distances shall be ensured between all live parts and the test finger 6.4.1 6.4.3
E2	Provision for earthing		7.3.13	Resistance between accessible metal parts and the earthing contact			6.5.3
E3	Degree of protection IP code		7.3.6.3 7.3.7	IP code as specified by the manufacturer or by the DS			6.12

Annex A
(informative)

Information to be specified in the detail specification, if any, or manufacturer's specification

A.1 Information already given on the product, its packaging and in the manufacturer's technical documentation

a) Manufacturer's name, trade mark or mark of origin
b) Type identification
c) Rated current in ampere (A)
d) Rated voltages or rated insulation voltages between line to earth and line to line in volt (V)
e) Rated impulse voltage in kilovolt (kV), if specified
f) Pollution degree
g) Degree of protection by enclosure according to IEC 60529, IP code, if applicable
h) Temperature range (LLT –ULT)
i) Type of terminals
j) Connectable conductors
k) Reference to this standard or to the detail specification (DS), if applicable

A.2 Additional information available on request of the user

All connectors (CBCs and COCs):

- derating curves according to IEC 60512, test 5b;
- number of no-load operating cycles;
- with or without protective earthing contact;
- with or without interlock;
- connector for class II equipment;
- glow-wire flammability index (GWFI) of connector materials according to IEC 60695-2-12;
- needle flame test according to IEC 60695-11-5;
- ball pressure test according to IEC 60695-10-2.

Fixed connectors, only:

- mounting means.

Free connectors, only:

- cable clamp;
- range of cable diameter;
- number of bendings, if non-rewirable.

Unenclosed connectors:

- handback or finger safety when mated.

Connectors with breaking capacity (CBCs) only:

- number of on-load operating cycles;
- nature of the supply voltage (a.c. and/or d.c.).

A.3 Information for testing additional to those mentioned above

- Insulating material group (CTI value) of the insulating material.

  It is recommended to check the insulating material group by the PTI value.
- Relevant detail specification, if available, for example loaded temperature according to IEC 60512, Test 9b.

Annex B
(informative)

Additional information on connector classification

Table B.1 – Scheme of connectors

5.4 Additional characteristics **c)** **Connector without breaking capacity** **(COC)**	**5.2a) Unenclosed** connector 3.7 unenclosed connector Connector, for which the protection against electric shock is provided by the enclosure of the equipment in which the connector is mounted.	**C2)** with protection against electric shock for back of hand safety, when mated;
		C3) with protection against electric shock for finger safety, when mated.
	5.2b) Enclosed connector 3.6 enclosed connector Connector for which the protection against electric shock is ensured by the housing of the connector itself.	**C2)** with protection against electric shock for back of hand safety, when mated;
		C3) with protection against electric shock for finger safety, when mated.
	5.2c) Connector for class II equipment Connector in which the protection against indirect contact is realised by double or reinforced insulation.	**C3)** with protection against electric shock for finger safety, when mated.

5.4 Additional characteristics **d)** **Connector with breaking capacity (CBC)**	**5.2a) unenclosed** connector 3.7 unenclosed connector Connector, for which the protection against electric shock is provided by the enclosure of the equipment in which the connector is mounted.	with protection against electric shock for finger safety only, both in mated and unmated condition.
	5.2b) enclosed connector 3.6 enclosed connector Connector for which the protection against electric shock is ensured by the housing of the connector itself.	
	5.2c) Connector for class II equipment Connector in which the protection against indirect contact is realised by double or reinforced insulation.	with protection against electric shock for finger safety only, both in mated and unmated condition.

Connectors should be applied in the energy flow direction of the circuit in such way that the accessible contacts are not energized in unmated condition.

This recommendation does not apply to connectors with breaking capacity (CBC) and connectors without breaking capacity (COC) which are so locked to each other, that they can only be disconnected by the aid of a tool or which are so mounted in an encapsulated equipment or system that the protection against electric shock is assured by the enclosure (housing) of the equipment or system.

If these conditions are met, connectors are considered as enclosed even if the pins are accessible in unmated condition and, in mated condition, all active parts are protected against indirect contact.

Table B.2 – Help for the classification of connectors

Main feature			Style			Enclosure			Function			Connection methods		
		Sub-clause			Sub-clause			Sub-clause			Sub-clause			Subclause 5.4 j)
☐	**Connector without breaking capacity (COC)**	3.8				**Protection against electric shock**			**Protective conductor**			☐	Wrapped connections	IEC 60352-1
			☐	Free connector	3.2 5.3 b)	☐	Unenclosed	5.2 a)	☐	with PE	5.4 a) 6.5	☐	Crimp connections	IEC 60352-2
			☐	Fixed connector	3.3 5.3 a)		☐ HBS mated	5.4 c) 2) 6.4.2.2	☐	without PE	5.4 b)	☐	Insulation displacement connections	IEC 60352-3 (accessible IDC) or IEC 60998-2-3
			Cable clamp		6.17		☐ FS mated	5.4 c) 3) 6.4.2.3	**Interlock**			☐	Insulation displacement connections	IEC 60352-4 (non-accessible IDC) or IEC 60998-2-3
			☐	with		☐	Enclosed	5.2 b)	☐	Yes	3.12 5.4 f) 6.7	☐	Press-in connections	IEC 60352-5
			☐	without			☐ FS mated and unmated	5.4 d)	☐	No	5.4 g)	☐	Insulation piercing connections	IEC 60352-6 or IEC 60998-2-3
☐	**Connector with breaking capacity (CBC)**	3.7	**Kind of connection**				☐ IP-Code	5.4 e) 7.3.6.3				☐	Screwless-type clamping units	IEC 60999-1 or IEC 60999-2 or IEC 60352-7
			☐	rewirable	3.4 5.4 i)								Screw-type clamping units	IEC 60999-1 IEC 60999-2
			☐	non-rewirable	3.5 5.4 h)	**Protection class**						☐	Flat, quick-connect terminations	IEC 61210 IEC 60760
						☐	I					☐		
						☐	II	3.10 5.2 c) 6.5.2				☐		

NOTE 1 HBS Back of hand safety

NOTE 2 FS Finger safety

Bibliography

IEC 60068-2-20:1979, *Environmental testing – Part 2: Tests. Test T: Soldering*
Amendment 2 (1987)

IEC 60112:2003, *Method for the determining of the proof and the comparative tracking indices of solid insulating materials*

IEC 60364-5-54:2002, *Electrical installations of buildings – Part 5-54: Selection and erection of electrical equipment – Earthing arrangements, protective conductors and protective bonding conductors*

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

IEC 60695-2-12, *Fire hazard testing – Part 2-12: Glowing/hot-wire based test methods – Glow-wire flammability test method for materials*

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

IEC 60695-11-5, *Fire hazard testing – Part 11-5: Test flames – Needle-flame test method – Apparatus, confirmatory test arrangement and guidance*

IEC 60998-2-1:2002, *Connecting devices for low-voltage circuits for household and similar purposes – Part 2-1: Particular requirements for connecting devices an separate entities with screw-type clamping units*

IEC 60998-2-2:2002, *Connecting devices for low-voltage circuits for household and similar purposes – Part 2-2: Particular requirements for connecting devices as separate entities with screwless-type clamping units*

This page deliberately left blank

British Standards Institution (BSI)

BSI is the independent national body responsible for preparing British Standards. It presents the UK view on standards in Europe and at the international level.

It is incorporated by Royal Charter.

Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover.

Tel: +44 (0)20 8996 9000 Fax: +44 (0)20 8996 7400

BSI offers members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

Buying standards

Orders for all BSI, international and foreign standards publications should be addressed to BSI Customer Services.

Tel: +44 (0)20 8996 9001 Fax: +44 (0)20 8996 7001
Email: orders@bsigroup.com

You may also buy directly using a debit/credit card from the BSI Shop on the website **www.bsigroup.com/shop**

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

Information on standards

BSI provides a wide range of information on national, European and international standards through its Library.

Various BSI electronic information services are also available which give details on all its products and services. Contact the Information Centre.

Tel: +44 (0)20 8996 7111
Fax: +44 (0)20 8996 7048 Email: info@bsigroup.com

Subscribing members of BSI are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration.

Tel: +44 (0)20 8996 7002 Fax: +44 (0)20 8996 7001
Email: membership@bsigroup.com

Information regarding online access to British Standards via British Standards Online can be found at **www.bsigroup.com/BSOL**

Further information about BSI is available on the BSI website at **www.bsigroup.com**

Copyright

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

Tel +44 (0)20 8996 9001
Fax +44 (0)20 8996 7001
www.bsigroup.com/standards

raising standards worldwide™

British Standards