

INTERNATIONAL STANDARD



Installation couplers intended for permanent connection in fixed installations

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INTERNATIONAL
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COMMISSION

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**INSTALLATION COUPLERS INTENDED FOR PERMANENT
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IEC 61535 has been prepared by IEC technical committee 23: Electrical accessories. It is an International Standard.

This third edition cancels and replaces the second edition published in 2019. This edition constitutes a technical revision.

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

- a) inclusion of a definition for "live part" based on IEC 61140;
- b) additional optional cross medial documentation, e.g. marking with QR-Code;
- c) corrections on the consistent use of the expressions "earth", "earthing contact", "earthing circuit" and "protective earth(ing)" throughout the document;
- d) addition of missing compliance provisions to 13.3;
- e) update of Figure D.1 of Annex D;
- f) inclusion of new Annex F for cold climate requirements.

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

Draft	Report on voting
23/1062/FDIS	23/1066/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

In this standard, the following print types are used:

- requirements proper: in roman type;
- *test specifications: in italic type;*
- explanatory matter: in smaller roman type.

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- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

AC and DC installation couplers according to this document may be used, for example, in prefabricated buildings, commercial showrooms, installation cavities, such as suspended floors and ceilings, in partition walls and in any similar applications, or cable tray systems, cable ladder systems, cable ducting systems and cable trunking systems or in furniture complying with IEC 60364-7-713.

This document may be used as a guide for installation couplers with additional contacts for voltages other than mains voltages.

Particular requirements for installation couplers, for example, for use at higher or lower ambient temperatures, with higher mechanical durability (e.g. metal housings), with higher fire resistance and for use in control circuits (e.g. SELV), are under consideration.

National rules can have requirements concerning the accessibility of installation couplers.

National rules can specify who is allowed to carry out the connection and disconnection of installation couplers.

National rules can have requirements concerning installation couplers with metal conduits.

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INSTALLATION COUPLERS INTENDED FOR PERMANENT CONNECTION IN FIXED INSTALLATIONS

1 Scope

This document applies to two-wire, up to five-wire installation couplers, ~~including earth~~ with or without earthing contact, if provided, with a rated voltage up to and including 500 V AC or 500 V DC and a rated connecting capacity up to and including 10 mm² and a rated current not exceeding 32 A for permanent connection in electrical installations. Installation couplers with additional contacts for voltages other than mains voltages are outside the scope of this document.

An installation coupler consists of an installation female connector and an installation male connector for permanent connection not intended to be engaged or disengaged under load nor to be engaged or disengaged other than during first installation or during reconfiguration or maintenance of the wiring system in which installation couplers have been installed. This means that installation couplers are intended for infrequent use only.

Installation couplers are not suitable for use in place of socket-outlet systems. Installation couplers are not suitable for use in place of devices for connecting luminaires (DCLs) according to IEC 61995 (all parts) or in place of luminaire supporting couplers (LSCs).

Installation couplers complying with this document are suitable for use at ambient temperatures not normally exceeding +40 °C, but their average over a period of 24 h does not exceed +35 °C, with a lower limit of the ambient air temperature of –5 °C, either for indoor or outdoor use.

NOTE 1 Additional tests for use in cold climates are ~~under consideration~~ shown in Annex F, which is normative in following countries: FI. Necessary information can be given in the manufacturer's installation instructions.

NOTE 2 For other temperatures, necessary information can be given in the manufacturer's installation instructions.

In locations where special conditions prevail, as in ships, vehicles and the like and in hazardous locations, for example where explosions are liable to occur, special constructions can be required.

NOTE 3 Installation couplers are intended to be installed by instructed or skilled persons.

NOTE 4 As a guide to using installation coupler systems, see Annex D.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60068-2-31:2008, *Environmental testing – Part 2-31: Tests – Test Ec: Rough handling shocks, primarily for equipment-type specimens*

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

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

IEC 60664-1:2007/2020, *Insulation coordination for equipment within low-voltage supply systems – Part 1: Principles, requirements and tests*

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

IEC 60998-2-3, *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 mm² up to 35 mm² (included)*

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

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

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

Where the terms "voltage" and "current" are used in this document, they are RMS values, unless otherwise specified.

3.1

rated voltage

voltage assigned to the installation coupler by the manufacturer

3.2

rated current

maximum current assigned to the installation coupler by the manufacturer

Note 1 to entry: Rated current refers to the installation coupler itself and not to an electric circuit.

3.3

rated connecting capacity

cross-sectional area of the largest conductor(s) to be connected as stated by the manufacturer of the installation coupler

3.4

permanent connection

connecting method in an installation which is only opened for maintenance or wiring system re-configuration

Note 1 to entry: The expression "permanent connection" is to be understood as a connection which is maintained as long as an installation exists.

3.5

installation coupler

connecting device consisting of an installation female connector and an installation male connector provided with retaining means for permanent connection not intended to be engaged or disengaged under load nor to be engaged or disengaged other than during first installation, during maintenance of the wiring system or during re-configuration of the wiring system

3.6**installation male connector**

load side portion of an installation coupler which contains the male contacts

3.7**installation female connector**

supply side portion of an installation coupler which contains the female contacts

3.8**installation coupler system**

family of installation couplers consisting of one or more installation female connectors compatible by mechanical coding features with one or more installation male connectors, with the same ratings produced according to the specification of one manufacturer

Note 1 to entry: The meaning of "one manufacturer" in this case, is "one and the same manufacturer".

3.9**wiring system**

assembly made up of a cable or cables or busbars and the parts which secure and if necessary enclose the cables or busbars

[SOURCE: IEC 60364-5-52:2009, 520.3.1, modified – "bare or insulated conductors" has been replaced with "a cable".]

3.10**rewirable installation coupler**

installation coupler so constructed that the cable can be replaced

3.11**non-rewirable installation coupler**

installation coupler so constructed that it forms a complete unit with the cable after connection and assembly by the manufacturer

Note 1 to entry: See also 12.15.

3.12**non-rewirable moulded-on installation coupler**

non-rewirable installation coupler so constructed that the contacts, terminals or connections and the attached cable ends are surrounded by insulating material manufactured by a moulding process

3.13**non-rewirable non-moulded-on installation coupler**

non-rewirable installation coupler so constructed that the contacts, terminals or connections and the attached cable ends are surrounded by separate parts of insulating material

3.14**distribution block**

device intended for branching of circuits

3.15**retaining means**

arrangement by which an installation female connector and an installation male connector are held in position when they are properly engaged and prevents unintentional disengagement

Note 1 to entry: The disengagement may be done by hand or by the use of a tool.

3.16

cap

removable barrier to prevent ready accessibility to an unused installation female connector

3.17

routine test

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

3.18

type test

test of one or more devices made to a certain design to show that the design meets certain requirements

3.19

readily accessible, adj

~~accessibility~~ accessible to touch ~~extending~~ from any point on a surface where persons usually stand or move about to the limits which a person can reach with the hand, in any direction without assistance

Note 1 to entry: See IEC 60364-4-41:2005, Annex B.

3.20

terminal

part of an accessory to which a conductor is attached, providing a reusable connection

3.21

termination

part of an accessory to which a conductor is permanently attached

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

3.22

live part

conductive part intended to be energized in normal conditions, including a neutral conductor or mid-point conductor, but by convention not a PEN conductor or PEM conductor or PEL conductor

Note 1 to entry: This concept does not necessarily imply a risk of electric shock.

[SOURCE: IEC 61140:2016, 3.4]

4 General requirements

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

Compliance is checked by carrying out all the relevant tests specified in this document.

NOTE In ~~the USA, these~~ some countries, installation couplers are not permitted to be used where they will not be visible after installation: CA, US.

5 Conditions for tests

5.1 General

Tests shall be carried out to check compliance with the relevant requirements of this document.

Only connectors (male and female) of one installation coupler system according to the specification of one and the same manufacturer shall be mated together for carrying out the test.

Tests are as follows:

- type tests shall be made on representative specimens of each type of installation coupler;
- routine tests shall be made on each installation coupler as required in this document.

Tests of 5.2 to 5.6 are applicable to type tests and 5.7 to routine tests.

NOTE In the UK, where installation couplers have more than 5 wires, they shall meet the requirements of IEC 61535 as though they were included in the scope and shall be tested in such a way that all of the mains voltage pins are subjected to the same level of testing.

5.2 Test conditions

Unless otherwise specified, the tests shall be carried out on specimens as delivered and under conditions of normal use at an ambient temperature between 15 °C and 35 °C.

Where the value of the temperature is of importance, the test shall be carried out at 20 °C ± 5 °C.

5.3 Tests on non-rewirable installation couplers

For testing purposes, non-rewirable installation couplers shall be provided with cables of at least 1 m length unless otherwise specified in this document.

5.4 Order of tests

If not otherwise specified in this document, the tests shall be carried out in the order of the clauses/subclauses as specified in Annex C, Table C.1.

5.5 Specification of tests

Installation male connectors, caps, installation female connectors and distribution blocks shall be tested in connection with their matching counterparts complying with this document.

The sets of test specimens shall undergo the tests as specified in Annex C, Table C.1.

5.6 Compliance requirements

Specimens are deemed not to comply with this document if there is more than one specimen failure in any one of the tests.

If one specimen of a given set fails in a test due to an assembly or manufacturing fault, that test and those preceding it, which may have influenced the result of that test, are repeated on another set of specimens of the same set number as specified in Annex C, Table C.1, all of which shall then comply with the repeated tests.

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

5.7 Routine tests for non-rewirable installation couplers

Routine tests for non-rewirable installation couplers are specified in Annex A.

6 Ratings

6.1 Rated voltage

Installation couplers should preferably have a rated voltage chosen either from Table 1 for AC application or from Table 2 for DC application.

All components of the same installation coupler system shall have the same phase to neutral voltage rating.

Table 1 – Voltage rating for installation couplers in AC application

Nominal voltage of power supply system V	Rated voltage V	Rated impulse voltage kV
100	125	2,5
100/200	125/250	2,5
230	250	4,0
230/400	250/400	4,0
277/480	320/500	4,0

Table 2 – Voltage rating for installation couplers in DC application

Nominal voltage of power supply system V	Rated voltage V	Rated impulse voltage kV
12	12	to-be-defined 0,8
60	60	to-be-defined 1,5
120 ^a to 240 ^b	125/250	2,5
220 ^a to 440 ^b	250/500	4,0

NOTE For DC applications up to 60 V, due to load switching, much higher voltages than the rated voltage are also possible, therefore the complete circuit ~~has to~~ can be considered when defining the rating for impulse voltage.

^a Voltage live conductor against reference conductor / earth.

^b Voltage live conductor (+ / – polarity).

6.2 Rated current

Installation couplers should preferably have a rated current chosen from the following values:

- 10 A
- 13 A
- 16 A
- 20 A
- 25 A
- 32 A.

6.3 Rated connecting capacity

Installation couplers should preferably have a rated connecting capacity chosen from the following values:

- 1,5 mm²
- 2,5 mm²
- 4 mm²
- 6 mm²
- 10 mm²

6.4 Tests

Compliance with 6.1, 6.2 and 6.3 is checked by inspection of markings according to Clause 8.

7 Classification

Installation couplers are classified according to Table 3.

Table 3 – Classes Classification of installation couplers

Criterion		Classification criteria		Possible classes of installation couplers	
7.1	Rated impulse voltage	7.1.1	2,5 kV		
		7.1.2	4 kV		
7.2	Method of connecting the cable	7.2.1	Rewirable		
		7.2.2	Non-rewirable		
		7.2.2.1	Non-rewirable moulded-on		
		7.2.2.2	Non-rewirable non-moulded-on		
7.3	Degree of protection against ingress of solid foreign objects and ingress of water according to IEC 60529 (IP-Code)				
7.4	Location where installation couplers will be installed	7.4.1	Readily accessible ^a		
		7.4.2	Non-readily accessible		
7.5	Existence of an earthing contact	7.5.1	With earthing contact		
		7.5.2	Without earthing contact		
7.6	Type of conductors to be connected	7.6.1	Solid		
		7.6.2	Rigid (solid and stranded)		
		7.6.3	Flexible		
		7.6.4	Both rigid (solid and stranded) and flexible		
7.7	Type of terminals for rewirable installation couplers only	7.7.1	Installation couplers with screw-type terminals		
		7.7.2	Installation couplers with screwless terminals		
		7.7.3	Installation couplers with insulation piercing terminals		
7.8	Application	7.8.1	AC		
		7.8.2	DC		
^a Installation couplers for readily accessible areas can also be used in non-readily accessible areas.					

8 Marking and documentation

8.1 General

Installation couplers shall be marked with:

- a) rated current in amperes (A);
- a) rated voltage in volts (V);
- b) manufacturer's or responsible vendor's name, trademark or identification mark;
- c) IP-code if higher than IP43 as follows:

The first characteristic numeral for the degree of protection against access to hazardous parts and against harmful effects due to ingress of solid foreign objects shall be marked if declared to be higher than 4, in which case the second characteristic numeral shall also be marked.

The second characteristic numeral for the degree of protection against harmful effects due to ingress of water shall be marked if declared to be higher than 3, in which case the first characteristic numeral shall also be marked;

- d) type reference;
- e) rated connecting capacity for rewirable installation coupler in mm²;
- f) connected conductor size in mm² for non-rewirable installation coupler;
- g) DC, when constructed to be used in direct current systems;
- h) a warning symbol according to Annex E, when constructed to be used in a DC system. For connectors too small to have a marking, a separate label with this warning symbol shall be available for installation couplers for direct current.

8.2 Use of symbols or letters

When symbols or letters are used, they shall be as follows:

- | | |
|---|---|
| • rated connecting capacity in square millimetres | mm ² or □ |
| • volts | V |
| • amperes | A |
| • alternating current | ~ or AC |
| • direct current | =  or DC |
| • positive pole (in DC systems) | + |
| • negative pole (in DC systems) | - |
| • neutral | N |
| • mid-point | M |
| • earth |  or PE
(IEC 60617-S00200:2001-07) |
| • protective earth |  or PE (IEC 60417-5019:2006-08) |

8.3 Markings

Markings on the installation coupler and label according to items in 8.1 shall be readily visible before installation.

Terminal markings for AC application shall be L1, L2, L3 or 1, 2, 3, or equivalent. Neutral terminals shall be marked with N. Terminal markings for DC application shall be L+, L-, +, -,

or equivalent. Mid-point terminals shall be marked with M. ~~Earth~~^{Protective earth} terminals shall have the relevant marking. These markings shall not be placed on screws, removable washers or any other easily removable parts.

If terminals are designed to accept only one type of conductor, for example, flexible, or rigid (stranded or solid), this shall either be clearly marked on the installation coupler by the letter "f" for flexible or "r" for rigid or "s" for solid or shall be indicated on the smallest packaging unit or in the technical information and catalogue.

Markings and labels shall be durable and clearly legible with normal or corrected vision, without additional magnification.

Compliance is checked by inspection and by the following test:

The marking is rubbed by hand for 15 s with a piece of cloth soaked with water and again for 15 s with a piece of cloth soaked with petroleum spirit.

~~NOTE—Petroleum spirit is defined as an aliphatic solvent hexane with a content of aromatics of maximum 0,1 volume percentage, a kauri-butanol value of 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.~~

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

A warning label for DC use "Do not connect or disconnect under load" according to Annex E shall be provided.

8.4 Documentation

The manufacturer's catalogue or installation instructions shall contain the following information:

- a) installation couplers are intended for connection and disconnection without load only;
- b) types of cables intended to be fitted into the installation couplers;
- c) if the installation coupler is not suitable for installation in readily accessible areas;
- d) if additional parts or precautions are necessary for use in readily accessible areas;
- e) an appropriate marking indicating the length of insulation to be removed before the insertion of the conductor into the screwless terminal;
- f) length of slack of a PE conductor for rewirable installation couplers (see 12.14);
- g) warning advising the installer that dangerous compatibility between different manufacturer installation coupler systems is not automatically prevented by compliance with IEC 61535;
- h) statement that installation coupler systems are not replacements for the national ~~domestic~~^{household} plug and socket outlet system;
- i) if looping-in is intended, wiring instructions shall be specified in the manufacturer's technical documentation;
- j) for DC use, a label "Do not connect or disconnect under load" according to Annex E shall be provided by the manufacturer. Instruction to the installer shall be provided in the installation instructions to attach the warning label as close as possible to the installation coupler for direct current;
- k) statement that installation couplers shall be used with the retaining means as provided by the manufacturers (see 12.10).

All documentation may additionally be given cross-medial.

~~NOTE~~ For example, QR-codes with reference to internet, electronic catalogues, web-link on the package unit or delivery papers, etc.

The installation instructions shall be available in the manufacturer's catalogue, in the technical documentation or inside or on the smallest packaging unit.

9 Dangerous compatibility

9.1 Unintended or improper connection

An installation coupler system shall be designed and constructed so that unintended or improper connection is prevented.

An installation coupler system shall be designed and constructed so that connection between alternating current and direct current is prevented.

NOTE Unintended or improper connection includes single-pole connection, except for ~~earth-to-earth connection~~ earthing contact to earthing contact.

Compliance is checked by inspection and the following test.

It shall not be possible to insert the installation male connector into the installation female connector resulting in a dangerous situation.

Engagement of the installation male and installation female connector is attempted in any unintended configuration using a force of 80 N for installation couplers marked as "10 A", "13 A", "16 A" and "20 A" or a force of 120 N for installation couplers marked as "25 A" and "32 A". The force shall be applied on the same axis of the connection for 1 min during which time the installation male and installation female connector contacts shall not engage.

Where the use of elastomeric or thermoplastic material is likely to influence the results of the test, it shall be carried out at an ambient temperature of $35\text{ °C} \pm 2\text{ °C}$, all parts of the installation coupler being at this temperature.

During the test, no contact shall occur.

9.2 Engagement

It shall not be possible, within a given installation coupler system, to engage an installation male connector with an installation female connector:

- with a different number of live poles; exceptions may be admitted for installation female connectors which are specially constructed for the purpose of allowing engagement with installation male connectors of a lower number of poles, provided that no dangerous situation can arise;
- without earthing contact if the installation male connector is an installation male connector with earthing contact;
- with different phase to neutral voltage ratings or different rated currents.

Compliance is checked by the test in accordance with 9.1.

9.3 Compatibility of different installation coupler systems

Installation couplers of different systems from the same manufacturer shall not be dangerously compatible.

Compliance is checked by the test in accordance with 9.1.

9.4 Compatibility with standard systems

Installation couplers in accordance with this document shall not be compatible with systems specified in standard sheets of IEC 60309 (all parts), IEC 60320 (all parts), IEC 60906 (all parts), or with the national household plug and socket-outlet systems of the country where the product is placed on the market.

NOTE Some national plug and socket-outlet systems are shown in IEC TR 60083.

Compliance is checked by manual test and, in case of doubt, by examination of drawings.

10 Protection against electric shock

10.1 Degree of protection against ingress of solid foreign objects

An engaged installation coupler shall comply with the requirements of IP 2XC. The installation coupler shall be so designed that live parts are not accessible if the installation male and installation female connector are partially or completely engaged. The installation female connector shall be so designed that live parts are not accessible when disengaged and shall comply with the requirements for IP 2X. The earthing contact and any metal parts connected to the earthing contact shall not be accessible when the installation coupler is completely engaged, except for installation couplers in metal conduits (where erection rules ask for such practice).

NOTE 1 National rules can have requirements concerning installation couplers with metal conduits.

NOTE 2 Live parts as mentioned in this document are regarded as hazardous parts in accordance with IEC 60529.

Installation couplers for use in readily accessible areas shall comply with IP 2XD both engaged and unengaged.

If the engagement face of the installation female connector for readily accessible areas does not comply with IP 2XD, the manufacturer shall make caps available. These caps shall only be removable with the aid of a tool.

Compliance is checked after the removal of parts which can be removed without the use of a tool by using test probe C in accordance with Figure 3 of IEC 61032:1997, test probe D in accordance with Figure 4 of IEC 61032:1997 and test probe 11 in accordance with Figure 7 of IEC 61032:1997. Test probes are applied in accordance with IEC 60529.

10.2 Access to live parts

It shall not be possible to access live parts without the aid of a tool.

Bushes, if any, in the entry holes for the male contacts shall be adequately fixed and it shall not be possible to remove them without dismantling the installation coupler.

Compliance is checked by inspection and by manual test.

10.3 External parts

External parts of installation couplers, with the exception of assembly screws and the like, shall be of insulating material.

NOTE National rules can have requirements concerning installation couplers with metal housings.

Compliance is checked by inspection.

11 Terminals, terminations and connectable conductors

11.1 Terminals and terminations

11.1.1 General

For installation couplers with clamping units, IEC 60999-1:1999 applies, as applicable, with the exception of the test of 9.10 ~~thereof~~ of IEC 60999-1:1999.

NOTE 1 The test of 9.10 of IEC 60999-1:1999 is covered by the cycling ageing test in accordance with 21.5 of this document.

NOTE 2 The test of 9.8 of IEC 60999-1:1999 is covered by the contact resistance test in accordance with 15.2 of this document.

11.1.2 Terminals of rewirable installation couplers

Rewirable installation couplers shall be provided with screw-type terminals, with screwless terminals or reusable insulation piercing terminals.

Terminals with screw clamping means shall allow the conductor to be connected without any special preparation but shall also allow prepared conductors if specified.

Insulation piercing terminals shall comply with IEC 60998-2-3.

11.1.3 Terminations of non-rewirable installation couplers

Non-rewirable installation couplers shall be provided with soldered, welded, crimped terminations or means for insulation piercing or screwless clamping units or equally effective permanent means.

Screwless terminals and insulation piercing terminals are not allowed for non-rewirable moulded-on installation couplers except when means are included that prevent the moulding material from penetrating into the clamping unit.

Solder-type terminations shall be provided with means that are independent of the solder for mechanically fixing the conductor in position.

Compliance is checked by inspection, ~~measurement and the test of 22.1.~~

11.2 Connectable conductors

Terminals for the rewirable installation female connector and the rewirable installation male connector shall not have smaller rated connecting capacities than as follows:

- 1,5 mm² for installation couplers marked 10 A according to the maximum current rating;
- 1,5 mm² for installation couplers marked 13 A according to the maximum current rating;
- 1,5 mm² for installation couplers marked 16 A according to the maximum current rating;
- 2,5 mm² for installation couplers marked 20 A according to the maximum current rating;
- 4 mm² for installation couplers marked 25 A according to the maximum current rating;
- 6 mm² for installation couplers marked 32 A according to the maximum current rating.

NOTE National wiring rules determine the rating of the circuit in which the relevant installation coupler is allowed to be used.

Compliance is checked by the following test.

Conductors with the indicated cross-sectional areas and types shall be connected and screws shall be tightened with the torque values specified in Table 6. For installation couplers classified according to 7.6.3 and 7.6.4 in Table 3, the test is carried out in conjunction with the test of 12.8.

12 Construction

12.1 ~~Earth~~ Connection between earthing contacts

Installation couplers shall be so constructed that when inserting the installation male connector, the ~~earth~~ connection between earthing contacts, if any, is made at least 1 mm before the current-carrying contacts of the installation male connector become live.

When withdrawing the installation male connector, the current-carrying male contacts shall separate before the ~~earth~~ connection between earthing contacts is broken.

Compliance is checked by inspection of the manufacturing drawings taking into account the effect of tolerances and the most unfavourable positions and by checking the specimens against these drawings and/or by manual test.

12.2 Locking against rotation

Contacts of installation male connectors shall be locked against rotation if male contacts can be touched without the aid of a tool.

Compliance is checked by the following tests.

A torque with a value of 0,4 Nm is applied to the contacts for 60 s in one direction and for 60 s in the opposite direction. The contact parts shall not rotate more than an angle of 30° in total.

NOTE Terminal screws can be used to prevent the contacts from rotating.

12.3 Mechanical strength of contacts

Contacts shall be securely fixed and shall have sufficient mechanical strength. They shall not be removable without the aid of a tool.

~~NOTE~~—This requirement does not exclude floating contacts.

Compliance is checked by inspection and by the following test.

The installation coupler shall be mounted as for normal use and with all contacts installed. Any accessory or cover which is not essential for the contact retaining system may be loosened or removed.

The installation coupler shall be placed in a heating cabinet for 1 h at a temperature of $(70 \pm 2) ^\circ\text{C}$.

Immediately after the heating period, an axial force of 40 N shall be applied to each contact of the installation female connector and installation male connector in both directions consecutively. This force shall be reached by gradual increase at a rate not exceeding 20 N/s until the specified value is reached.

The maximum value shall be maintained for 60 s.

After the test the installation coupler is allowed to cool to room temperature and then no contact shall have been displaced in the body of the installation coupler by more than 1 mm.

12.4 Housing of rewirable installation couplers

The housing of rewirable installation couplers shall completely enclose the terminals and the ends of cable sheaths. It shall be possible to arrange each conductor such that its insulation cannot come into contact with live parts having another polarity.

Compliance is checked by inspection and manual test.

12.5 Housing of non-rewirable installation couplers

The housing of non-rewirable installation couplers shall completely enclose the terminations and the ends of cable sheaths. The conductors shall be so arranged that their insulation cannot come into contact with live parts having another polarity.

Compliance is checked by inspection and manual test.

12.6 Dismantling and opening of rewirable installation couplers

Rewirable installation coupler housings shall be reliably fixed and it shall not be possible to dismantle the installation coupler without the aid of a tool.

For rewirable installation couplers, there shall be independent means for fixing and locating the parts of the installation coupler with respect to each other, at least one of which shall be operated with the aid of a tool for opening.

Compliance is checked by inspection and by manual test.

12.7 Earthing contact and earthing terminal

If the earthing contact and the earthing terminal are not in one piece, the various parts shall be connected together by a reliable manner.

NOTE 1—Clamping units complying with IEC 60999-1:1999, riveting and welding are considered as a reliable manner.

NOTE 2—Clamping screws or the spring of screwless-type clamping units are not considered to be part of the contact.

Compliance is checked by inspection and test in accordance with Clause 16.

12.8 Loose conductor strands

12.8.1 General

Rewirable installation couplers classified according to 7.6.3 or 7.6.4 of Table 3 shall be so designed that loose conductor strands in the installation coupler will not present a risk of electric shock.

For non-rewirable installation couplers, means shall be provided to prevent loose conductor strands from reducing the minimum clearance and creepage distance requirements and the distance through solid insulation between conductors and all accessible external surfaces of the installation coupler, with the exception of the engagement face of the installation male connector of the installation coupler.

Compliance is checked by the following:

- for rewirable installation couplers, the test of 12.8.2;
- for non-rewirable non-moulded-on installation couplers, the test of 12.8.3;

- for non-rewirable moulded-on installation couplers, by verification and inspection according to 12.8.4.

12.8.2 Strand test for rewirable installation couplers

A length of 6 mm of insulation is removed from the end of a flexible conductor, having a minimum cross-sectional area specified by the manufacturer. One strand of the flexible conductor is left free and the remaining strands are fully inserted into and clamped in the terminal, as for normal use.

The free strand is bent, without tearing the insulation back, in every possible direction but without making sharp bends around barriers.

NOTE The prohibition against making sharp bends around barriers does not imply that the free strand has to be kept straight during the test. Sharp bends are, moreover, made if it is considered likely that such bends can occur during the normal assembly of the installation coupler, for example when the cover is pushed on.

It shall not be possible for a free strand of a conductor connected to a live terminal to touch any accessible metal part, be able to emerge from the enclosure or touch an earthing terminal when the installation coupler has been assembled.

It shall not be possible for a free strand of a conductor connected to an earthing terminal to touch a live part.

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

12.8.3 Strand test for non-rewirable non-moulded-on installation couplers

A length of insulation equivalent to the maximum designed stripping length declared by the manufacturer +2 mm is removed from the end of a flexible conductor having the cross-sectional area as fitted. One strand of the flexible conductor is left free in the most unfavourable position whilst the remaining strands are terminated to suit the construction of the installation coupler.

The free strand is bent without tearing the insulation back, in every possible direction but without making sharp bends around barriers.

NOTE The prohibition against making sharp bends around barriers does not imply that the free strand has to be kept straight during the test. Sharp bends are, moreover, made if it is considered likely that such bends can occur during the normal assembly of the installation coupler, for example when the cover is pushed on.

It shall not be possible for a free strand of a conductor connected to a live termination to touch any accessible metal parts, or to touch an earthing-terminal termination, or to reduce the creepage distance and clearance through any constructional gap to the external surface below 1,5 mm.

It shall not be possible for a free conductor connected to an earth termination to touch any live parts.

12.8.4 Strand test for non-rewirable moulded-on installation couplers

Non-rewirable moulded-on installation couplers shall be inspected to verify that there are means to prevent stray conductor strands and/or live parts from touching an earthing terminal or reducing the minimum distance through insulation to the external accessible surface with the exception of the engagement face of the installation male connector below 1,5 mm.

The verification of "means" may require the checking of the product construction or product assembly method.

12.9 Incorporation of electrical devices

Installation couplers themselves shall not incorporate other electrical devices, for example, switches, fuses, relays, thermostats, surge protective devices and thermal current-limiting devices.

The use of installation couplers as connection for the electrical devices listed above is permitted.

12.10 Retaining means

Installation couplers shall be provided with retaining means which engages automatically when the installation coupler or cap is connected and which is capable of disengagement for disconnecting. It shall only be possible to disengage the retaining means by a deliberate or intentional act. For installation couplers classified in accordance with 7.4.1 and 7.8.2 of Table 3, for disengagement, the retaining means shall be opened with a key or tool only.

Compliance is checked by the following test.

The fully engaged installation coupler shall be subjected to a smooth axial traction force of 80 N for a period of 1 min, during which the retaining device shall be fully engaged. The installation coupler shall not loosen or become disconnected.

12.11 Distribution blocks

The distribution block shall include one installation male connector only for each circuit. The distribution blocks intended for fixed mounting shall have means for fixing to the support, for example, screw holes.

Compliance is checked by inspection.

12.12 Shrouds

Installation male connectors shall have a shroud, which shall be at least as long as the longest pin.

Compliance is checked by inspection.

12.13 Factory wiring

Non-rewirable installation couplers shall be factory-wired.

12.14 Stress test

12.14.1 General

In installation couplers with earthing contact, the length of the conductors between the terminals or terminations and the cable anchorage shall be so adjusted that the current-carrying conductors will be stressed before the protective earthing conductor if the cable slips out of its cable anchorage.

12.14.2 Stress test of rewirable installation couplers

Rewirable installation couplers shall have adequate space for the slack of the protective earthing conductor so that, if the cable anchorage becomes inoperative, the protective earthing conductor connection is subjected to strain after the connections of the current-carrying conductors and that, in case of excessive stresses, the protective earthing conductor will break after the current-carrying conductors.

Compliance is checked by the following test.

The cable is connected to the installation coupler so that the current-carrying conductors are led from the cable anchorage to the corresponding terminals by the shortest route.

After the current-carrying conductors are correctly connected, the core of the protective earthing conductor is led to its terminal and cut off at a distance 8 mm longer than necessary when using the shortest possible path for its correct connection.

After the protective earthing conductor is connected to the terminal, it shall be possible to accommodate the loop formed by the surplus length of the protective earthing conductor when the installation coupler is assembled correctly.

12.14.3 Stress test of non-rewirable installation couplers

In non-rewirable installation couplers with earthing contact, the length of the conductors between the terminations and the cable anchorage shall be so adjusted that the current-carrying conductors will be stressed before the protective earthing conductor if the cable slips in its cable anchorage.

Compliance is checked by inspection.

12.15 Separation of non-rewirable installation couplers

In non-rewirable installation couplers, it shall not be possible for the cable to be separated from the installation coupler without making it permanently useless.

NOTE An installation coupler is considered to be permanently useless when for re-assembling the installation coupler, parts or materials other than the originals are to be used.

Compliance is checked by inspection and by manual test.

13 Protection against harmful ingress of solid foreign objects and against harmful ingress of water

13.1 General

The minimum IP rating shall be IP 20.

13.2 Protection against harmful ingress of solid foreign objects

The minimum IP rating shall be IP 2X.

The housing of the installation coupler shall provide a degree of protection against ingress of solid foreign objects as declared by the manufacturer.

Compliance is checked in accordance with IEC 60529. For numeral 5, category 2 applies. IP classification is measured when the mating parts are engaged completely and caps are used for open installation female connectors.

13.3 Protection against harmful ingress of water

The minimum IP rating shall be IP X0.

The housing of the installation coupler shall provide a degree of protection against harmful ingress of water as declared by the manufacturer.

Compliance is checked ~~in accordance with~~ by the appropriate test of IEC 60529 and with the treatment specified in the two paragraphs below, followed immediately by wiping the surplus surface water from the specimen and carrying out the electric strength test of 14.3.

The specimens shall withstand an electric strength test as specified in 14.3, which shall be started within 5 min of completion of the tests according to 13.3 and inspection shall show that water has not reached current-carrying parts.

For numerals 3 and 4, the oscillating tube in Figure 4 of IEC 60529:1989 is used. IP classification is measured when the mating parts are engaged completely and caps are used for open installation female connectors.

14 Insulation resistance and electric strength

14.1 General

The insulation resistance and the electric strength of installation couplers shall be adequate between parts described in 14.2 and 14.3 after the following treatment.

Installation couplers shall be fitted with cables and not in engagement when subjected to the humidity treatment.

The humidity treatment is carried out in a humidity cabinet containing air with a relative humidity maintained between 91 % and 95 %. The temperature of the air, at all places where specimens can be located, is maintained within ± 1 °C of any convenient value t °C between 20 °C and 30 °C.

Before being placed in the humidity cabinet, the specimens are brought to a temperature between t °C and t °C + 4 °C.

The specimens are kept in the cabinet for:

- 48 h (2 days) for installation couplers with IP-rating IP X0;
- 168 h (7 days) for installation couplers with IP-rating higher than IP X0.

After this treatment, the specimens shall show no damage within the meaning of this document and they shall be able to pass the tests in accordance with 14.2 followed by those of 14.3.

14.2 Insulation resistance

The insulation resistance is measured with a DC voltage of approximately 500 V applied as listed below, each measurement being made 1 min after application of the voltage:

- a) between current-carrying parts of different polarity;
- b) between all current-carrying parts connected together and the body;
- c) on the installation female connector not engaged to its counterpart, between all current-carrying parts and a metal foil in contact with the exposed front surface;
- d) between each current-carrying part and parts of the earthing circuit.

NOTE The term "body" includes accessible metal parts, metal foil in contact with the outer surface, accessible external parts of insulating material, fixing screws of bases or covers and external assembly screws.

While wrapping the metal foil round the outer surface or placing it in contact with the inner surface of parts of insulating material, it is pressed against holes or grooves, without any appreciable force, by means of an unjointed test finger test probe 11 of IEC 61032:1997.

The insulation resistance shall not be less than 5 MΩ.

14.3 Electric strength

A voltage of substantially sine-wave form, having a frequency of 50 Hz to 60 Hz is applied for 1 min between the parts indicated in 14.2.

The test voltage is:

- a) 1 500 V between current-carrying parts of different polarity;
- b) 3 000 V between all current-carrying parts connected together and the body;
- c) 3 000 V on the installation female connector not engaged to its counterpart, between all current-carrying parts and a metal foil in contact with the exposed front surface;
- d) 1 500 V between each current-carrying part and parts of the earthing circuit;
- e) for rewirable installation couplers, 1 500 V between accessible metal parts of the cable anchorage including clamping screws and a metal rod of the maximum diameter of the cable inserted in its place.

NOTE The term "body" includes accessible metal part, metal foil in contact with the outer surface, accessible external parts of insulating material, fixing screws of bases or covers, and external assembly screws.

While wrapping the metal foil round the outer surface or placing it in contact with the inner surface of parts of insulating material, it is pressed against holes or grooves, without any appreciable force, by means of an unjointed test finger test probe 11 of IEC 61032:1997.

Initially, not more than half the prescribed voltage is applied, then it is raised rapidly to the full value.

No flashover or breakdown shall occur during the test.

The high-voltage transformer used for the test should be so designed that when the output terminals are short-circuited after the output voltage has been adjusted to the appropriate test voltage, the output current is at least 200 mA. The overcurrent relay shall not trip when the output current is less than 100 mA.

Care should be taken so that the RMS value of the test voltage applied is measured within ± 3 %.

~~NOTE 2—Glow discharges without a drop in voltage are neglected.~~

~~NOTE 3—An appropriate impulse test is under consideration.~~

15 Construction of contacts

15.1 Resiliency

Installation female connector contact assemblies shall have sufficient resilience to ensure adequate contact pressure on installation male connector pins.

Compliance is checked by the tests according to Clause 16 to Clause 18.

15.2 Resistance of connections

The resistance of connections including the ~~earthing~~ connection **between earthing contacts** shall be sufficiently low.

The contact resistance across the installation coupler is measured and it shall not exceed 1 m Ω per clamping unit.

NOTE—The contact between the installation female connector contact assembly and the installation male connector contact pin is also considered to be a clamping unit for the purpose of this requirement.

Compliance is checked by the following test.

Conductors having the rated cross-sectional areas specified by the manufacturer shall be connected to installation couplers. The clamping screws, if any, are tightened with the torque values specified in Table 6. Non-rewirable installation couplers shall be tested with conductors of the rated connecting capacity. The installation coupler is fully engaged and loaded with the rated current for 1 h. The voltage drop across the clamping unit is measured and the contact resistance is calculated.

When measuring the contact resistance across the distribution block, the relevant counterpart is introduced into an installation female connector as well as into an installation male connector. The contact resistance is then measured across this combination and it shall not exceed 10 mΩ.

15.3 Contact pressure

Electrical connections shall be designed in such a way that contact pressure is not transmitted through insulating material other than ceramic, pure mica or other material with characteristics no less suitable unless there is sufficient resiliency in the metallic parts to compensate for any possible shrinkage or yielding of the insulating material.

Compliance is checked by inspection.

16 Temperature rise

Contacts and other current-carrying parts shall be so designed as to prevent excessive temperature rise due to current flow under normal operation.

Compliance is checked by the following test.

Installation couplers are fitted with cables having the cross-sectional areas shown in Table 4, the terminal screws, if any, being tightened with a torque of the values specified in Table 6.

Distribution blocks are tested as delivered.

Test circuits for three pole and five pole installation couplers as well as three pole to three pole and five pole to three pole distribution blocks are shown in schematic diagrams of Annex B, Figure B.1 to Figure B.8. Five to five pole distribution blocks shall be measured (or wired) in the same way as is done for three to three pole distribution blocks.

Installation couplers shall be fully engaged.

The test current shown in Table 4 is passed through the current-carrying contacts for 1 h. After this, one current-carrying contact and the earthing contact shall be loaded with the test current shown in Table 4 for 1 h.

For installation couplers having three or more poles, the test current during the test shall be passed through the phase contacts. If there is a neutral contact and an earthing contact, a separate test shall be carried out passing the test current through the neutral contact and the earthing contact. If there is either a neutral contact or an earthing contact, the current is passed through the neutral contact or through the earthing contact and the nearest phase contact.

The temperature rise shall be measured at the specified measuring points shown in the schematic diagrams of Annex B, Figure B.1 to Figure B.8. During the above tests, the

temperature rise shall not exceed 45 K in single-phase test circuits and 50 K in poly-phase test circuits.

Table 4 – Test currents for installation couplers

Rated current A	Test conductor mm ²	Test current A
10	1,5	12,5
13	1,5	16,25
16	1,5	20,0
20	2,5	25,0
25	4,0	31,0
32	6,0	40,0

17 Breaking capacity

This test is not applicable for installation couplers for DC use only.

Installation couplers for AC applications shall have an adequate breaking capacity.

Compliance is checked by the following test.

Installation couplers shall be mounted according to the manufacturer's instructions. Before the test, the retention device shall be made ineffective, the installation couplers shall then be operated 100 strokes without load and 50 strokes with load.

The installation couplers shall be tested at their rated voltage and rated current in a circuit with a $\cos\phi = 0,6$.

NOTE A stroke is an engagement or a disengagement of the installation male connector.

The installation male connector is inserted into and withdrawn from the installation female connector at a rate of 15 strokes per minute. The speed of engagement and disengagement of the installation male connector shall be $0,8 \text{ m/s} \pm 0,1 \text{ m/s}$. Electrical contact shall be maintained for no more than 4 s and no less than 2 s.

During the test, no arc shall persist, no flashover shall occur and the contact parts shall not become loose. Live parts shall not become accessible.

Compliance is checked by the test in accordance with Clause 10.

After the test, the specimens shall withstand an electric strength test as specified in 14.3, the test voltage being reduced to 1 500 V.

The specimens shall show no

- wear impairing their further use;
- deterioration of enclosures or barriers;
- damage on the entry holes for the male contacts that might impair proper working;
- loosening of electrical or mechanical connections;
- seepage of sealing compound.

The humidity treatment is not repeated before the electric strength test of 14.3 referred to in this clause.

18 Forces necessary to disengage the parts of the installation coupler

Installation couplers shall be such that the installation coupler can be easily disengaged; however, a deliberate act for disengagement is required.

Compliance is checked by the following test.

The retaining means shall be rendered ineffective before the test. Installation couplers shall be engaged and disengaged 10 times. The pull-force measured during the 10th disengagement shall not exceed 80 N.

For the test of installation couplers with an IP code higher than IP 2XC, the sealing (gasket), if any, may be removed.

19 Cables and their connection

19.1 Capability of being fitted

Installation couplers shall be capable of being fitted with types of cables and cross-sectional areas specified by the manufacturer of the installation coupler. Pre-wired installation couplers shall only be supplied with the appropriate conductors connected to the correct terminals or terminations (see Clause 8).

NOTE For installation instructions concerning suitable cables, see 8.4.

Compliance is checked by inspection.

19.2 Relief from pull, thrust and torsion

Installation couplers shall be so constructed that the clamping units of the cables shall be relieved from pull, thrust and torsion and the cable sheath at the entrance shall be protected against abrasion, for example, by a cable anchorage for rewirable installation couplers.

Compliance is checked by inspection and by the test in accordance with 19.4.

19.3 ~~Relief~~ Cable anchorage

For rewirable installation couplers,

- it shall be clear how the relief from strain and the prevention of twisting is intended to be effected;
- the cable anchorage, or at least part of it, shall be integral with or fixed to one of the other components of the installation coupler;
- makeshift methods, such as tying the cable into a knot or tying the ends with string, shall not be used;
- the cable anchorage shall be suitable for the types of cables specified by the manufacturer;
- the cable anchorage shall be of insulating material or be provided with an insulating lining fixed to the metal parts;
- it shall not be possible for the cable to touch the clamping screws of the cable anchorage if these screws are accessible with the test probe B according to Figure 2 of IEC 61032:1997;
- metal parts of the cable anchorage, including its screws, if any, shall be insulated from the earthing circuit.

Compliance is checked by inspection and by the test of 19.4.

19.4 Capability to connect cables with different cross-sectional area

Rewirable installation couplers shall be tested with the types of cables specified by the manufacturer, first with the smallest and then with the largest cross-sectional area.

Non-rewirable installation couplers shall be tested with the cables as delivered.

Conductors of the cable of rewirable installation couplers are introduced into the terminals. The terminal screws, if any, are tightened just sufficiently to prevent the conductors from easily changing their position.

The cable anchorage is used in the normal way, clamping screws, if any, being tightened with a torque as specified in Table 6. After reassembly of the specimen, the components shall fit correctly and it shall not be possible to push the cable with a force of 10 N into the installation coupler to any appreciable extent.

The specimen shall be fixed in an apparatus as shown in Figure 1 such that the axis of the cable runs vertically downwards from the cable entry of the installation coupler.

The cable shall be subjected 50 times to a pull force according to Table 5 for 1 s in one smooth and continuous motion.

Table 5 – Forces to be applied to cable anchorages

External dimensions of the cable mm	Pull forces N
Up to and including 5,2 × 7,6	40 ± 2
Up to and including 8	50 ± 2
Over 8 up to and including 11	60 ± 2
Over 11 up to and including 16	80 ± 2
Over 16	100 ± 2

The cable shall not be damaged during testing. After the test, the cable shall not have been longitudinally displaced by more than 2 mm.

Immediately after this, a torque of 0,25 Nm is to be applied to the cable for 1 min. After this test, the cable shall not be distorted by more than 45°.

For the measurement of the longitudinal displacement, a mark is made on the cable before starting the test while subjecting it to a preliminary pull of the value specified, at a distance of approximately 2 cm from the end of the installation coupler or the cable anchorage.

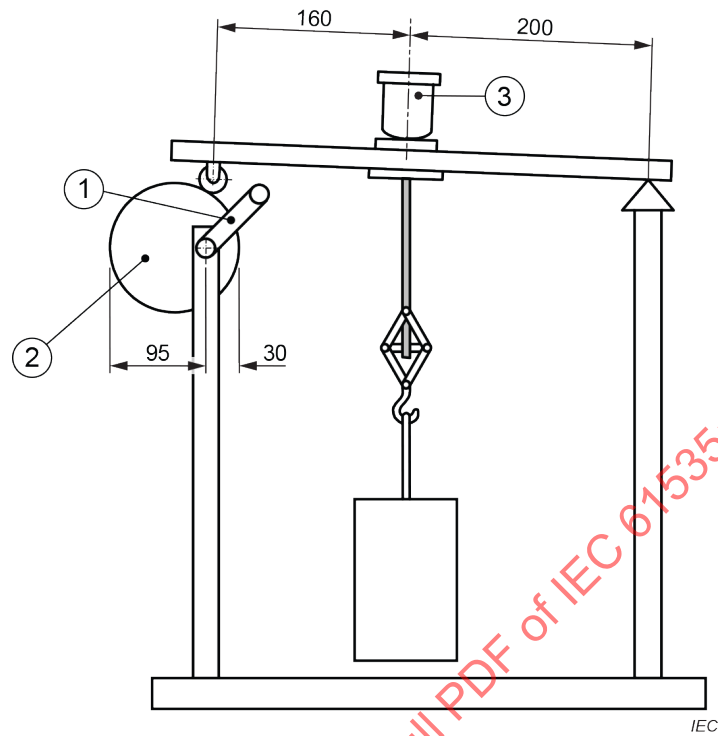
After the test, the displacement of the mark on the cable in relation to the installation coupler or the cable anchorage is measured while the cable is no longer subjected to the pull force.

For the measurement of the distortion, the installation coupler is to be fixed in an apparatus, an example of which is shown in Figure 2. The distance between the cable clamp and the end of the installation coupler or the cable anchorage shall be equal to the cable diameter. The distortion will be measured immediately behind the cable anchorage while the cable is subjected to the torque.

For non-rewirable installation couplers, a hole may be drilled into the housing so that the cable may become accessible for the measuring indicator just behind the cable anchorage.

The effectiveness of the cable anchorage shall not be affected by drilling the hole.

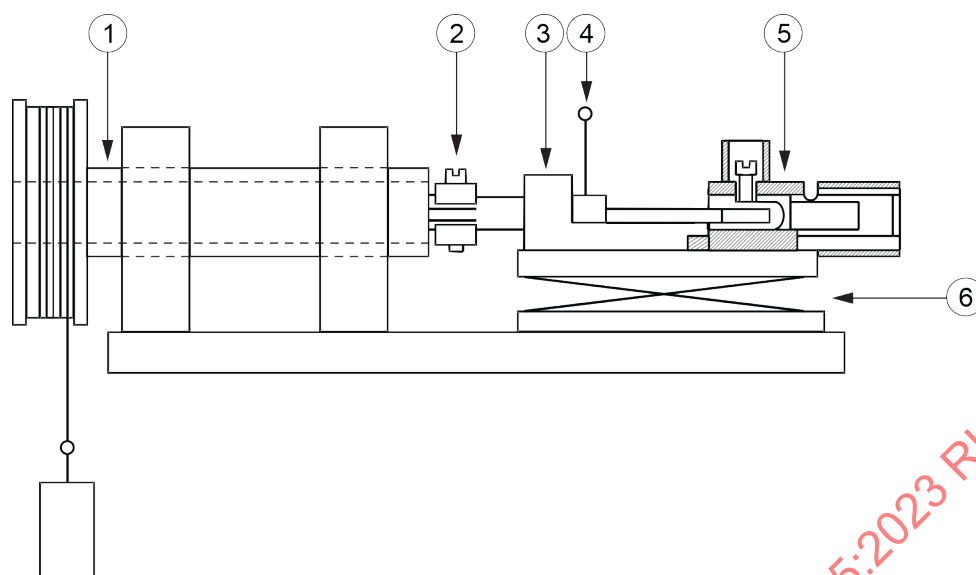
Dimensions in millimetres



Key

- 1 crank
- 2 eccentric
- 3 sample

Figure 1 – Apparatus for testing the cable anchorage



IEC

Key

- 1 hollow axle for easy twisting
- 2 cable clamp for the test cable
- 3 cable anchorage of the test specimen
- 4 measuring indicator (e.g. a needle)
- 5 installation coupler
- 6 vertical movable mounting support

The hollow axle and the mounting block should be easily movable with respect to each other to compensate for any shrinkage of the cable while twisting.

Figure 2 – Apparatus for measuring the distortion (example)

19.5 Sharp edges

Installation couplers shall be so designed that the cable cannot be damaged by sharp edges where it enters the installation coupler.

If guards are provided for this purpose, they shall be of insulating material and shall be reliably fixed.

Compliance is checked by inspection ~~and by the relevant tests of 21.4.~~

20 Mechanical strength

Installation couplers shall have adequate mechanical strength.

Compliance is checked by the following test.

The specimens shall be tested with and without caps fitted.

Rewirable installation couplers are fitted with the cable specified by the manufacturer, having the smallest cross-sectional area and a free length of approximately 100 mm.

Terminal screws and assembly screws are tightened with a torque equal to the value specified in Table 6.

Non-rewirable installation couplers are tested as delivered, the flexible cable being cut so that a free length of about 100 mm projects from the installation coupler.

The specimen is subjected to the free fall test, procedure 2, of IEC 60068-2-31:2008, the number of falls being 50.

After the test, live parts shall not become accessible with the test probe B according to Figure 2 of IEC 61032:1997, the installation coupler shall not show any cracks when inspected by normal or corrected vision without additional magnification and the cable anchorage shall remain operational.

Small pieces which are broken off shall not lead to rejection provided that the protection against electric shock is maintained.

Damage to finish and small dents which do not reduce the creepage distances or clearances below values specified in Clause 23 are neglected.

The approximate 100 mm length may be reduced in order to ensure free fall.

21 Resistance to heat and ageing

21.1 Resistance to heat

Installation couplers shall be sufficiently resistant to heat.

Compliance is checked by the tests of 21.2, 21.3, 21.4 and 21.5, as applicable.

21.2 Dry heat storage

Specimens of installation couplers and caps are kept for 1 h in a heating cabinet at a temperature of $100\text{ °C} \pm 2\text{ °C}$.

During the test, the specimens shall not undergo any change impairing their further use, and the sealing compound shall not flow to such an extent that live parts are exposed.

A slight displacement of the sealing compound shall be neglected provided that safety is not impaired.

21.3 Ball pressure test

Parts of insulation material, with the exception of elastomeric or similar materials for installation couplers shall be subjected to a ball-pressure test by means of the apparatus shown in Figure 3. Three additional samples are required for this test.

Before the test is started, the ball and the support on which the specimen shall be placed are brought to the temperature specified. The part under test shall be placed on a 3 mm thick steel plate in direct contact with it, so as to be supported to withstand the test force. When it is not possible to carry out the test on the specimen, the test shall be carried out on a special test specimen of the same material at least 2 mm thick.

The surface of the part to be tested is placed in the horizontal position and a steel ball of 5 mm diameter is pressed against the surface with a force of 20 N.

The test is made in a heating cabinet maintained at a temperature of:

- $125\text{ °C} \pm 2\text{ °C}$ for those parts of installation couplers which retain current-carrying parts and parts of the earthing circuit in position;

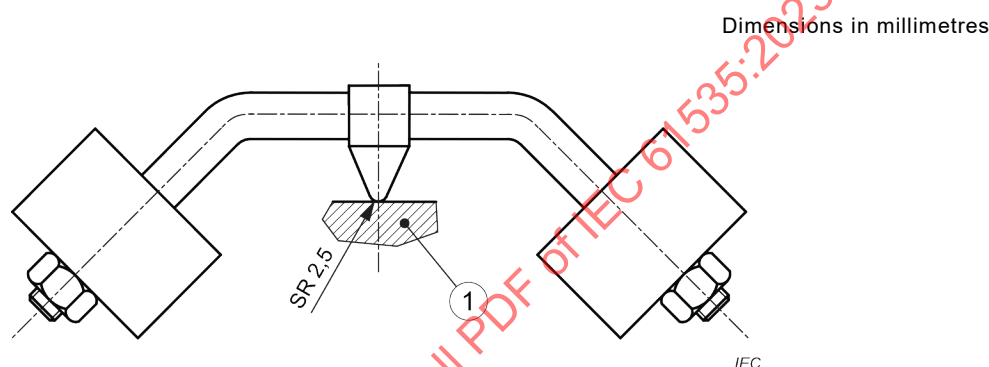
– $70\text{ °C} \pm 2\text{ °C}$ for other parts of installation couplers.

A current-carrying part or a part of the earthing circuit retained by a mechanical means is considered to be retained in position. The use of grease or the like is not considered to be mechanical means.

In case of doubt, to determine whether an insulating material is necessary to retain current-carrying parts and parts of the earthing circuit in position, the device is examined without conductors while being held in all positions with the insulating material in question removed.

After 1 h, the ball is removed from the specimen which is then cooled down, within 10 s, to approximately room temperature by immersion in cold water.

The diameter of the impression caused by the ball is measured and shall not exceed 2 mm.



Key

1 sample

Figure 3 – Ball-pressure apparatus

21.4 Ageing of elastomeric and thermoplastic material

Installation couplers of elastomeric and thermoplastic materials shall be adequately resistant to ageing.

Compliance is checked for installation couplers by the following test.

Two specimens which have previously been tested for their compliance with Clause 18 shall be used.

Installation couplers are subjected to an accelerated ageing test carried out in an atmosphere having the composition and pressure of the ambient air. The specimens are suspended freely in a heating cabinet, ventilated by natural air circulation. They are kept in the cabinet, which is maintained at a temperature of $70\text{ °C} \pm 2\text{ °C}$, for 240 h (10 days).

After this test, the specimens are allowed to attain approximately ambient temperature, and are then examined.

The specimens shall show no damage which would lead to non-compliance with this document.

21.5 Current cycling test

Installation couplers shall be sufficiently resistant to ageing.

Compliance is checked by the following test.

Resistance to ageing for the installation coupler engaged as for normal use is checked by the current cycling ageing test at ambient temperature.

NOTE 1 For screwless-type clamping units, if any, this test also covers the temperature cycling test with current according to 9.10 of IEC 60999-1:1999.

The test is carried out at ambient temperature on all poles of three installation couplers. Rewirable installation couplers are wired with conductors of cross-section according to Table 4 prepared as for the voltage drop test according to the test in 9.8 of IEC 60999-1:1999. Non-rewirable installation couplers shall be tested as delivered.

During the test, a test current according to Table 4 is passed through all poles except during the cooling period.

NOTE 2 The earthing contact is not a pole and is not loaded.

The whole test arrangement, including the conductors, shall not be moved until all the following voltage drop tests in this subclause have been completed.

The assembled installation couplers are then subjected to 384 cycles, each cycle having a duration of approximately 1 h, divided into 30 min with current and 30 min without current.

The voltage drop is measured after the 24th, 192nd and 384th temperature cycles are completed using the test current in accordance with Table 4 and the test arrangement previously specified in this subclause.

The allowable voltage drop per clamping unit shall not exceed the smaller of the two following values:

- either 22,5 mV;
- or 1,5 times the value measured after the 24th cycle.

In addition, after this test, an inspection with normal or corrected vision, without additional magnification, shall show no changes impairing further use, such as cracks, deformations or the like.

NOTE 3 A contact is considered to be a clamping unit for the purpose of this document.

22 Screws, current-carrying parts and connections

22.1 Screws and nuts

Electrical or mechanical connections using screws and nuts shall withstand the mechanical stresses occurring in normal use.

Screws and nuts which transmit contact pressure shall be of metal and in engagement with a metal thread.

Other screws and nuts which are operated when mounting an installation coupler during installation may be in engagement with a thread of insulation material.

Compliance is checked by inspection and, for screws and nuts which are likely to be operated during the life of the installation coupler, by the following test.

The screws and nuts are tightened and loosened:

- 10 times for metal screws in engagement with a thread of insulating material and for screws of insulating material;
- 5 times in all other cases.

Screws or nuts in engagement with a thread of insulating material and screws of insulating material are completely removed and reinserted each time. The test is carried out by means of a suitable test screwdriver or spanner applying a torque as shown in Table 6.

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

When testing terminal screws of installation couplers, a conductor is placed in the terminal. The conductor is moved each time the screw or nut is loosened.

The screws and nuts shall be tightened smoothly.

Table 6 – Torque applied for the tightening and loosening test

Nominal diameter of thread mm	Torque Nm	
	I	II
Up to and including 2,8	0,2	0,4
Over 2,8 up to and including 3,0	0,25	0,5
Over 3,0 up to and including 3,2	0,3	0,6
Over 3,2 up to and including 3,6	0,4	0,8
Over 3,6 up to and including 4,1	0,7	1,2
Over 4,1 up to and including 4,7	0,8	1,8
Over 4,7 up to and including 5,3	0,8	2,0
Over 5,3	-	2,5

Column I applies to screws without heads which, when tightened, do not protrude from the hole and to other screws which cannot be tightened by means of a screwdriver with a blade wider than the diameter of the screw.

Column II applies to other screws and nuts that are tightened by means of a screwdriver.

During the test, there shall be no damage that will impair the further use of the installation coupler.

NOTE Terminal screws or nuts, connection screws, etc. are those screws or nuts which are used when the installation coupler is assembled.

22.2 Screws and insulating material

For screws in engagement with a thread of insulating material and screws of insulating material that are operated during the installation of the installation coupler and/or are likely to be operated during the life of the installation coupler, a correct introduction of the screw into the screw hole or nut shall be ensured.

NOTE—The requirement with regard to correct introduction is met if the introduction of the screw in a slanting manner is prevented, for example, by guiding the screw by the part to be fixed, by a recess in the female thread or by the use of a screw with the leading thread removed.

Compliance is checked by inspection and by manual test.

22.3 Screws and rivets for electrical and mechanical connections

Screws and rivets that serve as electrical as well as mechanical connections shall be locked against loosening or turning.

Compliance is checked by inspection and manual tests.

NOTE 1 Spring washers can provide satisfactory locking.

NOTE 2 For rivets, a non-circular shank or an appropriate notch can be sufficient.

NOTE 3 A sealing compound which softens on heating provides satisfactory locking only for screw connections not subject to torsion in normal use.

22.4 Metals of current-carrying parts

Current-carrying parts and earthing contacts shall comply with 8.1.1 of IEC 60999-1:1999.

23 Clearances, creepage distances and distances through solid insulation

The clearances shall at least meet the requirements for overvoltage category III. For creepage distances, pollution degree 2 as specified in IEC 60664-1 shall be applied. Minimum values for clearances and creepage distances are given in Table 7 to Table 11.

Table 7 – Installation couplers intended for use in supply systems with a maximum voltage to earth of 150 V AC, rated impulse voltage 2,5 kV

	Clearance mm	Creepage distances ^c mm			
		Rated insulation voltage			
		All material groups	Material group		
			I	II	III
		≤ 125 V AC	≤ 250 V AC		
Between:					
Live parts of different polarity	1,5	1,5	1,5	1,8	2,5
Live parts and					
– accessible external surface ^a	3,0	3,0	----		
– inaccessible external screws or the like ^b	1,5	1,5	----		
Parts of the earthing circuit and					
– live parts	1,5	1,5	----		
– accessible screws or the like	1,5	1,5			
– inaccessible external screws or the like ^b	1,0	1,0			
^a The accessible external surface includes a metal foil in contact with the external surfaces of insulating material.					
^b Inaccessible external screws are those which cannot be touched with the test probe B of IEC 61032:1997.					
^c Values for creepage distances are adapted to clearances because creepage distances cannot be smaller than the corresponding clearances.					

Table 8 – Installation couplers intended for use in supply systems with a maximum voltage to earth of 300 V AC, rated impulse voltage 4,0 kV

	Clearance mm	Creepage distances ^c									
		mm									
		Rated insulation voltage									
		All material groups	Material group			Material group			Material group		
			I	II	III	I	II	III	I	II	III
≤ 250 V AC	≤ 320 V AC			≤ 400 V AC			≤ 500 V AC				
Between:											
Live parts of different polarity	3,0	3,0	3,0	3,0	3,2	3,0	3,0	4,0	3,0	3,6	5,0
Live parts and											
– accessible external surface ^a	5,5	5,5	5,5	5,5	6,4	----			----		
– inaccessible external screws or the like ^b	3,0	3,0	3,0	3,0	3,2	----			----		
Parts of the earthing circuit and											
– live parts	3,0	3,0	3,0	3,0	3,2						
– accessible screws or the like	3,0	3,0	3,0	3,0	3,2	----			----		
– inaccessible external screws or the like ^b	1,5	1,5	1,5	1,5	1,5	----			----		

^a The accessible external surface includes a metal foil in contact with the external surfaces of insulating material.

^b Inaccessible external screws are those which cannot be touched with the test probe B of IEC 61032:1997.

^c Values for creepage distances are adapted to clearances because creepage distances cannot be smaller than the corresponding clearances.

Table 9 – Installation couplers intended for use in single-phase two-wire systems 50 V DC and single-phase three-wire systems 60 V DC, rated impulse voltage 0,8 kV

	Clearance mm	Creepage distances ^c mm						
		Rated insulation voltage						
			Material group			Material group		
			I	II	III	I	II	III
			≤ 50 V DC			≤ 63 V DC		
Between:								
Live parts of different polarity	0,2		0,60	0,85	1,20	0,63	0,90	1,25
Live parts and								
– accessible external surface ^a	0,5		1,2	1,7	2,4	-	-	-
– inaccessible external screws or the like ^b	0,2		0,60	0,85	1,2	-	-	-
Parts of the earthing circuit and								
– live parts	0,2		0,6	0,85	1,2	-	-	-
– accessible screws or the like	0,2		0,6	0,85	1,2	-	-	-
– inaccessible external screws or the like ^b	0,2		0,6	0,85	1,2			
NOTE – The values of the creepage distances in this Table 9 are also applicable for a rated impulse voltage of 1,5 kV.								
^a The accessible external surface includes a metal foil in contact with the external surfaces of insulating material.								
^b Inaccessible external screws are those which cannot be touched with the test probe B of IEC 61032:1997.								
^c Values for creepage distances are adapted to clearances because creepage distances cannot be smaller than the corresponding clearances.								

Table 10 – Installation couplers intended for use in single-phase two-wire systems 120 V DC and single-phase three-wire systems 240 V DC, rated impulse voltage 2,5 kV

	Clearance mm	Creepage distances ^c mm			
		Rated insulation voltage			
		All material groups	Material group		
			I	II	III
		≤ 125 V DC	≤ 250 V DC		
Between:					
Live parts of different polarity	1,5	1,5	1,5	1,8	2,5
Live parts and					
– accessible external surface ^a	3,0	3,0	3,0	3,6	5,0
– inaccessible external screws or the like ^b	1,5	1,5	1,5	1,8	2,5
Parts of the earthing circuit and					
– live parts	1,5	1,5	1,5	1,8	2,5
– accessible screws or the like	1,5	1,5	1,5	1,8	2,5
– inaccessible external screws or the like ^b	1,0	1,0	1,0	1,0	1,0
^a The accessible external surface includes a metal foil in contact with the external surfaces of insulating material.					
^b Inaccessible external screws are those which cannot be touched with the test probe B of IEC 61032:1997.					
^c Values for creepage distances are adapted to clearances because creepage distances cannot be smaller than the corresponding clearances.					

Table 11 – Installation couplers intended for use in single-phase two-wire systems 220 V DC and single-phase three-wire systems 440 V DC, rated impulse voltage 4,0 kV

	Clearance mm	Creepage distances ^c mm						
		Rated insulation voltage						
		All material Groups	Material group			Material group		
			I	II	III	I	II	III
		≤ 250 V DC	≤ 400 V DC			≤ 500 V DC		
Between:								
Live parts of different polarity	3,0	3,0	3,0	3,0	4,0	3,0	3,6	5,0
Live parts and								
– accessible external surface ^a	5,5	5,5	5,5	5,6	8,0	5,5	7,2	10,0
– inaccessible external screws or the like ^b	3,0	3,0	3,0	3,0	4,0	3,0	3,6	5,0
Parts of the earthing circuit and								
– live parts	3,0	3,0	3,0	3,0	4,0	3,0	3,6	5,0
– accessible screws or the like	3,0	3,0	3,0	3,0	4,0	3,0	3,6	5,0
– inaccessible external screws or the like ^b	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5
^a The accessible external surface includes a metal foil in contact with the external surfaces of insulating material.								
^b Inaccessible external screws are those which cannot be touched with the test probe B of IEC 61032:1997.								
^c Values for creepage distances are adapted to clearances because creepage distances cannot be smaller than the corresponding clearances.								

Installation female connectors are tested when not engaged with the installation male connector. Installation male connectors are only tested when engaged with its mating installation female connector.

For rewirable installation couplers, the measurements are made with conductors having the smallest and the largest cross-sectional area as specified by the manufacturer. Non-rewirable couplers are tested as delivered.

24 Resistance to abnormal heat and to tracking

24.1 Resistance to abnormal heat

Parts made of insulating material which might be exposed to thermal stresses due to electrical effects and whose deterioration might impair safety shall not be unduly affected by abnormal heat generated within the installation coupler.

Compliance is checked by the glow-wire test according to IEC 60695-2-11 under the following conditions:

- 650 °C for parts made of insulating material not intended to retain current-carrying parts and parts of the earthing circuit in position even though they may be in contact with the current-carrying part;
- 850 °C for parts made of insulating material intended to retain current-carrying parts and parts of the earthing circuit in position.

A current-carrying part or a part of the earthing circuit retained by a mechanical means is considered to be retained in position. The use of grease or the like is not considered to be mechanical means.

In case of doubt, to determine whether an insulating material is necessary to retain current-carrying parts and parts of the earthing circuit in position, the device is examined without conductors while being held in all positions with the insulating material in question removed.

The specified tests are carried out at several places on the same specimen but care shall be taken to ensure that any deterioration caused by previous tests does not affect the results of the test to be made.

Small parts, where each surface lies completely within a circle of 15 mm diameter, or where any part of the surface lies outside a 15 mm diameter circle and where it is not possible to fit a circle of 8 mm diameter on any part of the surface, are not subjected to the test of this subclause (see Figure 4 for explanation of "small parts").

NOTE 1—When checking a surface, projections on the surfaces and holes which are not greater than 2 mm on the largest dimension ~~are~~ can be disregarded.

NOTE The glow-wire test is applied to ensure that an electrically heated test wire under defined test conditions does not cause ignition of insulating parts or to ensure that a part made of insulating material, which can be ignited by the heated test wire under defined conditions, burns for a limited time only and that without spreading fire by flame or burning parts or by drops falling down from the part under test.

If the test cannot be made on the complete specimen, a suitable part may be cut from it for the purpose of the test.

The test is made on one specimen only. In case of doubt, the test shall be repeated on two further specimens.

The test is made by applying the glow-wire only once.

The specimen shall be positioned during the test in the most unfavourable position of its intended use with the surface tested in a vertical position.

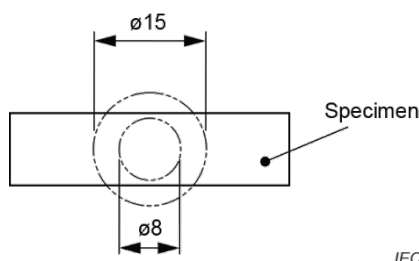
The tip of the glow-wire shall be applied to the specified surface of the test specimen taking into account the conditions of the intended use under which a hot part may come into contact with the specimen.

The specimen is regarded as having passed the glow-wire test if:

- *there is no visible flame and no sustained glowing, or if*
- *flames and glowing on the specimen extinguish within 30 s after removal of the glow-wire.*

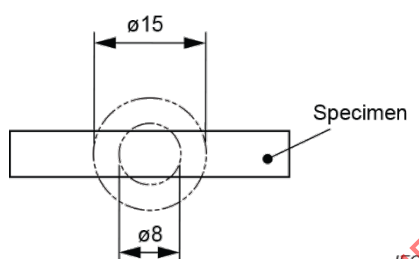
There shall be no ignition of the tissue paper or scorching of the board.

Dimensions in millimetres



a) To be tested

Dimensions in millimetres



b) No test is required

Figure 4 – Explanation of "small part"

24.2 Resistance to tracking

For installation couplers, parts of insulating material retaining live parts in position shall be of material resistant to tracking.

Compliance is checked in accordance with IEC 60112.

Ceramic parts are not tested.

The material under test shall pass a proof-tracking-index (PTI) of minimum 175 V using test solution A with the interval between drops 30 s ± 5 s.

If the manufacturer specifies the used material as to be of ~~PTI~~ CTI ≥ 400 V (material group II) or ~~PTI~~ CTI ≥ 600 V (material group I), the reduced creepage distances of Table 7, Table 8, Table 9, Table 10, and Table 11 apply.

NOTE 1 The term "reduced creepage distance" means in this context the next smaller creepage distance value.

NOTE 2 The PTI value is also used for the assessment of the tracking resistance of insulating materials (CTI). An insulating material can be referred to one of the material groups I up to IV if the PTI value tested according to IEC 60112, test solution A, is equal to or higher than the lower limiting value for this material group.

No flashover or breakdown between electrodes shall occur before a total of 50 drops has fallen.

25 Resistance to rusting

Ferrous parts shall be adequately protected against rusting.

Compliance is checked by the following test.

All grease is removed from the parts to be tested by immersion in a cold chemical degreaser such as petroleum ether for 10 min.

The parts are then immersed for 10 min in a 10 % solution of ammonium chloride in water at a temperature of $20\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$.

Without drying, but after shaking off any drops, the parts are placed for 10 min in a box containing air saturated with moisture at a temperature of $20\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$.

After the parts have been dried for 10 min in a heating cabinet at a temperature of $100\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ and have been left at room temperature for 24 h, their surface shall show no signs of rust. Traces of rust on sharp edges and any yellowish film removable by rubbing are ignored.

For small springs and the like and for inaccessible parts exposed to abrasion, a layer of grease may provide sufficient protection against rusting. Such parts are only subjected to the test if there is doubt about the effectiveness of the grease film and the test shall then be made without previous removal of the grease.

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Annex A (normative)

Routine **protective** earth ~~(PE)~~ continuity tests

All non-rewirable installation couplers shall be subjected to the following test. This test does not apply to distribution blocks for which incorrect wiring is reliably prevented by design.

The test on **protective** earth ~~(PE)~~ continuity shall be done using SELV applied for a period of not less than 2 s between the corresponding PE male and/or female contacts of the installation coupler at each end of the cable.

NOTE 1—The period of 2 s can be reduced or other type of voltages can be used if correct results can be guaranteed with automatic timing.

NOTE 2—Any other test which proves that the **protective** earth continuity is present is also acceptable.

Protective earth continuity shall be present.

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Annex B (normative)

Test circuits for temperature rise test

For test circuits for temperature rise according to Clause 16, see Figure B.1 to Figure B.8.

~~All non-rewirable installation couplers shall be subjected to the following test. This test does not apply to distribution blocks for which incorrect wiring is reliably prevented by design.~~

~~The test on earth (PE) continuity shall be done using SELV applied for a period of not less than 2 s between the corresponding PE male and/or female contacts of the installation coupler at each end of the cable.~~

~~NOTE 1—The period of 2 s can be reduced or other type of voltages can be used if correct results can be guaranteed with automatic timing.~~

~~NOTE 2—Any other test which proves that the earth continuity is present is also acceptable.~~

~~Earth continuity shall be present.~~

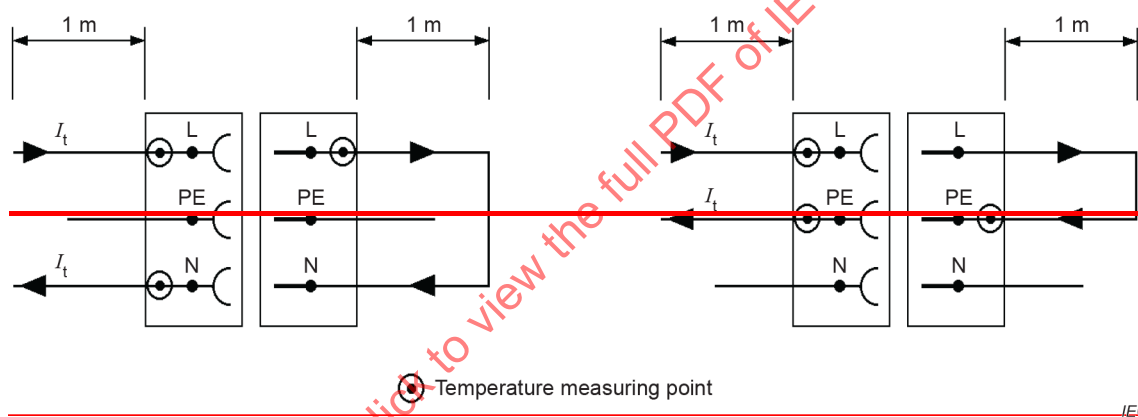


Figure B.1 — 1P + N + PE installation couplers, including N (left figure), including PE (right figure)

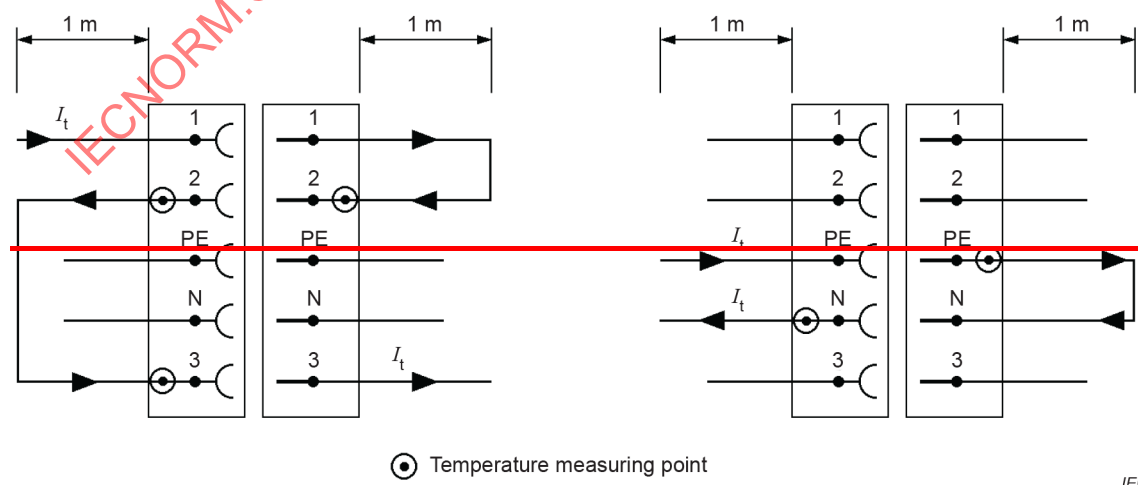
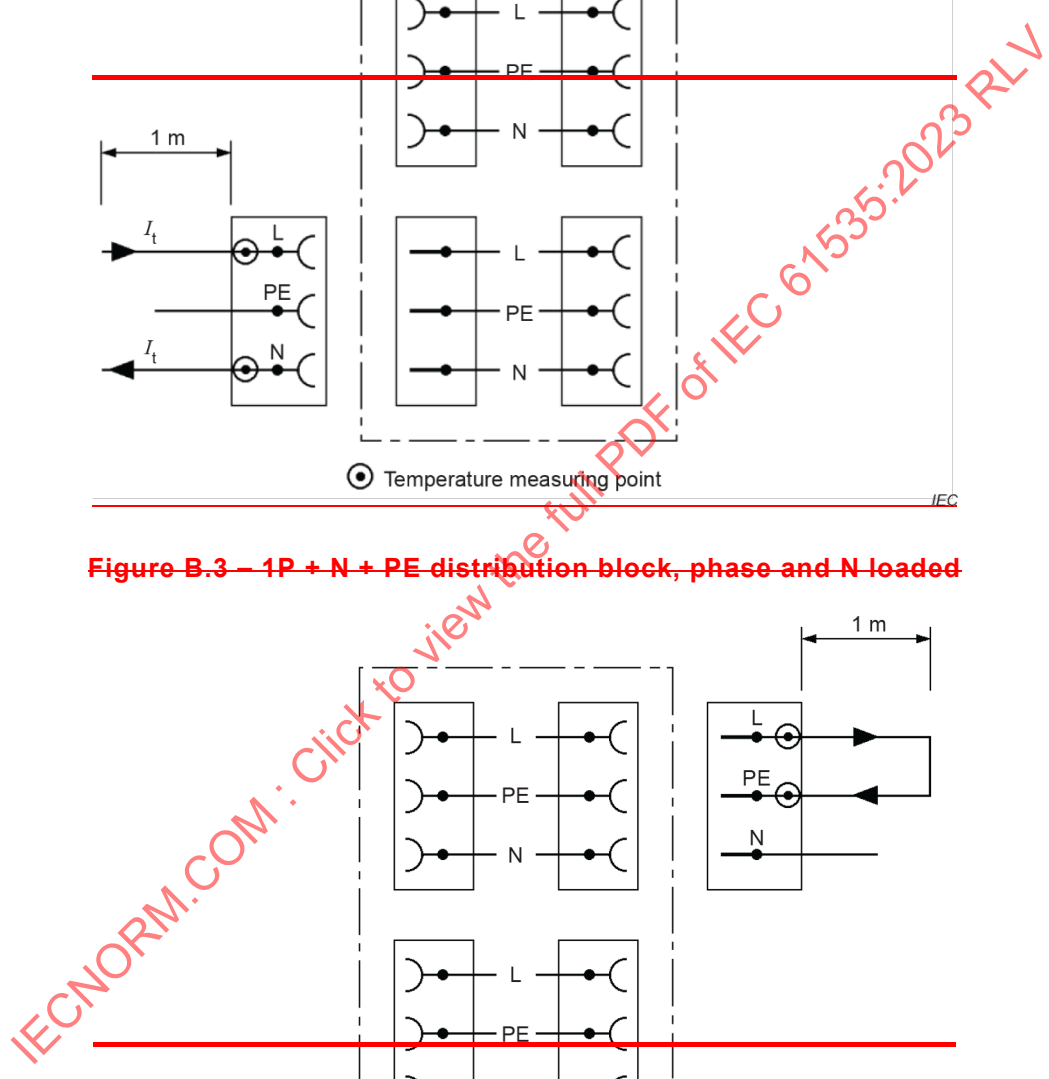
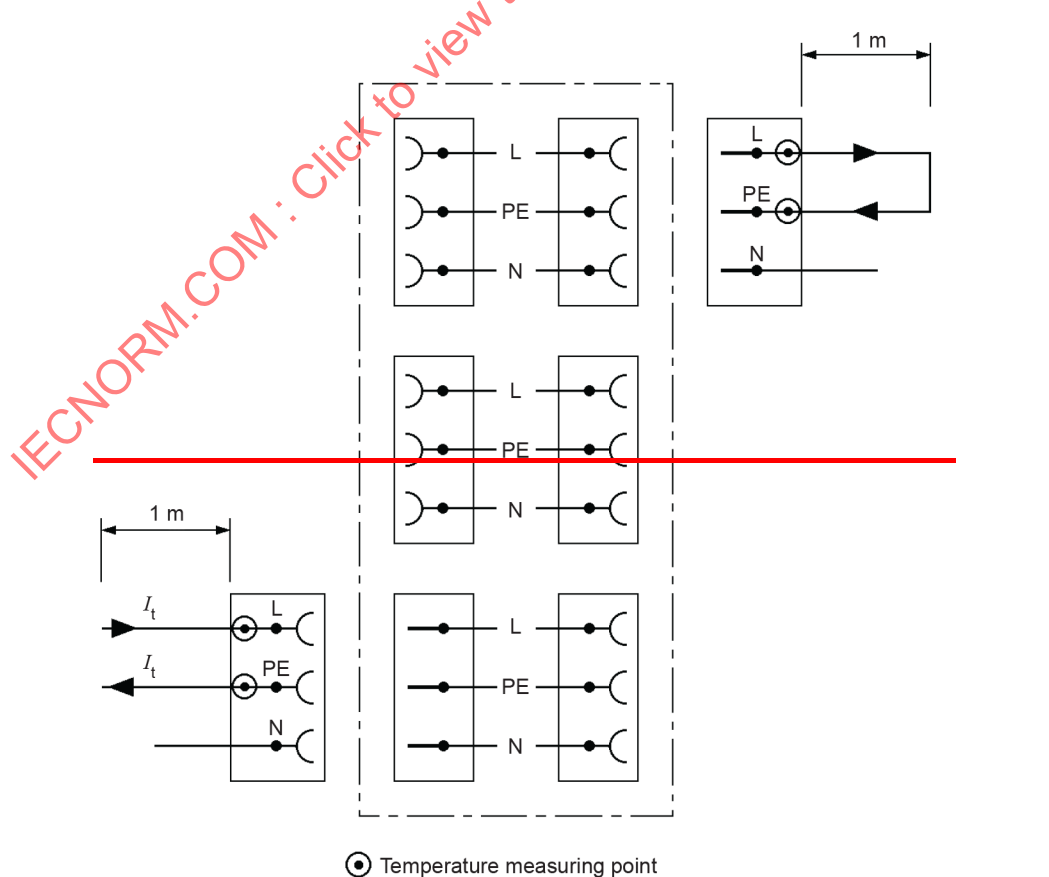


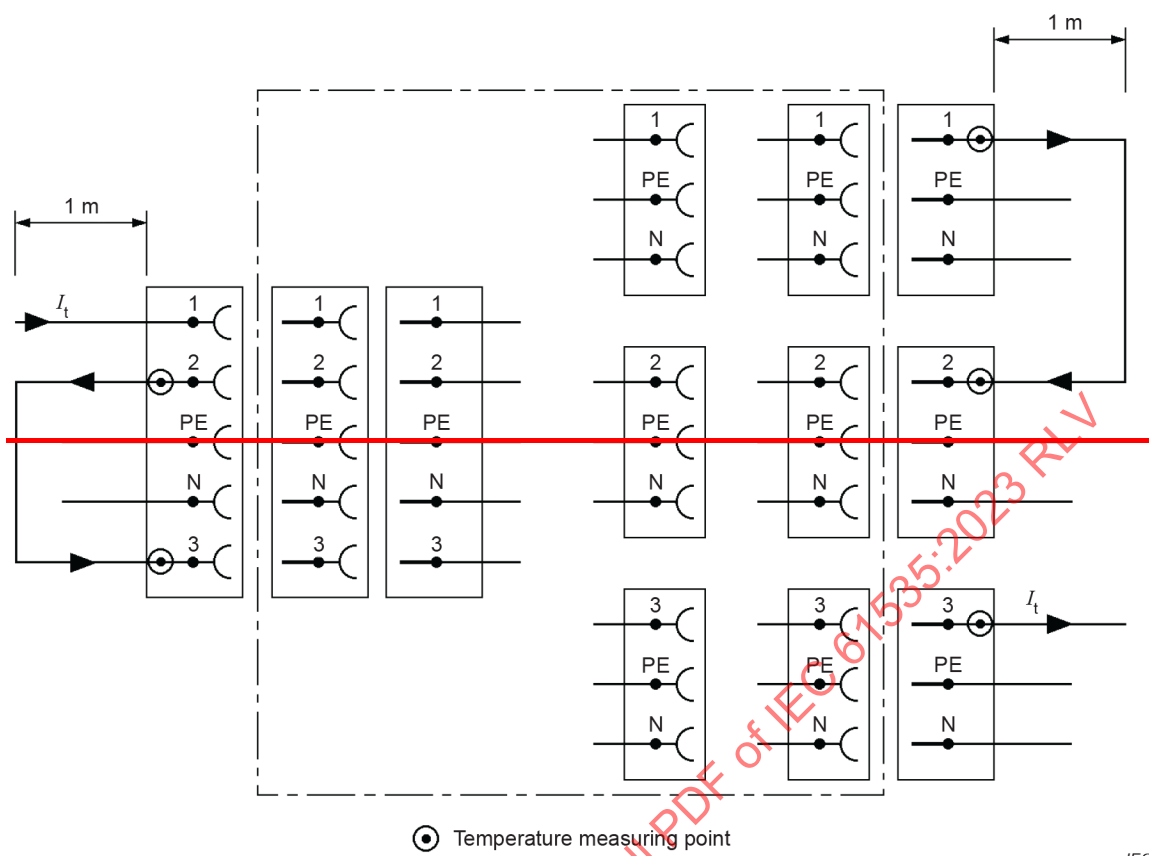
Figure B.2 — 3P + N + PE installation couplers, 3 phases loaded (left figure), N and PE loaded (right figure)



~~Figure B.3 – 1P + N + PE distribution block, phase and N loaded~~



~~Figure B.4 – 1P + N + PE distribution block, phase and PE loaded~~



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Figure B.5 — 3P + N + PE to 1P + N + PE distribution block, 3 phases loaded

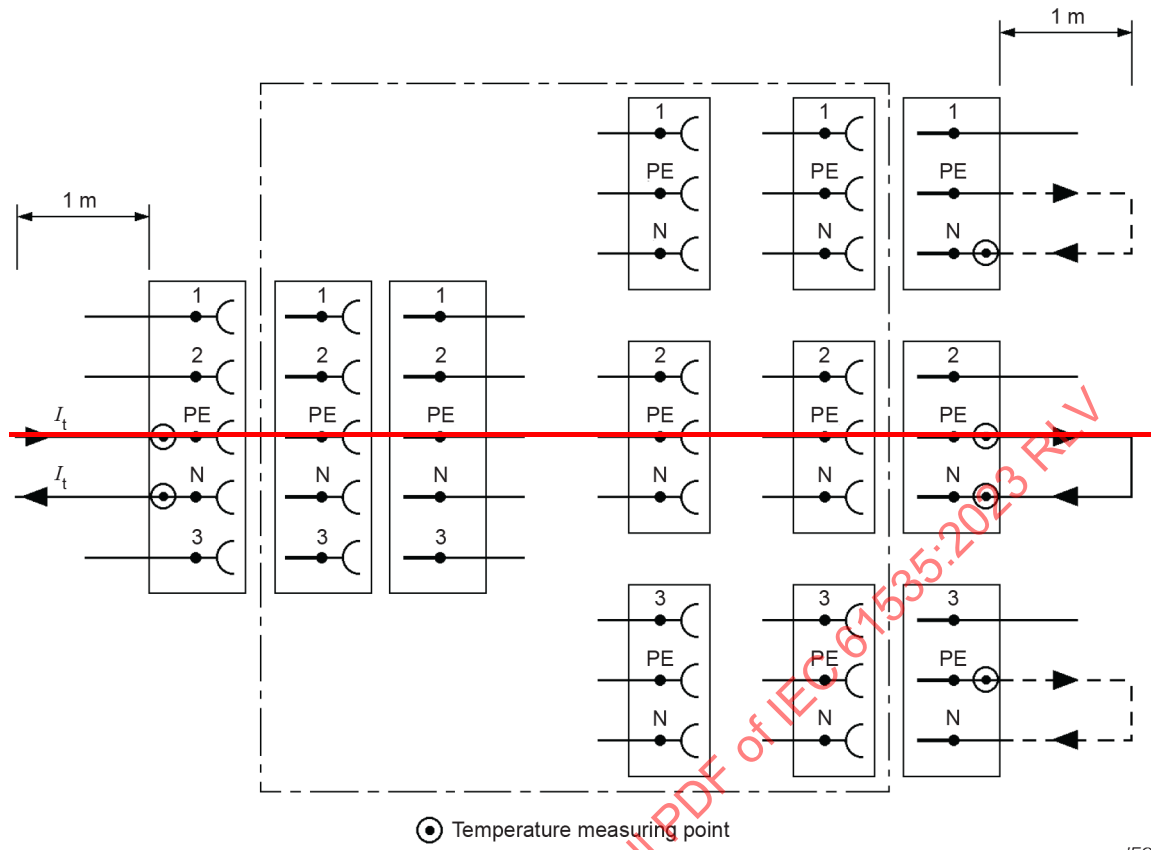
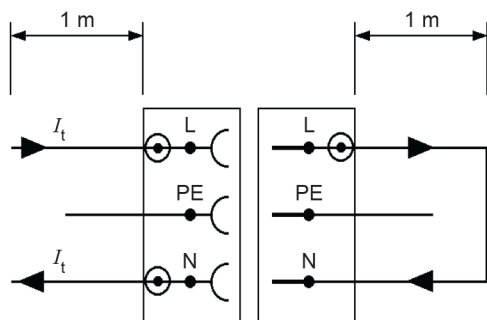
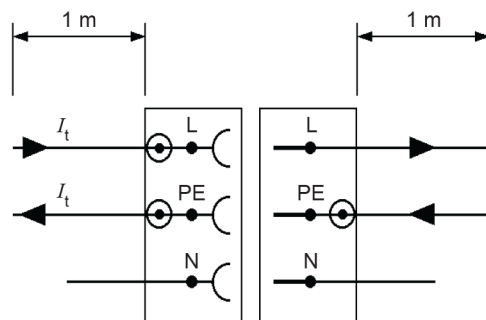


Figure B.6 — 3P + N + PE to 1P + N + PE distribution block, N and PE loaded



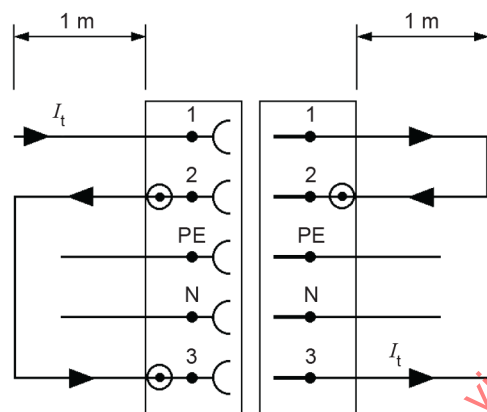
● Temperature measuring point

Figure B.1 – 1P + N + PE installation couplers, including N



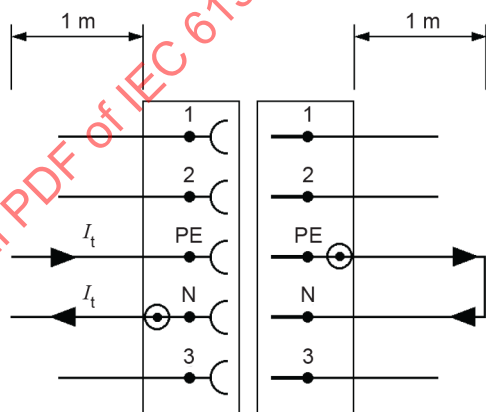
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Figure B.2 – 1P + N + PE installation couplers, including PE



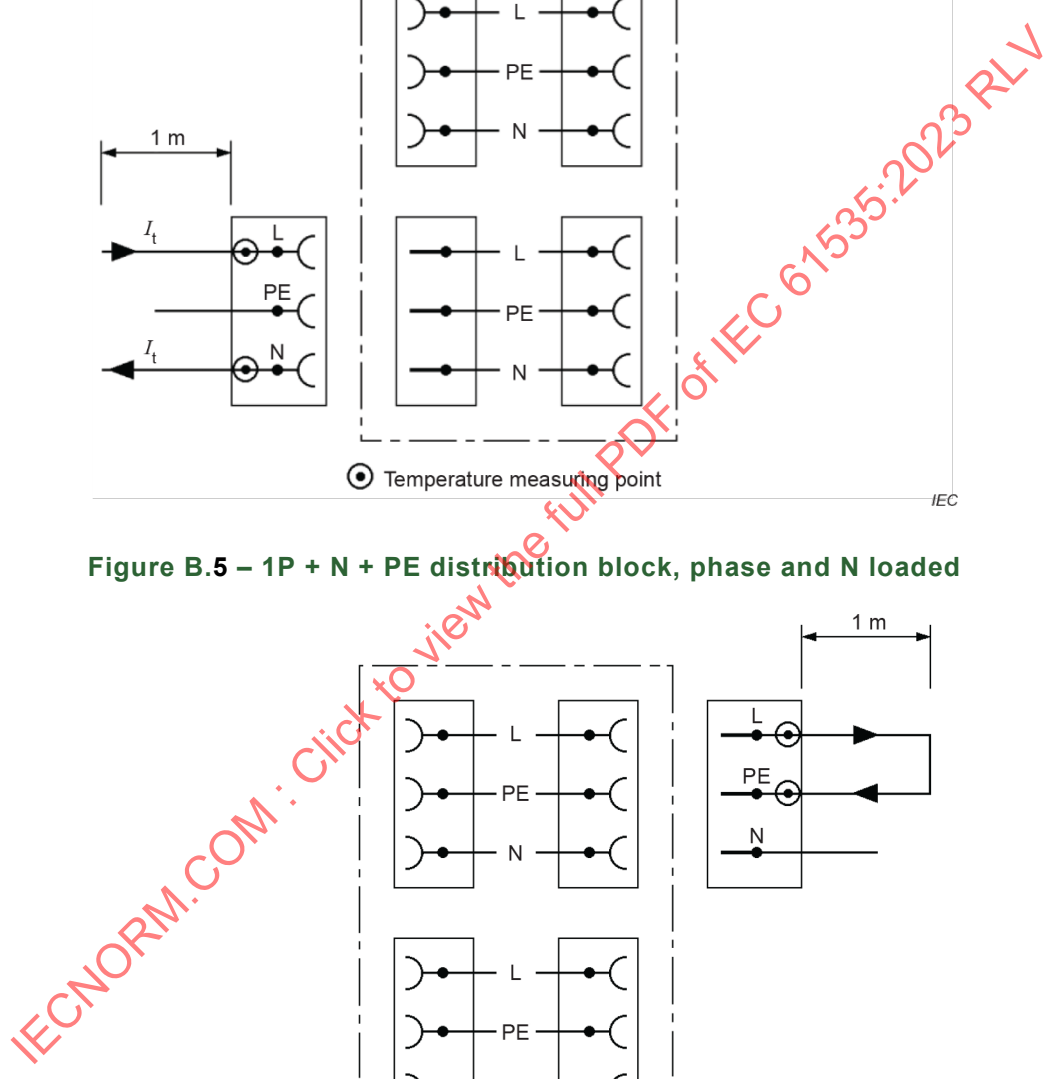
● Temperature measuring point

Figure B.3 – 3P + N + PE installation couplers, 3 phases loaded



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Figure B.4 – 3P + N + PE installation couplers, N and PE loaded



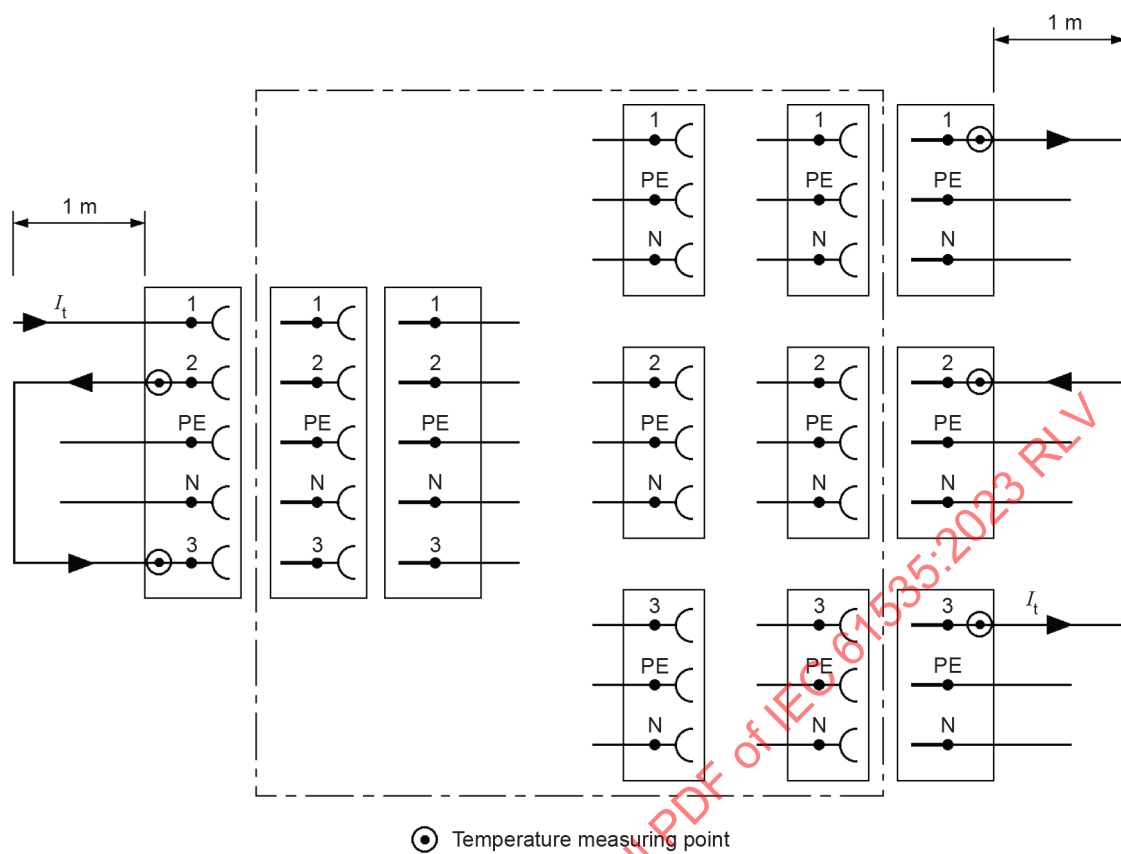


Figure B.7 – 3P + N + PE to 1P + N + PE distribution block, 3 phases loaded

Annex C

(normative)

Number of sets of test samples used for the tests and sequence of tests for each set

Table C.1 – Sets of samples

Clause/Subclause	Title	Set number	Number of samples
8	Marking and documentation	No. 1	3
9	Dangerous compatibility		
10	Protection against electric shock		
11	Terminals, terminations and connectable conductors		
12	Construction		
19	Cables and their connection		
23	Clearances, creepage distances and distances through solid insulation		
12.3	Mechanical strength of contacts	No. 2	3
13.3	Protection against harmful ingress of water	No. 3	3
13.2	Protection against harmful ingress of solid foreign objects		
14	Insulation resistance and electric strength	No. 4	3
15	Construction of contacts		
16	Temperature rise		
17	Breaking capacity ^c	No. 5	3
18	Forces necessary to disengage the parts of the installation coupler	No. 6	3
21.4	Resistance to ageing		
20	Mechanical strength	No. 7	3
22	Screws, current-carrying parts and connections		
21.5	Current cycling test	No. 8	3 (6) ^a
24.1	Resistance to abnormal heat	No. 9	3
21.2	Dry heat storage		
25	Resistance to rusting		
24.2	Resistance to tracking	(Separate test specimen) ^b	
21.3	Resistance to heat (Ball pressure test)	(Separate test specimen) ^b	
^a One additional set of 3 samples may be necessary for testing with conductors of the smallest and largest cross section. See 9.8 of IEC 60999-1:1999.			
^b An additional set of 3 samples is necessary, if applicable, or separate test probes, produced by a similar moulding process and tool, shall be used.			
^c Does not apply for DC application.			

Annex D (informative)

Guide to use

D.1 General

Installation coupler systems can be used in applications where the quick and easy connecting of different parts of the installation is required. These systems are all designed for rapid connecting which guarantees the correct connection. The use of installation couplers facilitates the installation and ~~disconnecting~~ maintenance or reconfiguration. Possible changes and repairs can be made easily afterwards.

Use of the installation coupler system makes planning easier. Cable sets can be prefabricated. Installation couplers may be used with rigid or flexible cables.

Installation couplers are not intended to be used instead of plug and socket-outlet systems. Installation couplers are intended to be connected and disconnected without current flowing. Product committees may elect to use installation couplers for connections to equipment which is intended for permanent connection (e.g. hot water services, fixed installed luminaires).

D.2 Applications

Installation coupler systems can be used in suspended floors and ceilings which are nowadays normal in commercial and office buildings. In this kind of application, the flexibility of the installation is achieved by using the installation coupler system because the fitting and furnishing of rooms are easily changeable. By using the installation coupler system the installation work becomes quicker than by using traditional mounting methods.

In houses, the use of installation coupler systems has a role due to the fact that houses are sometimes assembled from prefabricated elements.

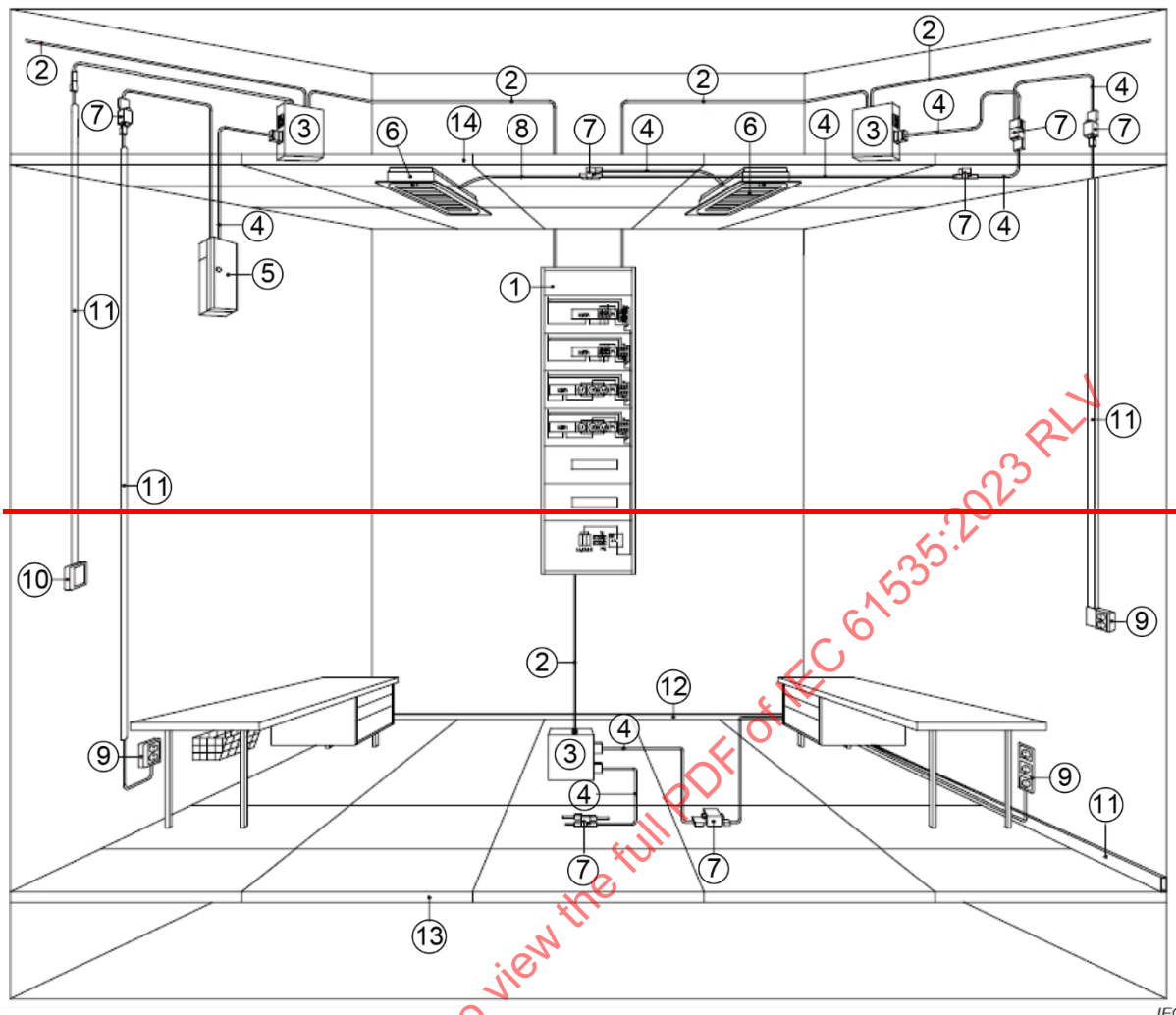
Installation couplers can be a part or a component of equipment, not just a method of connecting cables. Separate luminaires are a typical group of electrical equipment which can be easily linked to a comprehensive lighting system by using installation couplers. Machinery commonly consists of different units connected to each other by several installation couplers. Typical examples are air conditioners and heat recovery units which have separate motors, control units and pumps.

Installation couplers may be used in outdoor applications. For example, they can be used for the lighting system of a crane or for the installation in a carport.

D.3 Examples of use of installation couplers

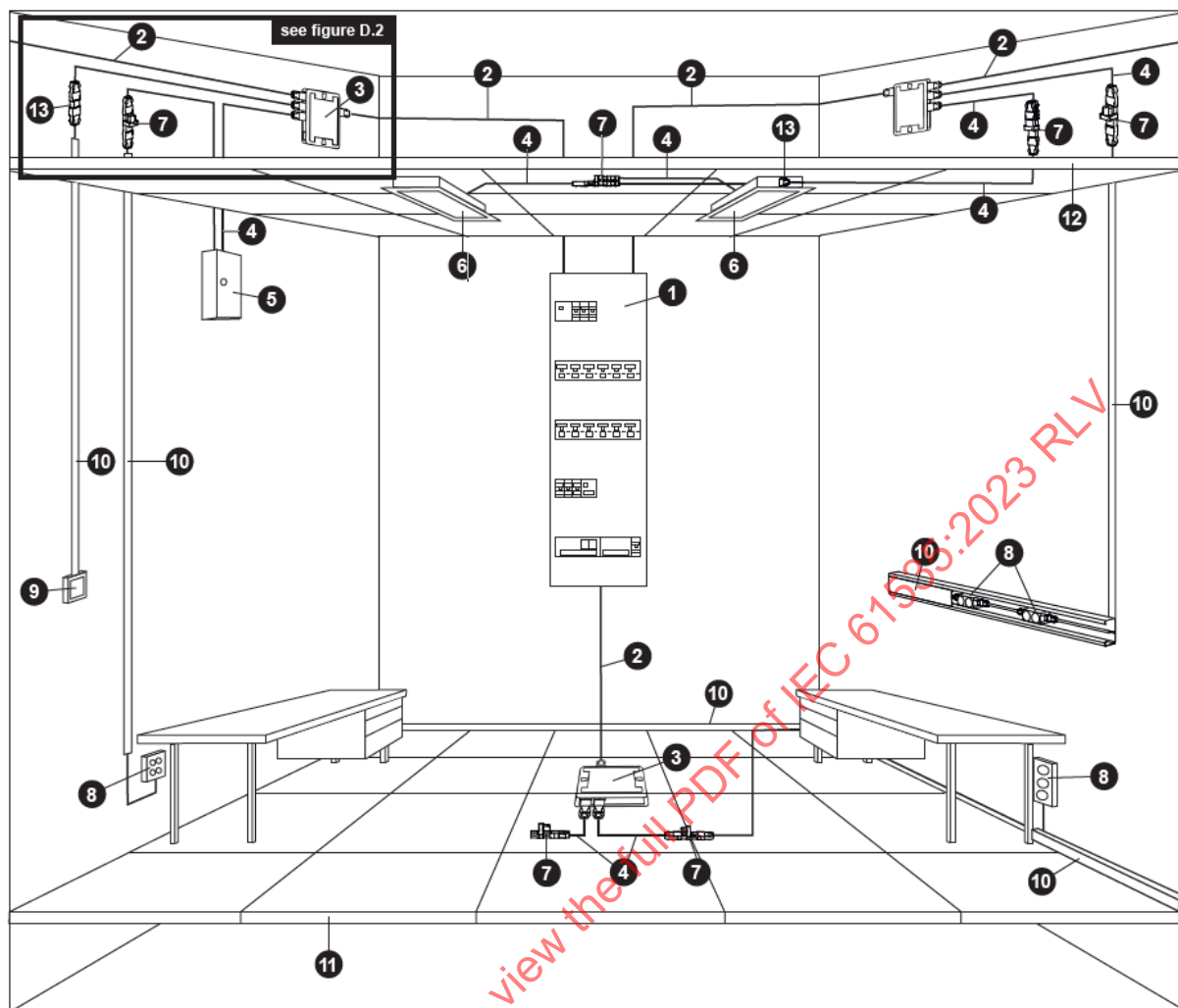
Use and the initial verification of installation couplers ~~should~~ can be carried out according to the national wiring rules. These are normally based on requirements laid down in the IEC 60364 series.

Installation couplers may be installed as shown in Figure D.1 and Figure D.2.



Key

- 1 Distribution board
- 2 Mains cables (fixed installation)
- 3 Junction box
- 4 Factory-wired cable set
- 5 Small distribution board
- 6 Lighting fixture
- 7 Distribution block
- 8 Factory-wired cable set
- 9 Socket-outlet for office desk
- 10 Switch
- 11 Pillar
- 12 Trunking/ducting
- 13 Suspended floor
- 14 Suspended ceiling



Key

- | | |
|-------------------------------------|-------------------------|
| 1 distribution board | 8 socket-outlet |
| 2 mains cables (fixed installation) | 9 switch |
| 3 junction box | 10 trunking/ducting |
| 4 cable set | 11 suspended floor |
| 5 small distribution board | 12 suspended ceiling |
| 6 lighting fixture | 13 installation coupler |
| 7 distribution block | |

Figure D.1 – Examples of use of installation couplers

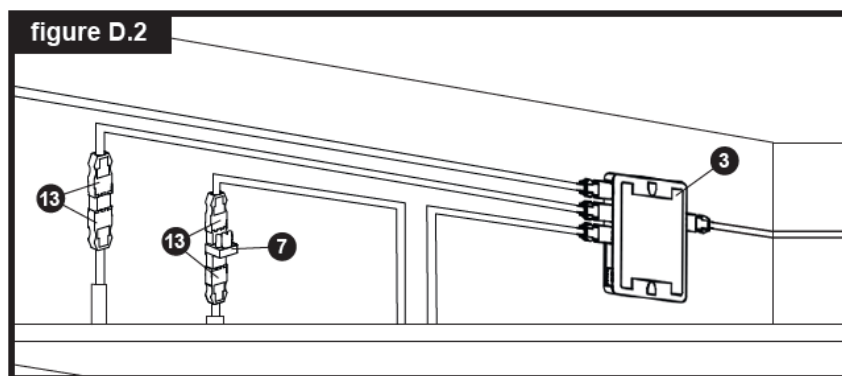


Figure D.9 – Magnified area of Figure D.1 to show installation couplers

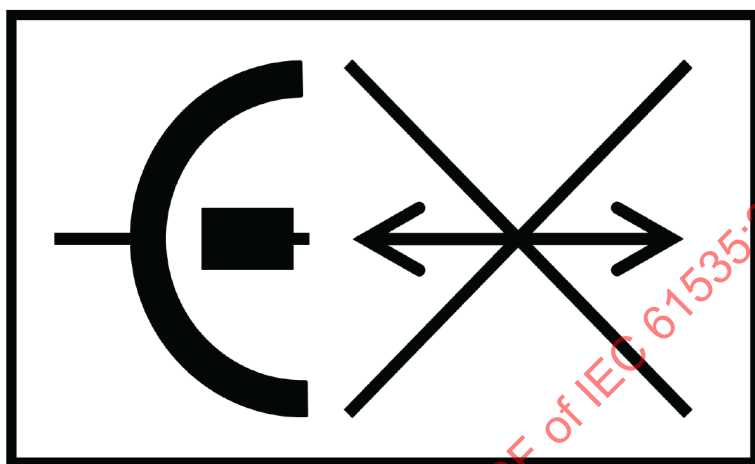
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Annex E

(normative)

Warning symbol used in DC applications

The following symbol (see Figure E.1 [IEC 60417-6070 (2011-06, but modified)]) shall be used to show that a DC-installation connector according to this document shall not be connected or disconnected under load.



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Figure E.1 – Symbol "DO NOT CONNECT OR DISCONNECT UNDER LOAD"

Annex F

(informative)

Additional tests and requirements for installation couplers intended to be used in ambient air temperature below –5 °C down to and including –45 °C

F.1 General

This annex provides tests and requirements for installation couplers operating in ambient air temperatures below –5 °C down to and including –45 °C.

The manufacturer shall declare the lower limit of the ambient air temperature the installation coupler is designed for, if lower than –5 °C. In this case the declared ambient air temperature shall be a multiple of 5 °C.

NOTE In the following countries, this Annex F is normative for installation couplers intended to be operated in temperatures below normal range, e.g. outdoor use: FI.

F.2 General requirements on tests

The following tests shall be conducted on three new installation male connectors and three new female installation connectors engaged together as for normal use. Three distribution blocks shall be tested with their matching counterparts complying with this document engaged thereto.

All tests in this Annex F shall be carried out at the declared temperature.

F.3 Additional marking and documentation

F.3.1 Additional marking

The requirements of Clause 8 of this document are supplemented by the following additional requirements.

Products declared as suitable for operation at an ambient temperature below –5 °C shall be additionally marked with the following symbol on the main part or if the part is too small so that the symbol is not readily visible, it can be given in the smallest package unit. The symbol shall indicate the declared value if applicable.

- Intended for use in cold environment, symbol IEC 60417-6292:2011-06



F.3.2 Additional documentation

In addition to requirements of 8.4, the instructions shall contain the following information:

- the lower limiting ambient air temperature shall be specified in the manufacturer's documentation;
- installation couplers shall not be installed, engaged or disengaged in an ambient air temperature below temperature –5 °C.

F.4 Mechanical strength at lower ambient air temperatures

In addition to the requirements of Clause 20 the tests shall be carried out according to the following procedure.

Rewirable installation couplers are fitted with the cable specified by the manufacturer, having the smallest cross-sectional area and a free length of approximately 100 mm.

Terminal screws and assembly screws are tightened with a torque equal to the value specified in Table 6.

Non-rewirable installation couplers are tested as delivered, the flexible cable being cut so that a free length of about 100 mm projects from the installation coupler.

The specimens shall be stored for at least 16 h, but not more than 24 h at the declared temperature. Then specimens are removed from a cold chamber and immediately afterwards (within 1 min) while the specimens are still cold, the specimens are subjected to the free fall repeated test, test procedure 2 according to IEC 60068-2-31:2008 as required in Clause 20 of this document.

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Installation couplers intended for permanent connection in fixed installations

Coupleurs d'installation pour connexions permanentes dans les installations fixes

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

INSTALLATION COUPLERS INTENDED FOR PERMANENT CONNECTION IN FIXED INSTALLATIONS

FOREWORD

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IEC 61535 has been prepared by IEC technical committee 23: Electrical accessories. It is an International Standard.

This third edition cancels and replaces the second edition published in 2019. This edition constitutes a technical revision.

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

- a) inclusion of a definition for "live part" based on IEC 61140;
- b) additional optional cross medial documentation, e.g. marking with QR-Code;
- c) corrections on the consistent use of the expressions "earth", "earthing contact", "earthing circuit" and "protective earth(ing)" throughout the document;
- d) addition of missing compliance provisions to 13.3;
- e) update of Figure D.1 of Annex D;
- f) inclusion of new Annex F for cold climate requirements.

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

Draft	Report on voting
23/1062/FDIS	23/1066/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

In this standard, the following print types are used:

- requirements proper: in roman type;
- *test specifications: in italic type;*
- explanatory matter: in smaller roman type.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

AC and DC installation couplers according to this document may be used, for example, in prefabricated buildings, commercial showrooms, installation cavities, such as suspended floors and ceilings, in partition walls and in any similar applications, or cable tray systems, cable ladder systems, cable ducting systems and cable trunking systems or in furniture complying with IEC 60364-7-713.

This document may be used as a guide for installation couplers with additional contacts for voltages other than mains voltages.

Particular requirements for installation couplers, for example, for use at higher or lower ambient temperatures, with higher mechanical durability (e.g. metal housings), with higher fire resistance and for use in control circuits (e.g. SELV), are under consideration.

National rules can have requirements concerning the accessibility of installation couplers.

National rules can specify who is allowed to carry out the connection and disconnection of installation couplers.

National rules can have requirements concerning installation couplers with metal conduits.

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INSTALLATION COUPLERS INTENDED FOR PERMANENT CONNECTION IN FIXED INSTALLATIONS

1 Scope

This document applies to two-wire, up to five-wire installation couplers, with or without earthing contact, if provided, with a rated voltage up to and including 500 V AC or 500 V DC and a rated connecting capacity up to and including 10 mm² and a rated current not exceeding 32 A for permanent connection in electrical installations. Installation couplers with additional contacts for voltages other than mains voltages are outside the scope of this document.

An installation coupler consists of an installation female connector and an installation male connector for permanent connection not intended to be engaged or disengaged under load nor to be engaged or disengaged other than during first installation or during reconfiguration or maintenance of the wiring system in which installation couplers have been installed. This means that installation couplers are intended for infrequent use only.

Installation couplers are not suitable for use in place of socket-outlet systems. Installation couplers are not suitable for use in place of devices for connecting luminaires (DCLs) according to IEC 61995 (all parts) or in place of luminaire supporting couplers (LSCs).

Installation couplers complying with this document are suitable for use at ambient temperatures not normally exceeding +40 °C, but their average over a period of 24 h does not exceed +35 °C, with a lower limit of the ambient air temperature of –5 °C, either for indoor or outdoor use.

NOTE 1 Additional tests for use in cold climates are shown in Annex F, which is normative in following countries: FI. Necessary information can be given in the manufacturer's installation instructions.

NOTE 2 For other temperatures, necessary information can be given in the manufacturer's installation instructions.

In locations where special conditions prevail, as in ships, vehicles and the like and in hazardous locations, for example where explosions are liable to occur, special constructions can be required.

NOTE 3 Installation couplers are intended to be installed by instructed or skilled persons.

NOTE 4 As a guide to using installation coupler systems, see Annex D.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60068-2-31:2008, *Environmental testing – Part 2-31: Tests – Test Ec: Rough handling shocks, primarily for equipment-type specimens*

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

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

IEC 60664-1:2020, *Insulation coordination for equipment within low-voltage supply systems – Part 1: Principles, requirements and tests*

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

IEC 60998-2-3, *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 mm² up to 35 mm² (included)*

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

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

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

Where the terms "voltage" and "current" are used in this document, they are RMS values, unless otherwise specified.

3.1

rated voltage

voltage assigned to the installation coupler by the manufacturer

3.2

rated current

maximum current assigned to the installation coupler by the manufacturer

Note 1 to entry: Rated current refers to the installation coupler itself and not to an electric circuit.

3.3

rated connecting capacity

cross-sectional area of the largest conductor(s) to be connected as stated by the manufacturer of the installation coupler

3.4

permanent connection

connecting method in an installation which is only opened for maintenance or wiring system re-configuration

Note 1 to entry: The expression "permanent connection" is to be understood as a connection which is maintained as long as an installation exists.

3.5

installation coupler

connecting device consisting of an installation female connector and an installation male connector provided with retaining means for permanent connection not intended to be engaged or disengaged under load nor to be engaged or disengaged other than during first installation, during maintenance of the wiring system or during re-configuration of the wiring system

3.6**installation male connector**

load side portion of an installation coupler which contains the male contacts

3.7**installation female connector**

supply side portion of an installation coupler which contains the female contacts

3.8**installation coupler system**

family of installation couplers consisting of one or more installation female connectors compatible by mechanical coding features with one or more installation male connectors, with the same ratings produced according to the specification of one manufacturer

Note 1 to entry: The meaning of "one manufacturer" in this case, is "one and the same manufacturer".

3.9**wiring system**

assembly made up of a cable or cables or busbars and the parts which secure and if necessary enclose the cables or busbars

[SOURCE: IEC 60364-5-52:2009, 520.3.1, modified – "bare or insulated conductors" has been replaced with "a cable".]

3.10**rewirable installation coupler**

installation coupler so constructed that the cable can be replaced

3.11**non-rewirable installation coupler**

installation coupler so constructed that it forms a complete unit with the cable after connection and assembly by the manufacturer

Note 1 to entry: See also 12.15.

3.12**non-rewirable moulded-on installation coupler**

non-rewirable installation coupler so constructed that the contacts, terminals or connections and the attached cable ends are surrounded by insulating material manufactured by a moulding process

3.13**non-rewirable non-moulded-on installation coupler**

non-rewirable installation coupler so constructed that the contacts, terminals or connections and the attached cable ends are surrounded by separate parts of insulating material

3.14**distribution block**

device intended for branching of circuits

3.15**retaining means**

arrangement by which an installation female connector and an installation male connector are held in position when they are properly engaged and prevents unintentional disengagement

Note 1 to entry: The disengagement may be done by hand or by the use of a tool.

3.16

cap

removable barrier to prevent ready accessibility to an unused installation female connector

3.17

routine test

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

3.18

type test

test of one or more devices made to a certain design to show that the design meets certain requirements

3.19

readily accessible, adj

accessible to touch from any point on a surface where persons usually stand or move about to the limits which a person can reach with the hand, in any direction without assistance

Note 1 to entry: See IEC 60364-4-41:2005, Annex B.

3.20

terminal

part of an accessory to which a conductor is attached, providing a reusable connection

3.21

termination

part of an accessory to which a conductor is permanently attached

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

3.22

live part

conductive part intended to be energized in normal conditions, including a neutral conductor or mid-point conductor, but by convention not a PEN conductor or PEM conductor or PEL conductor

Note 1 to entry: This concept does not necessarily imply a risk of electric shock.

[SOURCE: IEC 61140:2016, 3.4]

4 General requirements

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

Compliance is checked by carrying out all the relevant tests specified in this document.

NOTE In some countries, installation couplers are not permitted to be used where they will not be visible after installation: CA, US.

5 Conditions for tests

5.1 General

Tests shall be carried out to check compliance with the relevant requirements of this document.

Only connectors (male and female) of one installation coupler system according to the specification of one and the same manufacturer shall be mated together for carrying out the test.

Tests are as follows:

- type tests shall be made on representative specimens of each type of installation coupler;
- routine tests shall be made on each installation coupler as required in this document.

Tests of 5.2 to 5.6 are applicable to type tests and 5.7 to routine tests.

NOTE In the UK, where installation couplers have more than 5 wires, they shall meet the requirements of IEC 61535 as though they were included in the scope and shall be tested in such a way that all of the mains voltage pins are subjected to the same level of testing.

5.2 Test conditions

Unless otherwise specified, the tests shall be carried out on specimens as delivered and under conditions of normal use at an ambient temperature between 15 °C and 35 °C.

Where the value of the temperature is of importance, the test shall be carried out at 20 °C ± 5 °C.

5.3 Tests on non-rewirable installation couplers

For testing purposes, non-rewirable installation couplers shall be provided with cables of at least 1 m length unless otherwise specified in this document.

5.4 Order of tests

If not otherwise specified in this document, the tests shall be carried out in the order of the clauses/subclauses as specified in Annex C, Table C.1.

5.5 Specification of tests

Installation male connectors, caps, installation female connectors and distribution blocks shall be tested in connection with their matching counterparts complying with this document.

The sets of test specimens shall undergo the tests as specified in Annex C, Table C.1.

5.6 Compliance requirements

Specimens are deemed not to comply with this document if there is more than one specimen failure in any one of the tests.

If one specimen of a given set fails in a test due to an assembly or manufacturing fault, that test and those preceding it, which may have influenced the result of that test, are repeated on another set of specimens of the same set number as specified in Annex C, Table C.1, all of which shall then comply with the repeated tests.

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

5.7 Routine tests for non-rewirable installation couplers

Routine tests for non-rewirable installation couplers are specified in Annex A.

6 Ratings

6.1 Rated voltage

Installation couplers should preferably have a rated voltage chosen either from Table 1 for AC application or from Table 2 for DC application.

All components of the same installation coupler system shall have the same phase to neutral voltage rating.

Table 1 – Voltage rating for installation couplers in AC application

Nominal voltage of power supply system V	Rated voltage V	Rated impulse voltage kV
100	125	2,5
100/200	125/250	2,5
230	250	4,0
230/400	250/400	4,0
277/480	320/500	4,0

Table 2 – Voltage rating for installation couplers in DC application

Nominal voltage of power supply system V	Rated voltage V	Rated impulse voltage kV
12	12	0,8
60	60	1,5
120 ^a to 240 ^b	125/250	2,5
220 ^a to 440 ^b	250/500	4,0

NOTE For DC applications up to 60 V, due to load switching, much higher voltages than the rated voltage are also possible, therefore the complete circuit can be considered when defining the rating for impulse voltage.

^a Voltage live conductor against reference conductor / earth.

^b Voltage live conductor (+ / – polarity).

6.2 Rated current

Installation couplers should preferably have a rated current chosen from the following values:

- 10 A
- 13 A
- 16 A
- 20 A
- 25 A
- 32 A.

6.3 Rated connecting capacity

Installation couplers should preferably have a rated connecting capacity chosen from the following values:

- 1,5 mm²
- 2,5 mm²
- 4 mm²
- 6 mm²
- 10 mm²

6.4 Tests

Compliance with 6.1, 6.2 and 6.3 is checked by inspection of markings according to Clause 8.

7 Classification

Installation couplers are classified according to Table 3.

Table 3 – Classification of installation couplers

Classification criteria		
7.1 Rated impulse voltage	7.1.1	2,5 kV
	7.1.2	4 kV
7.2 Method of connecting the cable	7.2.1	Rewirable
	7.2.2	Non-rewirable
	7.2.2.1	Non-rewirable moulded-on
	7.2.2.2	Non-rewirable non-moulded-on
7.3 Degree of protection against ingress of solid foreign objects and ingress of water according to IEC 60529 (IP-Code)		
7.4 Location where installation couplers will be installed	7.4.1	Readily accessible ^a
	7.4.2	Non-readily accessible
7.5 Existence of an earthing contact	7.5.1	With earthing contact
	7.5.2	Without earthing contact
7.6 Type of conductors to be connected	7.6.1	Solid
	7.6.2	Rigid (solid and stranded)
	7.6.3	Flexible
	7.6.4	Both rigid (solid and stranded) and flexible
7.7 Type of terminals for rewirable installation couplers only	7.7.1	Installation couplers with screw-type terminals
	7.7.2	Installation couplers with screwless terminals
	7.7.3	Installation couplers with insulation piercing terminals
7.8 Application	7.8.1	AC
	7.8.2	DC
^a Installation couplers for readily accessible areas can also be used in non-readily accessible areas.		

8 Marking and documentation

8.1 General

Installation couplers shall be marked with:

- a) rated current in amperes (A);
- b) rated voltage in volts (V);
- c) manufacturer's or responsible vendor's name, trademark or identification mark;
- d) IP-code if higher than IP43 as follows:

The first characteristic numeral for the degree of protection against access to hazardous parts and against harmful effects due to ingress of solid foreign objects shall be marked if declared to be higher than 4, in which case the second characteristic numeral shall also be marked.

The second characteristic numeral for the degree of protection against harmful effects due to ingress of water shall be marked if declared to be higher than 3, in which case the first characteristic numeral shall also be marked;

- e) type reference;
- f) rated connecting capacity for rewirable installation coupler in mm²;
- g) connected conductor size in mm² for non-rewirable installation coupler;
- h) DC, when constructed to be used in direct current systems;
- i) a warning symbol according to Annex E, when constructed to be used in a DC system. For connectors too small to have a marking, a separate label with this warning symbol shall be available for installation couplers for direct current.

8.2 Use of symbols or letters

When symbols or letters are used, they shall be as follows:

- | | |
|---|--|
| • rated connecting capacity in square millimetres | mm ² or □ |
| • volts | V |
| • amperes | A |
| • alternating current | ~ or AC |
| • direct current | ≡ or DC |
| • positive pole (in DC systems) | + |
| • negative pole (in DC systems) | – |
| • neutral | N |
| • mid-point | M |
| • protective earth |  or PE (IEC 60417-5019:2006-08) |

8.3 Markings

Markings on the installation coupler and label according to items in 8.1 shall be readily visible before installation.

Terminal markings for AC application shall be L1, L2, L3 or 1, 2, 3, or equivalent. Neutral terminals shall be marked with N. Terminal markings for DC application shall be L+, L–, +, –, or equivalent. Mid-point terminals shall be marked with M. Protective earth terminals shall have the relevant marking. These markings shall not be placed on screws, removable washers or any other easily removable parts.

If terminals are designed to accept only one type of conductor, for example, flexible, or rigid (stranded or solid), this shall either be clearly marked on the installation coupler by the letter "f" for flexible or "r" for rigid or "s" for solid or shall be indicated on the smallest packaging unit or in the technical information and catalogue.

Markings and labels shall be durable and clearly legible with normal or corrected vision, without additional magnification.

Compliance is checked by inspection and by the following test:

The marking is rubbed by hand for 15 s with a piece of cloth soaked with water and again for 15 s with a piece of cloth soaked with petroleum spirit.

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

A warning label for DC use "Do not connect or disconnect under load" according to Annex E shall be provided.

8.4 Documentation

The manufacturer's catalogue or installation instructions shall contain the following information:

- a) installation couplers are intended for connection and disconnection without load only;
- b) types of cables intended to be fitted into the installation couplers;
- c) if the installation coupler is not suitable for installation in readily accessible areas;
- d) if additional parts or precautions are necessary for use in readily accessible areas;
- e) an appropriate marking indicating the length of insulation to be removed before the insertion of the conductor into the screwless terminal;
- f) length of slack of a PE conductor for rewirable installation couplers (see 12.14);
- g) warning advising the installer that dangerous compatibility between different manufacturer installation coupler systems is not automatically prevented by compliance with IEC 61535;
- h) statement that installation coupler systems are not replacements for the national household plug and socket outlet system;
- i) if looping-in is intended, wiring instructions shall be specified in the manufacturer's technical documentation;
- j) for DC use, a label "Do not connect or disconnect under load" according to Annex E shall be provided by the manufacturer. Instruction to the installer shall be provided in the installation instructions to attach the warning label as close as possible to the installation coupler for direct current;
- k) statement that installation couplers shall be used with the retaining means as provided by the manufacturers (see 12.10).

All documentation may additionally be given cross-medial.

NOTE For example, QR-codes with reference to internet, electronic catalogues, web-link on the package unit or delivery papers, etc.

The installation instructions shall be available in the manufacturer's catalogue, in the technical documentation or inside or on the smallest packaging unit.

9 Dangerous compatibility

9.1 Unintended or improper connection

An installation coupler system shall be designed and constructed so that unintended or improper connection is prevented.

An installation coupler system shall be designed and constructed so that connection between alternating current and direct current is prevented.

NOTE Unintended or improper connection includes single-pole connection, except for earthing contact to earthing contact.

Compliance is checked by inspection and the following test.

It shall not be possible to insert the installation male connector into the installation female connector resulting in a dangerous situation.

Engagement of the installation male and installation female connector is attempted in any unintended configuration using a force of 80 N for installation couplers marked as "10 A", "13 A", "16 A" and "20 A" or a force of 120 N for installation couplers marked as "25 A" and "32 A". The force shall be applied on the same axis of the connection for 1 min during which time the installation male and installation female connector contacts shall not engage.

Where the use of elastomeric or thermoplastic material is likely to influence the results of the test, it shall be carried out at an ambient temperature of $35\text{ °C} \pm 2\text{ °C}$, all parts of the installation coupler being at this temperature.

During the test, no contact shall occur.

9.2 Engagement

It shall not be possible, within a given installation coupler system, to engage an installation male connector with an installation female connector:

- with a different number of live poles; exceptions may be admitted for installation female connectors which are specially constructed for the purpose of allowing engagement with installation male connectors of a lower number of poles, provided that no dangerous situation can arise;
- without earthing contact if the installation male connector is an installation male connector with earthing contact;
- with different phase to neutral voltage ratings or different rated currents.

Compliance is checked by the test in accordance with 9.1.

9.3 Compatibility of different installation coupler systems

Installation couplers of different systems from the same manufacturer shall not be dangerously compatible.

Compliance is checked by the test in accordance with 9.1.

9.4 Compatibility with standard systems

Installation couplers in accordance with this document shall not be compatible with systems specified in standard sheets of IEC 60309 (all parts), IEC 60320 (all parts), IEC 60906 (all parts), or with the national household plug and socket-outlet systems of the country where the product is placed on the market.

NOTE Some national plug and socket-outlet systems are shown in IEC TR 60083.

Compliance is checked by manual test and, in case of doubt, by examination of drawings.

10 Protection against electric shock

10.1 Degree of protection against ingress of solid foreign objects

An engaged installation coupler shall comply with the requirements of IP 2XC. The installation coupler shall be so designed that live parts are not accessible if the installation male and installation female connector are partially or completely engaged. The installation female connector shall be so designed that live parts are not accessible when disengaged and shall comply with the requirements for IP 2X. The earthing contact and any metal parts connected to the earthing contact shall not be accessible when the installation coupler is completely engaged, except for installation couplers in metal conduits (where erection rules ask for such practice).

NOTE 1 National rules can have requirements concerning installation couplers with metal conduits.

NOTE 2 Live parts as mentioned in this document are regarded as hazardous parts in accordance with IEC 60529.

Installation couplers for use in readily accessible areas shall comply with IP 2XD both engaged and unengaged.

If the engagement face of the installation female connector for readily accessible areas does not comply with IP 2XD, the manufacturer shall make caps available. These caps shall only be removable with the aid of a tool.

Compliance is checked after the removal of parts which can be removed without the use of a tool by using test probe C in accordance with Figure 3 of IEC 61032:1997, test probe D in accordance with Figure 4 of IEC 61032:1997 and test probe 11 in accordance with Figure 7 of IEC 61032:1997. Test probes are applied in accordance with IEC 60529.

10.2 Access to live parts

It shall not be possible to access live parts without the aid of a tool.

Bushes, if any, in the entry holes for the male contacts shall be adequately fixed and it shall not be possible to remove them without dismantling the installation coupler.

Compliance is checked by inspection and by manual test.

10.3 External parts

External parts of installation couplers, with the exception of assembly screws and the like, shall be of insulating material.

NOTE National rules can have requirements concerning installation couplers with metal housings.

Compliance is checked by inspection.

11 Terminals, terminations and connectable conductors

11.1 Terminals and terminations

11.1.1 General

For installation couplers with clamping units, IEC 60999-1:1999 applies, as applicable, with the exception of the test of 9.10 of IEC 60999-1:1999.

NOTE 1 The test of 9.10 of IEC 60999-1:1999 is covered by the cycling ageing test in accordance with 21.5 of this document.

NOTE 2 The test of 9.8 of IEC 60999-1:1999 is covered by the contact resistance test in accordance with 15.2 of this document.

11.1.2 Terminals of rewirable installation couplers

Rewirable installation couplers shall be provided with screw-type terminals, with screwless terminals or reusable insulation piercing terminals.

Terminals with screw clamping means shall allow the conductor to be connected without any special preparation but shall also allow prepared conductors if specified.

Insulation piercing terminals shall comply with IEC 60998-2-3.

11.1.3 Terminations of non-rewirable installation couplers

Non-rewirable installation couplers shall be provided with soldered, welded, crimped terminations or means for insulation piercing or screwless clamping units or equally effective permanent means.

Screwless terminals and insulation piercing terminals are not allowed for non-rewirable moulded-on installation couplers except when means are included that prevent the moulding material from penetrating into the clamping unit.

Solder-type terminations shall be provided with means that are independent of the solder for mechanically fixing the conductor in position.

Compliance is checked by inspection.

11.2 Connectable conductors

Terminals for the rewirable installation female connector and the rewirable installation male connector shall not have smaller rated connecting capacities than as follows:

- 1,5 mm² for installation couplers marked 10 A according to the maximum current rating;
- 1,5 mm² for installation couplers marked 13 A according to the maximum current rating;
- 1,5 mm² for installation couplers marked 16 A according to the maximum current rating;
- 2,5 mm² for installation couplers marked 20 A according to the maximum current rating;
- 4 mm² for installation couplers marked 25 A according to the maximum current rating;
- 6 mm² for installation couplers marked 32 A according to the maximum current rating.

NOTE National wiring rules determine the rating of the circuit in which the relevant installation coupler is allowed to be used.

Compliance is checked by the following test.

Conductors with the indicated cross-sectional areas and types shall be connected and screws shall be tightened with the torque values specified in Table 6. For installation couplers classified according to 7.6.3 and 7.6.4 in Table 3, the test is carried out in conjunction with the test of 12.8.

12 Construction

12.1 Connection between earthing contacts

Installation couplers shall be so constructed that when inserting the installation male connector, the connection between earthing contacts, if any, is made at least 1 mm before the current-carrying contacts of the installation male connector become live.

When withdrawing the installation male connector, the current-carrying male contacts shall separate before the connection between earthing contacts is broken.

Compliance is checked by inspection of the manufacturing drawings taking into account the effect of tolerances and the most unfavourable positions and by checking the specimens against these drawings and/or by manual test.

12.2 Locking against rotation

Contacts of installation male connectors shall be locked against rotation if male contacts can be touched without the aid of a tool.

Compliance is checked by the following tests.

A torque with a value of 0,4 Nm is applied to the contacts for 60 s in one direction and for 60 s in the opposite direction. The contact parts shall not rotate more than an angle of 30° in total.

NOTE Terminal screws can be used to prevent the contacts from rotating.

12.3 Mechanical strength of contacts

Contacts shall be securely fixed and shall have sufficient mechanical strength. They shall not be removable without the aid of a tool.

This requirement does not exclude floating contacts.

Compliance is checked by inspection and by the following test.

The installation coupler shall be mounted as for normal use and with all contacts installed. Any accessory or cover which is not essential for the contact retaining system may be loosened or removed.

The installation coupler shall be placed in a heating cabinet for 1 h at a temperature of $(70 \pm 2) ^\circ\text{C}$.

Immediately after the heating period, an axial force of 40 N shall be applied to each contact of the installation female connector and installation male connector in both directions consecutively. This force shall be reached by gradual increase at a rate not exceeding 20 N/s until the specified value is reached.

The maximum value shall be maintained for 60 s.

After the test the installation coupler is allowed to cool to room temperature and then no contact shall have been displaced in the body of the installation coupler by more than 1 mm.

12.4 Housing of rewirable installation couplers

The housing of rewirable installation couplers shall completely enclose the terminals and the ends of cable sheaths. It shall be possible to arrange each conductor such that its insulation cannot come into contact with live parts having another polarity.

Compliance is checked by inspection and manual test.

12.5 Housing of non-rewirable installation couplers

The housing of non-rewirable installation couplers shall completely enclose the terminations and the ends of cable sheaths. The conductors shall be so arranged that their insulation cannot come into contact with live parts having another polarity.

Compliance is checked by inspection and manual test.

12.6 Dismantling and opening of rewirable installation couplers

Rewirable installation coupler housings shall be reliably fixed and it shall not be possible to dismantle the installation coupler without the aid of a tool.

For rewirable installation couplers, there shall be independent means for fixing and locating the parts of the installation coupler with respect to each other, at least one of which shall be operated with the aid of a tool for opening.

Compliance is checked by inspection and by manual test.

12.7 Earthing contact and earthing terminal

If the earthing contact and the earthing terminal are not in one piece, the various parts shall be connected together by a reliable manner.

Clamping units complying with IEC 60999-1:1999, riveting and welding are considered as a reliable manner.

Clamping screws or the spring of screwless-type clamping units are not considered to be part of the contact.

Compliance is checked by inspection and test in accordance with Clause 16.

12.8 Loose conductor strands

12.8.1 General

Rewirable installation couplers classified according to 7.6.3 or 7.6.4 of Table 3 shall be so designed that loose conductor strands in the installation coupler will not present a risk of electric shock.

For non-rewirable installation couplers, means shall be provided to prevent loose conductor strands from reducing the minimum clearance and creepage distance requirements and the distance through solid insulation between conductors and all accessible external surfaces of the installation coupler, with the exception of the engagement face of the installation male connector of the installation coupler.

Compliance is checked by the following:

- *for rewirable installation couplers, the test of 12.8.2;*
- *for non-rewirable non-moulded-on installation couplers, the test of 12.8.3;*
- *for non-rewirable moulded-on installation couplers, by verification and inspection according to 12.8.4.*

12.8.2 Strand test for rewirable installation couplers

A length of 6 mm of insulation is removed from the end of a flexible conductor, having a minimum cross-sectional area specified by the manufacturer. One strand of the flexible conductor is left free and the remaining strands are fully inserted into and clamped in the terminal, as for normal use.

The free strand is bent, without tearing the insulation back, in every possible direction but without making sharp bends around barriers.

NOTE The prohibition against making sharp bends around barriers does not imply that the free strand has to be kept straight during the test. Sharp bends are, moreover, made if it is considered likely that such bends can occur during the normal assembly of the installation coupler, for example when the cover is pushed on.

It shall not be possible for a free strand of a conductor connected to a live terminal to touch any accessible metal part, be able to emerge from the enclosure or touch an earthing terminal when the installation coupler has been assembled.

It shall not be possible for a free strand of a conductor connected to an earthing terminal to touch a live part.

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

12.8.3 Strand test for non-rewirable non-moulded-on installation couplers

A length of insulation equivalent to the maximum designed stripping length declared by the manufacturer +2 mm is removed from the end of a flexible conductor having the cross-sectional area as fitted. One strand of the flexible conductor is left free in the most unfavourable position whilst the remaining strands are terminated to suit the construction of the installation coupler.

The free strand is bent without tearing the insulation back, in every possible direction but without making sharp bends around barriers.

NOTE The prohibition against making sharp bends around barriers does not imply that the free strand has to be kept straight during the test. Sharp bends are, moreover, made if it is considered likely that such bends can occur during the normal assembly of the installation coupler, for example when the cover is pushed on.

It shall not be possible for a free strand of a conductor connected to a live termination to touch any accessible metal parts, or to touch an earthing termination, or to reduce the creepage distance and clearance through any constructional gap to the external surface below 1,5 mm.

It shall not be possible for a free conductor connected to an earth termination to touch any live parts.

12.8.4 Strand test for non-rewirable moulded-on installation couplers

Non-rewirable moulded-on installation couplers shall be inspected to verify that there are means to prevent stray conductor strands and/or live parts from touching an earthing terminal or reducing the minimum distance through insulation to the external accessible surface with the exception of the engagement face of the installation male connector below 1,5 mm.

The verification of "means" may require the checking of the product construction or product assembly method.

12.9 Incorporation of electrical devices

Installation couplers themselves shall not incorporate other electrical devices, for example, switches, fuses, relays, thermostats, surge protective devices and thermal current-limiting devices.

The use of installation couplers as connection for the electrical devices listed above is permitted.

12.10 Retaining means

Installation couplers shall be provided with retaining means which engages automatically when the installation coupler or cap is connected and which is capable of disengagement for disconnecting. It shall only be possible to disengage the retaining means by a deliberate or intentional act. For installation couplers classified in accordance with 7.4.1 and 7.8.2 of Table 3, for disengagement, the retaining means shall be opened with a key or tool only.

Compliance is checked by the following test.

The fully engaged installation coupler shall be subjected to a smooth axial traction force of 80 N for a period of 1 min, during which the retaining device shall be fully engaged. The installation coupler shall not loosen or become disconnected.

12.11 Distribution blocks

The distribution block shall include one installation male connector only for each circuit. The distribution blocks intended for fixed mounting shall have means for fixing to the support, for example, screw holes.

Compliance is checked by inspection.

12.12 Shrouds

Installation male connectors shall have a shroud, which shall be at least as long as the longest pin.

Compliance is checked by inspection.

12.13 Factory wiring

Non-rewirable installation couplers shall be factory-wired.

12.14 Stress test

12.14.1 General

In installation couplers with earthing contact, the length of the conductors between the terminals or terminations and the cable anchorage shall be so adjusted that the current-carrying conductors will be stressed before the protective earthing conductor if the cable slips out of its cable anchorage.

12.14.2 Stress test of rewirable installation couplers

Rewirable installation couplers shall have adequate space for the slack of the protective earthing conductor so that, if the cable anchorage becomes inoperative, the protective earthing conductor connection is subjected to strain after the connections of the current-carrying conductors and that, in case of excessive stresses, the protective earthing conductor will break after the current-carrying conductors.

Compliance is checked by the following test.

The cable is connected to the installation coupler so that the current-carrying conductors are led from the cable anchorage to the corresponding terminals by the shortest route.

After the current-carrying conductors are correctly connected, the core of the protective earthing conductor is led to its terminal and cut off at a distance 8 mm longer than necessary when using the shortest possible path for its correct connection.

After the protective earthing conductor is connected to the terminal, it shall be possible to accommodate the loop formed by the surplus length of the protective earthing conductor when the installation coupler is assembled correctly.

12.14.3 Stress test of non-rewirable installation couplers

In non-rewirable installation couplers with earthing contact, the length of the conductors between the terminations and the cable anchorage shall be so adjusted that the current-carrying conductors will be stressed before the protective earthing conductor if the cable slips in its cable anchorage.

Compliance is checked by inspection.

12.15 Separation of non-rewirable installation couplers

In non-rewirable installation couplers, it shall not be possible for the cable to be separated from the installation coupler without making it permanently useless.

NOTE An installation coupler is considered to be permanently useless when for re-assembling the installation coupler, parts or materials other than the originals are to be used.

Compliance is checked by inspection and by manual test.

13 Protection against harmful ingress of solid foreign objects and against harmful ingress of water

13.1 General

The minimum IP rating shall be IP 20.

13.2 Protection against harmful ingress of solid foreign objects

The minimum IP rating shall be IP 2X.

The housing of the installation coupler shall provide a degree of protection against ingress of solid foreign objects as declared by the manufacturer.

Compliance is checked in accordance with IEC 60529. For numeral 5, category 2 applies. IP classification is measured when the mating parts are engaged completely and caps are used for open installation female connectors.

13.3 Protection against harmful ingress of water

The minimum IP rating shall be IP X0.

The housing of the installation coupler shall provide a degree of protection against harmful ingress of water as declared by the manufacturer.

Compliance is checked by the appropriate test of IEC 60529 and with the treatment specified in the two paragraphs below, followed immediately by wiping the surplus surface water from the specimen and carrying out the electric strength test of 14.3.

The specimens shall withstand an electric strength test as specified in 14.3, which shall be started within 5 min of completion of the tests according to 13.3 and inspection shall show that water has not reached current-carrying parts.

For numerals 3 and 4, the oscillating tube in Figure 4 of IEC 60529:1989 is used. IP classification is measured when the mating parts are engaged completely and caps are used for open installation female connectors.

14 Insulation resistance and electric strength

14.1 General

The insulation resistance and the electric strength of installation couplers shall be adequate between parts described in 14.2 and 14.3 after the following treatment.

Installation couplers shall be fitted with cables and not in engagement when subjected to the humidity treatment.

The humidity treatment is carried out in a humidity cabinet containing air with a relative humidity maintained between 91 % and 95 %. The temperature of the air, at all places where specimens can be located, is maintained within ± 1 °C of any convenient value t °C between 20 °C and 30 °C.

Before being placed in the humidity cabinet, the specimens are brought to a temperature between t °C and t °C + 4 °C.

The specimens are kept in the cabinet for:

- 48 h (2 days) for installation couplers with IP-rating IP X0;
- 168 h (7 days) for installation couplers with IP-rating higher than IP X0.

After this treatment, the specimens shall show no damage within the meaning of this document and they shall be able to pass the tests in accordance with 14.2 followed by those of 14.3.

14.2 Insulation resistance

The insulation resistance is measured with a DC voltage of approximately 500 V applied as listed below, each measurement being made 1 min after application of the voltage:

- a) *between current-carrying parts of different polarity;*
- b) *between all current-carrying parts connected together and the body;*
- c) *on the installation female connector not engaged to its counterpart, between all current-carrying parts and a metal foil in contact with the exposed front surface;*
- d) *between each current-carrying part and parts of the earthing circuit.*

NOTE The term "body" includes accessible metal parts, metal foil in contact with the outer surface, accessible external parts of insulating material, fixing screws of bases or covers and external assembly screws.

While wrapping the metal foil round the outer surface or placing it in contact with the inner surface of parts of insulating material, it is pressed against holes or grooves, without any appreciable force, by means of an unjointed test finger test probe 11 of IEC 61032:1997.

The insulation resistance shall not be less than 5 MΩ.

14.3 Electric strength

A voltage of substantially sine-wave form, having a frequency of 50 Hz to 60 Hz is applied for 1 min between the parts indicated in 14.2.

The test voltage is:

- a) 1 500 V between current-carrying parts of different polarity;
- b) 3 000 V between all current-carrying parts connected together and the body;
- c) 3 000 V on the installation female connector not engaged to its counterpart, between all current-carrying parts and a metal foil in contact with the exposed front surface;
- d) 1 500 V between each current-carrying part and parts of the earthing circuit;
- e) for rewirable installation couplers, 1 500 V between accessible metal parts of the cable anchorage including clamping screws and a metal rod of the maximum diameter of the cable inserted in its place.

NOTE The term "body" includes accessible metal part, metal foil in contact with the outer surface, accessible external parts of insulating material, fixing screws of bases or covers, and external assembly screws.

While wrapping the metal foil round the outer surface or placing it in contact with the inner surface of parts of insulating material, it is pressed against holes or grooves, without any appreciable force, by means of an unjointed test finger test probe 11 of IEC 61032:1997.

Initially, not more than half the prescribed voltage is applied, then it is raised rapidly to the full value.

No flashover or breakdown shall occur during the test.

The high-voltage transformer used for the test should be so designed that when the output terminals are short-circuited after the output voltage has been adjusted to the appropriate test voltage, the output current is at least 200 mA. The overcurrent relay shall not trip when the output current is less than 100 mA.

Care should be taken so that the RMS value of the test voltage applied is measured within ± 3 %.

Glow discharges without a drop in voltage are neglected.

15 Construction of contacts

15.1 Resiliency

Installation female connector contact assemblies shall have sufficient resilience to ensure adequate contact pressure on installation male connector pins.

Compliance is checked by the tests according to Clause 16 to Clause 18.

15.2 Resistance of connections

The resistance of connections including the connection between earthing contacts shall be sufficiently low.

The contact resistance across the installation coupler is measured and it shall not exceed 1 m Ω per clamping unit.

The contact between the installation female connector contact assembly and the installation male connector contact pin is also considered to be a clamping unit for the purpose of this requirement.

Compliance is checked by the following test.

Conductors having the rated cross-sectional areas specified by the manufacturer shall be connected to installation couplers. The clamping screws, if any, are tightened with the torque values specified in Table 6. Non-rewirable installation couplers shall be tested with conductors of the rated connecting capacity. The installation coupler is fully engaged and loaded with the rated current for 1 h. The voltage drop across the clamping unit is measured and the contact resistance is calculated.

When measuring the contact resistance across the distribution block, the relevant counterpart is introduced into an installation female connector as well as into an installation male connector. The contact resistance is then measured across this combination and it shall not exceed 10 mΩ.

15.3 Contact pressure

Electrical connections shall be designed in such a way that contact pressure is not transmitted through insulating material other than ceramic, pure mica or other material with characteristics no less suitable unless there is sufficient resiliency in the metallic parts to compensate for any possible shrinkage or yielding of the insulating material.

Compliance is checked by inspection.

16 Temperature rise

Contacts and other current-carrying parts shall be so designed as to prevent excessive temperature rise due to current flow under normal operation.

Compliance is checked by the following test.

Installation couplers are fitted with cables having the cross-sectional areas shown in Table 4, the terminal screws, if any, being tightened with a torque of the values specified in Table 6.

Distribution blocks are tested as delivered.

Test circuits for three pole and five pole installation couplers as well as three pole to three pole and five pole to three pole distribution blocks are shown in schematic diagrams of Annex B, Figure B.1 to Figure B.8. Five to five pole distribution blocks shall be measured (or wired) in the same way as is done for three to three pole distribution blocks.

Installation couplers shall be fully engaged.

The test current shown in Table 4 is passed through the current-carrying contacts for 1 h. After this, one current-carrying contact and the earthing contact shall be loaded with the test current shown in Table 4 for 1 h.

For installation couplers having three or more poles, the test current during the test shall be passed through the phase contacts. If there is a neutral contact and an earthing contact, a separate test shall be carried out passing the test current through the neutral contact and the earthing contact. If there is either a neutral contact or an earthing contact, the current is passed through the neutral contact or through the earthing contact and the nearest phase contact.

The temperature rise shall be measured at the specified measuring points shown in the schematic diagrams of Annex B, Figure B.1 to Figure B.8. During the above tests, the temperature rise shall not exceed 45 K in single-phase test circuits and 50 K in poly-phase test circuits.

Table 4 – Test currents for installation couplers

Rated current A	Test conductor mm ²	Test current A
10	1,5	12,5
13	1,5	16,25
16	1,5	20,0
20	2,5	25,0
25	4,0	31,0
32	6,0	40,0

17 Breaking capacity

This test is not applicable for installation couplers for DC use only.

Installation couplers for AC applications shall have an adequate breaking capacity.

Compliance is checked by the following test.

Installation couplers shall be mounted according to the manufacturer's instructions. Before the test, the retention device shall be made ineffective, the installation couplers shall then be operated 100 strokes without load and 50 strokes with load.

The installation couplers shall be tested at their rated voltage and rated current in a circuit with a $\cos\phi = 0,6$.

NOTE A stroke is an engagement or a disengagement of the installation male connector.

The installation male connector is inserted into and withdrawn from the installation female connector at a rate of 15 strokes per minute. The speed of engagement and disengagement of the installation male connector shall be $0,8 \text{ m/s} \pm 0,1 \text{ m/s}$. Electrical contact shall be maintained for no more than 4 s and no less than 2 s.

During the test, no arc shall persist, no flashover shall occur and the contact parts shall not become loose. Live parts shall not become accessible.

Compliance is checked by the test in accordance with Clause 10.

After the test, the specimens shall withstand an electric strength test as specified in 14.3, the test voltage being reduced to 1 500 V.

The specimens shall show no

- wear impairing their further use;
- deterioration of enclosures or barriers;
- damage on the entry holes for the male contacts that might impair proper working;
- loosening of electrical or mechanical connections;
- seepage of sealing compound.

The humidity treatment is not repeated before the electric strength test of 14.3 referred to in this clause.

18 Forces necessary to disengage the parts of the installation coupler

Installation couplers shall be such that the installation coupler can be easily disengaged; however, a deliberate act for disengagement is required.

Compliance is checked by the following test.

The retaining means shall be rendered ineffective before the test. Installation couplers shall be engaged and disengaged 10 times. The pull-force measured during the 10th disengagement shall not exceed 80 N.

For the test of installation couplers with an IP code higher than IP 2XC, the sealing (gasket), if any, may be removed.

19 Cables and their connection

19.1 Capability of being fitted

Installation couplers shall be capable of being fitted with types of cables and cross-sectional areas specified by the manufacturer of the installation coupler. Pre-wired installation couplers shall only be supplied with the appropriate conductors connected to the correct terminals or terminations (see Clause 8).

NOTE For installation instructions concerning suitable cables, see 8.4.

Compliance is checked by inspection.

19.2 Relief from pull, thrust and torsion

Installation couplers shall be so constructed that the clamping units of the cables shall be relieved from pull, thrust and torsion and the cable sheath at the entrance shall be protected against abrasion, for example, by a cable anchorage for rewirable installation couplers.

Compliance is checked by inspection and by the test in accordance with 19.4.

19.3 Cable anchorage

For rewirable installation couplers,

- it shall be clear how the relief from strain and the prevention of twisting is intended to be effected;
- the cable anchorage, or at least part of it, shall be integral with or fixed to one of the other components of the installation coupler;
- makeshift methods, such as tying the cable into a knot or tying the ends with string, shall not be used;
- the cable anchorage shall be suitable for the types of cables specified by the manufacturer;
- the cable anchorage shall be of insulating material or be provided with an insulating lining fixed to the metal parts;
- it shall not be possible for the cable to touch the clamping screws of the cable anchorage if these screws are accessible with the test probe B according to Figure 2 of IEC 61032:1997;
- metal parts of the cable anchorage, including its screws, if any, shall be insulated from the earthing circuit.

Compliance is checked by inspection and by the test of 19.4.

19.4 Capability to connect cables with different cross-sectional area

Rewirable installation couplers shall be tested with the types of cables specified by the manufacturer, first with the smallest and then with the largest cross-sectional area.

Non-rewirable installation couplers shall be tested with the cables as delivered.

Conductors of the cable of rewirable installation couplers are introduced into the terminals. The terminal screws, if any, are tightened just sufficiently to prevent the conductors from easily changing their position.

The cable anchorage is used in the normal way, clamping screws, if any, being tightened with a torque as specified in Table 6. After reassembly of the specimen, the components shall fit correctly and it shall not be possible to push the cable with a force of 10 N into the installation coupler to any appreciable extent.

The specimen shall be fixed in an apparatus as shown in Figure 1 such that the axis of the cable runs vertically downwards from the cable entry of the installation coupler.

The cable shall be subjected 50 times to a pull force according to Table 5 for 1 s in one smooth and continuous motion.

Table 5 – Forces to be applied to cable anchorages

External dimensions of the cable mm	Pull forces N
Up to and including 5,2 × 7,6	40 ± 2
Up to and including 8	50 ± 2
Over 8 up to and including 11	60 ± 2
Over 11 up to and including 16	80 ± 2
Over 16	100 ± 2

The cable shall not be damaged during testing. After the test, the cable shall not have been longitudinally displaced by more than 2 mm.

Immediately after this, a torque of 0,25 Nm is to be applied to the cable for 1 min. After this test, the cable shall not be distorted by more than 45°.

For the measurement of the longitudinal displacement, a mark is made on the cable before starting the test while subjecting it to a preliminary pull of the value specified, at a distance of approximately 2 cm from the end of the installation coupler or the cable anchorage.

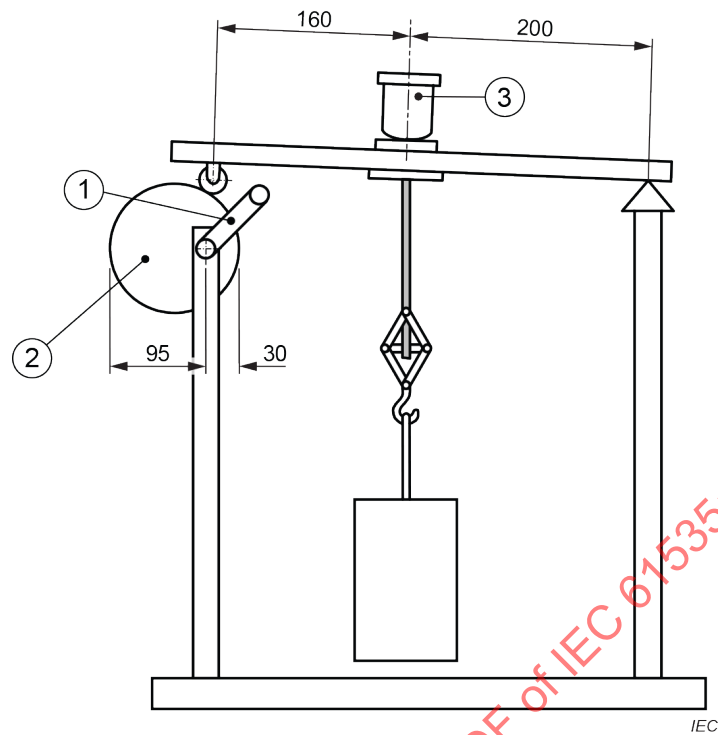
After the test, the displacement of the mark on the cable in relation to the installation coupler or the cable anchorage is measured while the cable is no longer subjected to the pull force.

For the measurement of the distortion, the installation coupler is to be fixed in an apparatus, an example of which is shown in Figure 2. The distance between the cable clamp and the end of the installation coupler or the cable anchorage shall be equal to the cable diameter. The distortion will be measured immediately behind the cable anchorage while the cable is subjected to the torque.

For non-rewirable installation couplers, a hole may be drilled into the housing so that the cable may become accessible for the measuring indicator just behind the cable anchorage.

The effectiveness of the cable anchorage shall not be affected by drilling the hole.

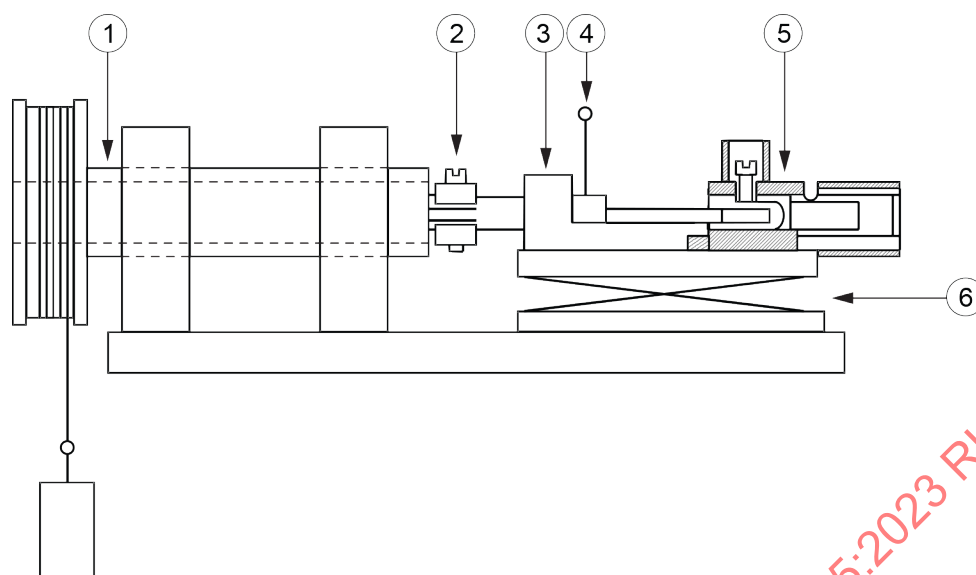
Dimensions in millimetres



Key

- 1 crank
- 2 eccentric
- 3 sample

Figure 1 – Apparatus for testing the cable anchorage



IEC

Key

- 1 hollow axle for easy twisting
- 2 cable clamp for the test cable
- 3 cable anchorage of the test specimen
- 4 measuring indicator (e.g. a needle)
- 5 installation coupler
- 6 vertical movable mounting support

The hollow axle and the mounting block should be easily movable with respect to each other to compensate for any shrinkage of the cable while twisting.

Figure 2 – Apparatus for measuring the distortion (example)

19.5 Sharp edges

Installation couplers shall be so designed that the cable cannot be damaged by sharp edges where it enters the installation coupler.

If guards are provided for this purpose, they shall be of insulating material and shall be reliably fixed.

Compliance is checked by inspection.

20 Mechanical strength

Installation couplers shall have adequate mechanical strength.

Compliance is checked by the following test.

The specimens shall be tested with and without caps fitted.

Rewirable installation couplers are fitted with the cable specified by the manufacturer, having the smallest cross-sectional area and a free length of approximately 100 mm.

Terminal screws and assembly screws are tightened with a torque equal to the value specified in Table 6.

Non-rewirable installation couplers are tested as delivered, the flexible cable being cut so that a free length of about 100 mm projects from the installation coupler.

The specimen is subjected to the free fall test, procedure 2, of IEC 60068-2-31:2008, the number of falls being 50.

After the test, live parts shall not become accessible with the test probe B according to Figure 2 of IEC 61032:1997, the installation coupler shall not show any cracks when inspected by normal or corrected vision without additional magnification and the cable anchorage shall remain operational.

Small pieces which are broken off shall not lead to rejection provided that the protection against electric shock is maintained.

Damage to finish and small dents which do not reduce the creepage distances or clearances below values specified in Clause 23 are neglected.

The approximate 100 mm length may be reduced in order to ensure free fall.

21 Resistance to heat and ageing

21.1 Resistance to heat

Installation couplers shall be sufficiently resistant to heat.

Compliance is checked by the tests of 21.2, 21.3, 21.4 and 21.5, as applicable.

21.2 Dry heat storage

Specimens of installation couplers and caps are kept for 1 h in a heating cabinet at a temperature of $100\text{ °C} \pm 2\text{ °C}$.

During the test, the specimens shall not undergo any change impairing their further use, and the sealing compound shall not flow to such an extent that live parts are exposed.

A slight displacement of the sealing compound shall be neglected provided that safety is not impaired.

21.3 Ball pressure test

Parts of insulation material, with the exception of elastomeric or similar materials for installation couplers shall be subjected to a ball-pressure test by means of the apparatus shown in Figure 3. Three additional samples are required for this test.

Before the test is started, the ball and the support on which the specimen shall be placed are brought to the temperature specified. The part under test shall be placed on a 3 mm thick steel plate in direct contact with it, so as to be supported to withstand the test force. When it is not possible to carry out the test on the specimen, the test shall be carried out on a special test specimen of the same material at least 2 mm thick.

The surface of the part to be tested is placed in the horizontal position and a steel ball of 5 mm diameter is pressed against the surface with a force of 20 N.

The test is made in a heating cabinet maintained at a temperature of:

- $125\text{ °C} \pm 2\text{ °C}$ for those parts of installation couplers which retain current-carrying parts and parts of the earthing circuit in position;

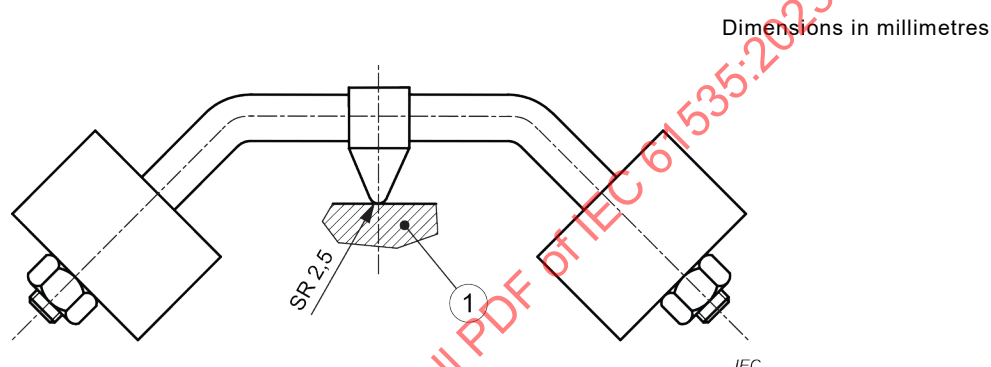
– $70\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for other parts of installation couplers.

A current-carrying part or a part of the earthing circuit retained by a mechanical means is considered to be retained in position. The use of grease or the like is not considered to be mechanical means.

In case of doubt, to determine whether an insulating material is necessary to retain current-carrying parts and parts of the earthing circuit in position, the device is examined without conductors while being held in all positions with the insulating material in question removed.

After 1 h, the ball is removed from the specimen which is then cooled down, within 10 s, to approximately room temperature by immersion in cold water.

The diameter of the impression caused by the ball is measured and shall not exceed 2 mm.



Key

1 sample

Figure 3 – Ball-pressure apparatus

21.4 Ageing of elastomeric and thermoplastic material

Installation couplers of elastomeric and thermoplastic materials shall be adequately resistant to ageing.

Compliance is checked for installation couplers by the following test.

Two specimens which have previously been tested for their compliance with Clause 18 shall be used.

Installation couplers are subjected to an accelerated ageing test carried out in an atmosphere having the composition and pressure of the ambient air. The specimens are suspended freely in a heating cabinet, ventilated by natural air circulation. They are kept in the cabinet, which is maintained at a temperature of $70\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$, for 240 h (10 days).

After this test, the specimens are allowed to attain approximately ambient temperature, and are then examined.

The specimens shall show no damage which would lead to non-compliance with this document.

21.5 Current cycling test

Installation couplers shall be sufficiently resistant to ageing.

Compliance is checked by the following test.

Resistance to ageing for the installation coupler engaged as for normal use is checked by the current cycling ageing test at ambient temperature.

NOTE 1 For screwless-type clamping units, if any, this test also covers the temperature cycling test with current according to 9.10 of IEC 60999-1:1999.

The test is carried out at ambient temperature on all poles of three installation couplers. Rewirable installation couplers are wired with conductors of cross-section according to Table 4 prepared as for the voltage drop test according to the test in 9.8 of IEC 60999-1:1999. Non-rewirable installation couplers shall be tested as delivered.

During the test, a test current according to Table 4 is passed through all poles except during the cooling period.

NOTE 2 The earthing contact is not a pole and is not loaded.

The whole test arrangement, including the conductors, shall not be moved until all the following voltage drop tests in this subclause have been completed.

The assembled installation couplers are then subjected to 384 cycles, each cycle having a duration of approximately 1 h, divided into 30 min with current and 30 min without current.

The voltage drop is measured after the 24th, 192nd and 384th temperature cycles are completed using the test current in accordance with Table 4 and the test arrangement previously specified in this subclause.

The allowable voltage drop per clamping unit shall not exceed the smaller of the two following values:

- either 22,5 mV;
- or 1,5 times the value measured after the 24th cycle.

In addition, after this test, an inspection with normal or corrected vision, without additional magnification, shall show no changes impairing further use, such as cracks, deformations or the like.

NOTE 3 A contact is considered to be a clamping unit for the purpose of this document.

22 Screws, current-carrying parts and connections

22.1 Screws and nuts

Electrical or mechanical connections using screws and nuts shall withstand the mechanical stresses occurring in normal use.

Screws and nuts which transmit contact pressure shall be of metal and in engagement with a metal thread.

Other screws and nuts which are operated when mounting an installation coupler during installation may be in engagement with a thread of insulation material.

Compliance is checked by inspection and, for screws and nuts which are likely to be operated during the life of the installation coupler, by the following test.

The screws and nuts are tightened and loosened:

- 10 times for metal screws in engagement with a thread of insulating material and for screws of insulating material;
- 5 times in all other cases.

Screws or nuts in engagement with a thread of insulating material and screws of insulating material are completely removed and reinserted each time. The test is carried out by means of a suitable test screwdriver or spanner applying a torque as shown in Table 6.

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

When testing terminal screws of installation couplers, a conductor is placed in the terminal. The conductor is moved each time the screw or nut is loosened.

The screws and nuts shall be tightened smoothly.

Table 6 – Torque applied for the tightening and loosening test

Nominal diameter of thread mm	Torque Nm	
	I	II
Up to and including 2,8	0,2	0,4
Over 2,8 up to and including 3,0	0,25	0,5
Over 3,0 up to and including 3,2	0,3	0,6
Over 3,2 up to and including 3,6	0,4	0,8
Over 3,6 up to and including 4,1	0,7	1,2
Over 4,1 up to and including 4,7	0,8	1,8
Over 4,7 up to and including 5,3	0,8	2,0
Over 5,3	-	2,5

Column I applies to screws without heads which, when tightened, do not protrude from the hole and to other screws which cannot be tightened by means of a screwdriver with a blade wider than the diameter of the screw.

Column II applies to other screws and nuts that are tightened by means of a screwdriver.

During the test, there shall be no damage that will impair the further use of the installation coupler.

NOTE Terminal screws or nuts, connection screws, etc. are those screws or nuts which are used when the installation coupler is assembled.

22.2 Screws and insulating material

For screws in engagement with a thread of insulating material and screws of insulating material that are operated during the installation of the installation coupler and/or are likely to be operated during the life of the installation coupler, a correct introduction of the screw into the screw hole or nut shall be ensured.

The requirement with regard to correct introduction is met if the introduction of the screw in a slanting manner is prevented, for example, by guiding the screw by the part to be fixed, by a recess in the female thread or by the use of a screw with the leading thread removed.

Compliance is checked by inspection and by manual test.

22.3 Screws and rivets for electrical and mechanical connections

Screws and rivets that serve as electrical as well as mechanical connections shall be locked against loosening or turning.

Compliance is checked by inspection and manual tests.

NOTE 1 Spring washers can provide satisfactory locking.

NOTE 2 For rivets, a non-circular shank or an appropriate notch can be sufficient.

NOTE 3 A sealing compound which softens on heating provides satisfactory locking only for screw connections not subject to torsion in normal use.

22.4 Metals of current-carrying parts

Current-carrying parts and earthing contacts shall comply with 8.1.1 of IEC 60999-1:1999.

23 Clearances, creepage distances and distances through solid insulation

The clearances shall at least meet the requirements for overvoltage category III. For creepage distances, pollution degree 2 as specified in IEC 60664-1 shall be applied. Minimum values for clearances and creepage distances are given in Table 7 to Table 11.

Table 7 – Installation couplers intended for use in supply systems with a maximum voltage to earth of 150 V AC, rated impulse voltage 2,5 kV

	Clearance mm	Creepage distances ^c mm			
		Rated insulation voltage			
		All material groups	Material group		
			I	II	III
		≤ 125 V AC	≤ 250 V AC		
Between:					
Live parts of different polarity	1,5	1,5	1,5	1,8	2,5
Live parts and					
– accessible external surface ^a	3,0	3,0	----		
– inaccessible external screws or the like ^b	1,5	1,5	----		
Parts of the earthing circuit and					
– live parts	1,5	1,5	----		
– accessible screws or the like	1,5	1,5			
– inaccessible external screws or the like ^b	1,0	1,0			
^a The accessible external surface includes a metal foil in contact with the external surfaces of insulating material.					
^b Inaccessible external screws are those which cannot be touched with the test probe B of IEC 61032:1997.					
^c Values for creepage distances are adapted to clearances because creepage distances cannot be smaller than the corresponding clearances.					

Table 8 – Installation couplers intended for use in supply systems with a maximum voltage to earth of 300 V AC, rated impulse voltage 4,0 kV

	Clearance mm	Creepage distances ^c									
		mm									
		Rated insulation voltage									
		All material groups	Material group			Material group			Material group		
			I	II	III	I	II	III	I	II	III
≤ 250 V AC	≤ 320 V AC	≤ 400 V AC	≤ 500 V AC								
Between:											
Live parts of different polarity	3,0	3,0	3,0	3,0	3,2	3,0	3,0	4,0	3,0	3,6	5,0
Live parts and											
– accessible external surface ^a	5,5	5,5	5,5	5,5	6,4	----			----		
– inaccessible external screws or the like ^b	3,0	3,0	3,0	3,0	3,2	----			----		
Parts of the earthing circuit and											
– live parts	3,0	3,0	3,0	3,0	3,2						
– accessible screws or the like	3,0	3,0	3,0	3,0	3,2	----			----		
– inaccessible external screws or the like ^b	1,5	1,5	1,5	1,5	1,5	----			----		

^a The accessible external surface includes a metal foil in contact with the external surfaces of insulating material.

^b Inaccessible external screws are those which cannot be touched with the test probe B of IEC 61032:1997.

^c Values for creepage distances are adapted to clearances because creepage distances cannot be smaller than the corresponding clearances.

Table 9 – Installation couplers intended for use in single-phase two-wire systems 50 V DC and single-phase three-wire systems 60 V DC, rated impulse voltage 0,8 kV

	Clearance mm	Creepage distances ^c mm						
		Rated insulation voltage						
			Material group			Material group		
			I	II	III	I	II	III
			≤ 50 V DC			≤ 63 V DC		
Between:								
Live parts of different polarity	0,2		0,60	0,85	1,20	0,63	0,90	1,25
Live parts and								
– accessible external surface ^a	0,5		1,2	1,7	2,4	-	-	-
– inaccessible external screws or the like ^b	0,2		0,60	0,85	1,2	-	-	-
Parts of the earthing circuit and								
– live parts	0,2		0,6	0,85	1,2	-	-	-
– accessible screws or the like	0,2		0,6	0,85	1,2	-	-	-
– inaccessible external screws or the like ^b	0,2		0,6	0,85	1,2			

The values of the creepage distances in this Table 9 are also applicable for a rated impulse voltage of 1,5 kV.

^a The accessible external surface includes a metal foil in contact with the external surfaces of insulating material.

^b Inaccessible external screws are those which cannot be touched with the test probe B of IEC 61032:1997.

^c Values for creepage distances are adapted to clearances because creepage distances cannot be smaller than the corresponding clearances.

Table 10 – Installation couplers intended for use in single-phase two-wire systems 120 V DC and single-phase three-wire systems 240 V DC, rated impulse voltage 2,5 kV

	Clearance mm	Creepage distances ^c mm			
		Rated insulation voltage			
		All material groups	Material group		
			I	II	III
		≤ 125 V DC	≤ 250 V DC		
Between:					
Live parts of different polarity	1,5	1,5	1,5	1,8	2,5
Live parts and					
– accessible external surface ^a	3,0	3,0	3,0	3,6	5,0
– inaccessible external screws or the like ^b	1,5	1,5	1,5	1,8	2,5
Parts of the earthing circuit and					
– live parts	1,5	1,5	1,5	1,8	2,5
– accessible screws or the like	1,5	1,5	1,5	1,8	2,5
– inaccessible external screws or the like ^b	1,0	1,0	1,0	1,0	1,0
^a The accessible external surface includes a metal foil in contact with the external surfaces of insulating material.					
^b Inaccessible external screws are those which cannot be touched with the test probe B of IEC 61032:1997.					
^c Values for creepage distances are adapted to clearances because creepage distances cannot be smaller than the corresponding clearances.					

Table 11 – Installation couplers intended for use in single-phase two-wire systems 220 V DC and single-phase three-wire systems 440 V DC, rated impulse voltage 4,0 kV

	Clearance mm	Creepage distances ^c mm						
		Rated insulation voltage						
		All material Groups	Material group			Material group		
			I	II	III	I	II	III
		≤ 250 V DC	≤ 400 V DC			≤ 500 V DC		
Between:								
Live parts of different polarity	3,0	3,0	3,0	3,0	4,0	3,0	3,6	5,0
Live parts and								
– accessible external surface ^a	5,5	5,5	5,5	5,6	8,0	5,5	7,2	10,0
– inaccessible external screws or the like ^b	3,0	3,0	3,0	3,0	4,0	3,0	3,6	5,0
Parts of the earthing circuit and								
– live parts	3,0	3,0	3,0	3,0	4,0	3,0	3,6	5,0
– accessible screws or the like	3,0	3,0	3,0	3,0	4,0	3,0	3,6	5,0
– inaccessible external screws or the like ^b	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5
^a The accessible external surface includes a metal foil in contact with the external surfaces of insulating material.								
^b Inaccessible external screws are those which cannot be touched with the test probe B of IEC 61032:1997.								
^c Values for creepage distances are adapted to clearances because creepage distances cannot be smaller than the corresponding clearances.								

Installation female connectors are tested when not engaged with the installation male connector. Installation male connectors are only tested when engaged with its mating installation female connector.

For rewirable installation couplers, the measurements are made with conductors having the smallest and the largest cross-sectional area as specified by the manufacturer. Non-rewirable couplers are tested as delivered.

24 Resistance to abnormal heat and to tracking

24.1 Resistance to abnormal heat

Parts made of insulating material which might be exposed to thermal stresses due to electrical effects and whose deterioration might impair safety shall not be unduly affected by abnormal heat generated within the installation coupler.

Compliance is checked by the glow-wire test according to IEC 60695-2-11 under the following conditions:

- 650 °C for parts made of insulating material not intended to retain current-carrying parts and parts of the earthing circuit in position even though they may be in contact with the current-carrying part;
- 850 °C for parts made of insulating material intended to retain current-carrying parts and parts of the earthing circuit in position.

A current-carrying part or a part of the earthing circuit retained by a mechanical means is considered to be retained in position. The use of grease or the like is not considered to be mechanical means.

In case of doubt, to determine whether an insulating material is necessary to retain current-carrying parts and parts of the earthing circuit in position, the device is examined without conductors while being held in all positions with the insulating material in question removed.

The specified tests are carried out at several places on the same specimen but care shall be taken to ensure that any deterioration caused by previous tests does not affect the results of the test to be made.

Small parts, where each surface lies completely within a circle of 15 mm diameter, or where any part of the surface lies outside a 15 mm diameter circle and where it is not possible to fit a circle of 8 mm diameter on any part of the surface, are not subjected to the test of this subclause (see Figure 4 for explanation of "small parts").

When checking a surface, projections on the surfaces and holes which are not greater than 2 mm on the largest dimension can be disregarded.

NOTE The glow-wire test is applied to ensure that an electrically heated test wire under defined test conditions does not cause ignition of insulating parts or to ensure that a part made of insulating material, which can be ignited by the heated test wire under defined conditions, burns for a limited time only and that without spreading fire by flame or burning parts or by drops falling down from the part under test.

If the test cannot be made on the complete specimen, a suitable part may be cut from it for the purpose of the test.

The test is made on one specimen only. In case of doubt, the test shall be repeated on two further specimens.

The test is made by applying the glow-wire only once.

The specimen shall be positioned during the test in the most unfavourable position of its intended use with the surface tested in a vertical position.

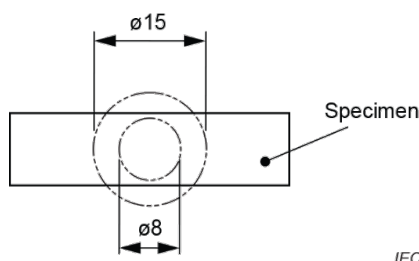
The tip of the glow-wire shall be applied to the specified surface of the test specimen taking into account the conditions of the intended use under which a hot part may come into contact with the specimen.

The specimen is regarded as having passed the glow-wire test if:

- there is no visible flame and no sustained glowing, or if*
- flames and glowing on the specimen extinguish within 30 s after removal of the glow-wire.*

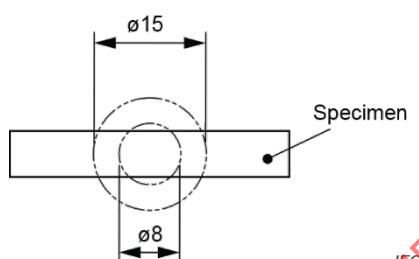
There shall be no ignition of the tissue paper or scorching of the board.

Dimensions in millimetres



a) To be tested

Dimensions in millimetres



b) No test is required

Figure 4 – Explanation of "small part"

24.2 Resistance to tracking

For installation couplers, parts of insulating material retaining live parts in position shall be of material resistant to tracking.

Compliance is checked in accordance with IEC 60112.

Ceramic parts are not tested.

The material under test shall pass a proof-tracking-index (PTI) of minimum 175 V using test solution A with the interval between drops 30 s ± 5 s.

If the manufacturer specifies the used material as to be of CTI ≥ 400 V (material group II) or CTI ≥ 600 V (material group I), the reduced creepage distances of Table 7, Table 8, Table 9, Table 10, and Table 11 apply.

NOTE 1 The term "reduced creepage distance" means in this context the next smaller creepage distance value.

NOTE 2 The PTI value is also used for the assessment of the tracking resistance of insulating materials (CTI). An insulating material can be referred to one of the material groups I up to IV if the PTI value tested according to IEC 60112, test solution A, is equal to or higher than the lower limiting value for this material group.

No flashover or breakdown between electrodes shall occur before a total of 50 drops has fallen.

25 Resistance to rusting

Ferrous parts shall be adequately protected against rusting.

Compliance is checked by the following test.

All grease is removed from the parts to be tested by immersion in a cold chemical degreaser such as petroleum ether for 10 min.

The parts are then immersed for 10 min in a 10 % solution of ammonium chloride in water at a temperature of $20\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$.

Without drying, but after shaking off any drops, the parts are placed for 10 min in a box containing air saturated with moisture at a temperature of $20\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$.

After the parts have been dried for 10 min in a heating cabinet at a temperature of $100\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ and have been left at room temperature for 24 h, their surface shall show no signs of rust. Traces of rust on sharp edges and any yellowish film removable by rubbing are ignored.

For small springs and the like and for inaccessible parts exposed to abrasion, a layer of grease may provide sufficient protection against rusting. Such parts are only subjected to the test if there is doubt about the effectiveness of the grease film and the test shall then be made without previous removal of the grease.

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Annex A (normative)

Routine protective earth continuity tests

All non-rewirable installation couplers shall be subjected to the following test. This test does not apply to distribution blocks for which incorrect wiring is reliably prevented by design.

The test on protective earth continuity shall be done using SELV applied for a period of not less than 2 s between the corresponding PE male and/or female contacts of the installation coupler at each end of the cable.

The period of 2 s can be reduced or other type of voltages can be used if correct results can be guaranteed with automatic timing.

Any other test which proves that the protective earth continuity is present is also acceptable.

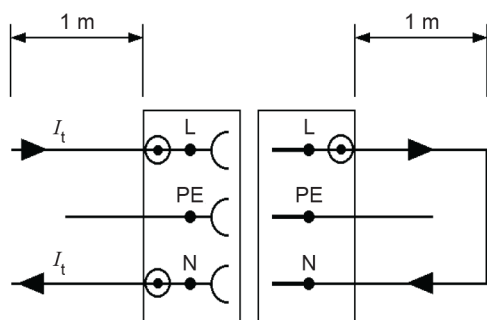
Protective earth continuity shall be present.

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Annex B (normative)

Test circuits for temperature rise test

For test circuits for temperature rise according to Clause 16, see Figure B.1 to Figure B.8.



⊙ Temperature measuring point

IEC

Figure B.1 – 1P + N + PE installation couplers, including N

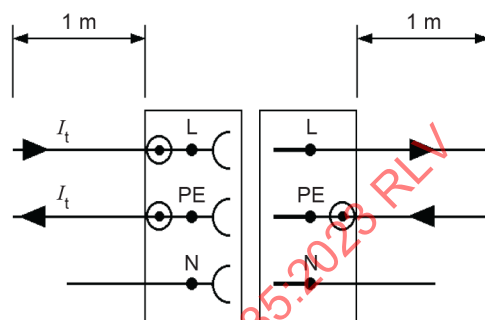
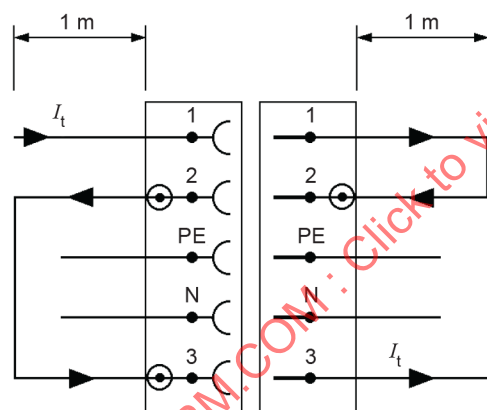


Figure B.2 – 1P + N + PE installation couplers, including PE



⊙ Temperature measuring point

IEC

Figure B.3 – 3P + N + PE installation couplers, 3 phases loaded

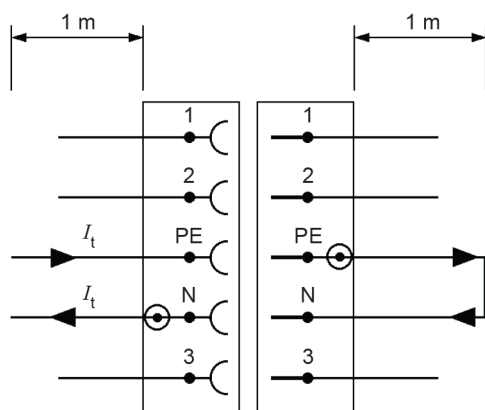


Figure B.4 – 3P + N + PE installation couplers, N and PE loaded

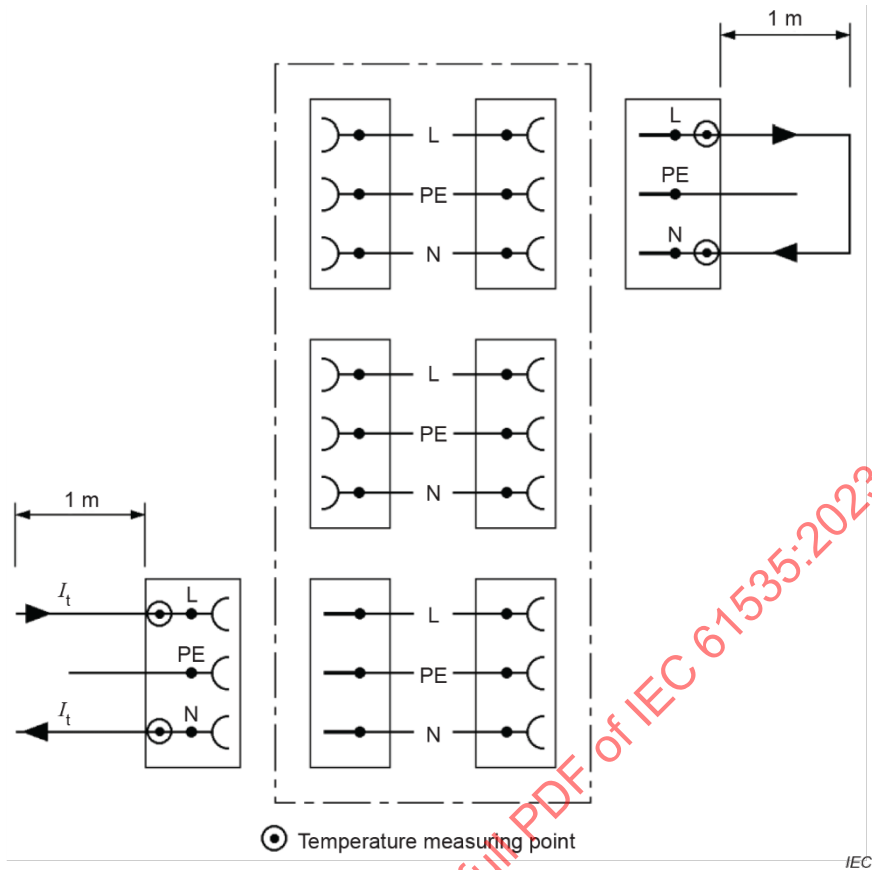


Figure B.5 – 1P + N + PE distribution block, phase and N loaded

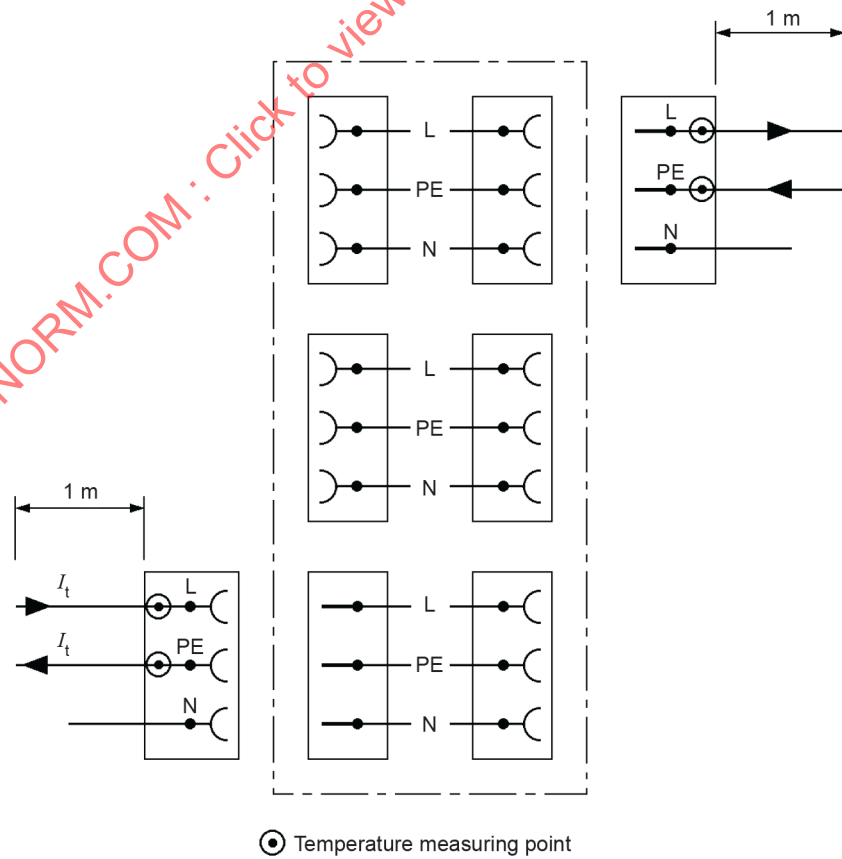
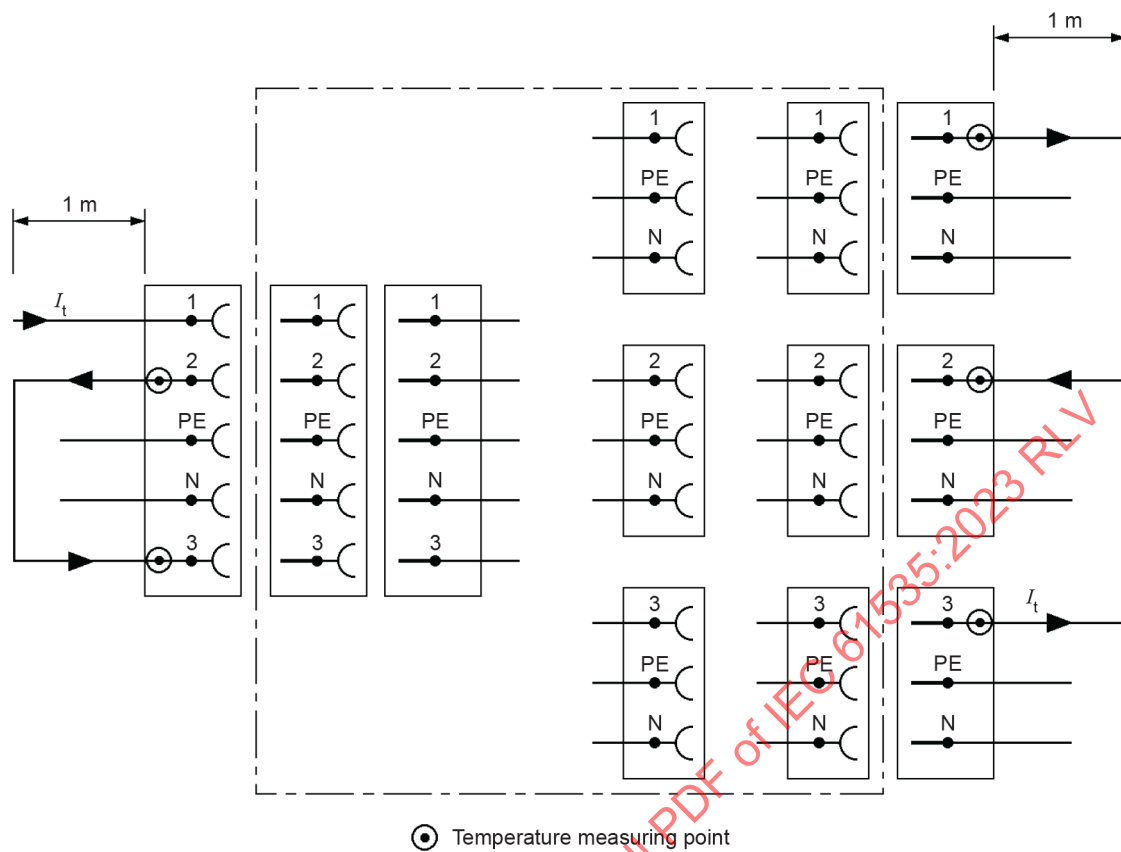
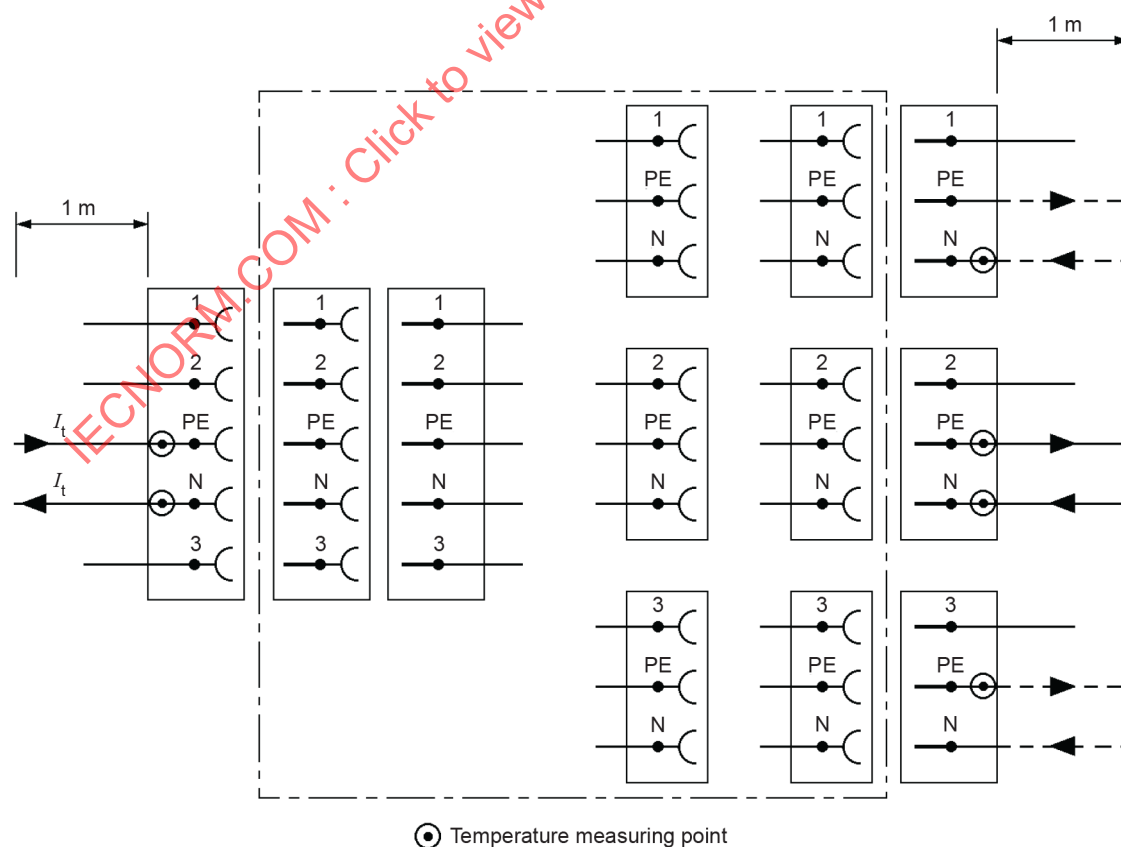


Figure B.6 – 1P + N + PE distribution block, phase and PE loaded



IEC

Figure B.7 – 3P + N + PE to 1P + N + PE distribution block, 3 phases loaded



IEC

Figure B.8 – 3P + N + PE to 1P + N + PE distribution block, N and PE loaded

Annex C (normative)

Number of sets of test samples used for the tests and sequence of tests for each set

Table C.1 – Sets of samples

Clause/Subclause	Title	Set number	Number of samples
8	Marking and documentation	No. 1	3
9	Dangerous compatibility		
10	Protection against electric shock		
11	Terminals, terminations and connectable conductors		
12	Construction		
19	Cables and their connection		
23	Clearances, creepage distances and distances through solid insulation		
12.3	Mechanical strength of contacts	No. 2	3
13.3	Protection against harmful ingress of water	No. 3	3
13.2	Protection against harmful ingress of solid foreign objects		
14	Insulation resistance and electric strength	No. 4	3
15	Construction of contacts		
16	Temperature rise		
17	Breaking capacity ^c	No. 5	3
18	Forces necessary to disengage the parts of the installation coupler	No. 6	3
21.4	Resistance to ageing		
20	Mechanical strength	No. 7	3
22	Screws, current-carrying parts and connections		
21.5	Current cycling test	No. 8	3 (6) ^a
24.1	Resistance to abnormal heat	No. 9	3
21.2	Dry heat storage		
25	Resistance to rusting		
24.2	Resistance to tracking	(Separate test specimen) ^b	
21.3	Ball pressure test	(Separate test specimen) ^b	

^a One additional set of 3 samples may be necessary for testing with conductors of the smallest and largest cross section. See 9.8 of IEC 60999-1:1999.

^b An additional set of 3 samples is necessary, if applicable, or separate test probes, produced by a similar moulding process and tool, shall be used.

^c Does not apply for DC application.

Annex D (informative)

Guide to use

D.1 General

Installation coupler systems can be used in applications where the quick and easy connecting of different parts of the installation is required. These systems are all designed for rapid connecting which guarantees the correct connection. The use of installation couplers facilitates the installation and maintenance or reconfiguration. Possible changes and repairs can be made easily afterwards.

Use of the installation coupler system makes planning easier. Cable sets can be prefabricated. Installation couplers may be used with rigid or flexible cables.

Installation couplers are not intended to be used instead of plug and socket-outlet systems. Installation couplers are intended to be connected and disconnected without current flowing. Product committees may elect to use installation couplers for connections to equipment which is intended for permanent connection (e.g. hot water services, fixed installed luminaires).

D.2 Applications

Installation coupler systems can be used in suspended floors and ceilings which are nowadays normal in commercial and office buildings. In this kind of application, the flexibility of the installation is achieved by using the installation coupler system because the fitting and furnishing of rooms are easily changeable. By using the installation coupler system the installation work becomes quicker than by using traditional mounting methods.

In houses, the use of installation coupler systems has a role due to the fact that houses are sometimes assembled from prefabricated elements.

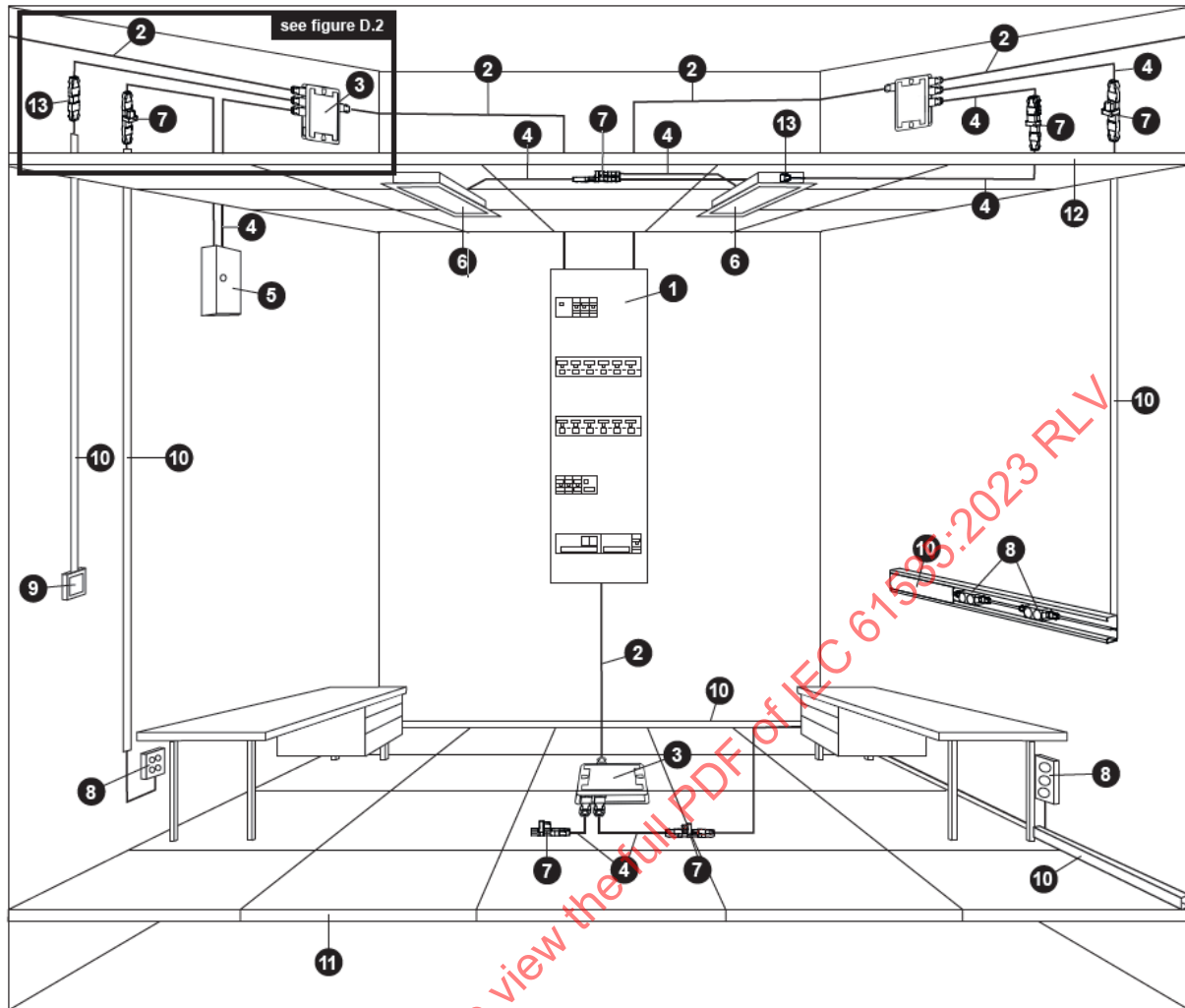
Installation couplers can be a part or a component of equipment, not just a method of connecting cables. Separate luminaires are a typical group of electrical equipment which can be easily linked to a comprehensive lighting system by using installation couplers. Machinery commonly consists of different units connected to each other by several installation couplers. Typical examples are air conditioners and heat recovery units which have separate motors, control units and pumps.

Installation couplers may be used in outdoor applications. For example, they can be used for the lighting system of a crane or for the installation in a carport.

D.3 Examples of use of installation couplers

Use and the initial verification of installation couplers can be carried out according to the national wiring rules. These are normally based on requirements laid down in the IEC 60364 series.

Installation couplers may be installed as shown in Figure D.1 and Figure D.2.



Key

- | | |
|-------------------------------------|-------------------------|
| 1 distribution board | 8 socket-outlet |
| 2 mains cables (fixed installation) | 9 switch |
| 3 junction box | 10 trunking/ducting |
| 4 cable set | 11 suspended floor |
| 5 small distribution board | 12 suspended ceiling |
| 6 lighting fixture | 13 installation coupler |
| 7 distribution block | |

Figure D.1 – Examples of use of installation couplers

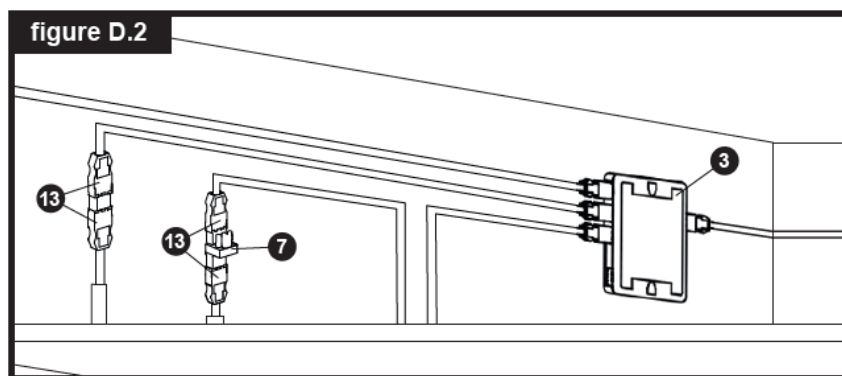


Figure D.2 – Magnified area of Figure D.1 to show installation couplers

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Annex E

(normative)

Warning symbol used in DC applications

The following symbol (see Figure E.1 [IEC 60417-6070 (2011-06, but modified)]) shall be used to show that a DC-installation connector according to this document shall not be connected or disconnected under load.

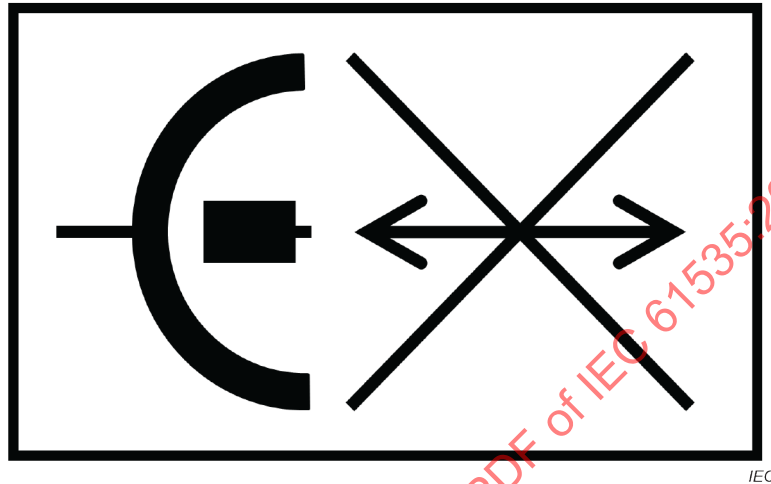


Figure E.1 – Symbol "DO NOT CONNECT OR DISCONNECT UNDER LOAD"

Annex F

(informative)

Additional tests and requirements for installation couplers intended to be used in ambient air temperature below –5 °C down to and including –45 °C

F.1 General

This annex provides tests and requirements for installation couplers operating in ambient air temperatures below –5 °C down to and including –45 °C.

The manufacturer shall declare the lower limit of the ambient air temperature the installation coupler is designed for, if lower than –5 °C. In this case the declared ambient air temperature shall be a multiple of 5 °C.

NOTE In the following countries, this Annex F is normative for installation couplers intended to be operated in temperatures below normal range, e.g. outdoor use: FI.

F.2 General requirements on tests

The following tests shall be conducted on three new installation male connectors and three new female installation connectors engaged together as for normal use. Three distribution blocks shall be tested with their matching counterparts complying with this document engaged thereto.

All tests in this Annex F shall be carried out at the declared temperature.

F.3 Additional marking and documentation

F.3.1 Additional marking

The requirements of Clause 8 of this document are supplemented by the following additional requirements.

Products declared as suitable for operation at an ambient temperature below –5 °C shall be additionally marked with the following symbol on the main part or if the part is too small so that the symbol is not readily visible, it can be given in the smallest package unit. The symbol shall indicate the declared value if applicable.

- Intended for use in cold environment, symbol IEC 60417-6292:2011-06



F.3.2 Additional documentation

In addition to requirements of 8.4, the instructions shall contain the following information:

- the lower limiting ambient air temperature shall be specified in the manufacturer's documentation;
- installation couplers shall not be installed, engaged or disengaged in an ambient air temperature below temperature –5 °C.

F.4 Mechanical strength at lower ambient air temperatures

In addition to the requirements of Clause 20 the tests shall be carried out according to the following procedure.

Rewirable installation couplers are fitted with the cable specified by the manufacturer, having the smallest cross-sectional area and a free length of approximately 100 mm.

Terminal screws and assembly screws are tightened with a torque equal to the value specified in Table 6.

Non-rewirable installation couplers are tested as delivered, the flexible cable being cut so that a free length of about 100 mm projects from the installation coupler.

The specimens shall be stored for at least 16 h, but not more than 24 h at the declared temperature. Then specimens are removed from a cold chamber and immediately afterwards (within 1 min) while the specimens are still cold, the specimens are subjected to the free fall repeated test, test procedure 2 according to IEC 60068-2-31:2008 as required in Clause 20 of this document.

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**COUPLEURS D'INSTALLATION POUR CONNEXIONS
PERMANENTES DANS LES INSTALLATIONS FIXES****AVANT-PROPOS**

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Cette troisième édition annule et remplace la deuxième édition parue en 2019. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

- a) inclusion d'une définition issue de l'IEC 61140 pour "partie active";
- b) documentation facultative supplémentaire disponible sur plusieurs supports, par exemple marquage avec QR code;
- c) corrections relatives à l'utilisation cohérente des expressions "terre", "contact de terre", "circuit de terre" et "(mise à la) terre de protection" dans l'ensemble du document;
- d) ajout de dispositions de conformité manquantes au 13.3;

- e) mise à jour de la Figure D.1 de l'Annexe D;
- f) ajout d'une nouvelle Annexe F pour les exigences relatives aux climats froids.

Le texte de cette Norme internationale est issu des documents suivants:

Projet	Rapport de vote
23/1062/FDIS	23/1066/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

Dans la présente norme, les caractères d'imprimerie suivants sont utilisés:

- exigences proprement dites: caractères romains;
- *modalités d'essais: caractères italiques;*
- notes/commentaires: petits caractères romains.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/standardsdev/publications.

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- supprimé,
- remplacé par une édition révisée, ou
- amendé.

INTRODUCTION

Les coupleurs d'installation en tension alternative et en tension continue conformément au présent document peuvent être utilisés, par exemple, dans les bâtiments préfabriqués, les salles d'exposition commerciales, les vides d'installation, tels que les planchers et les plafonds suspendus, dans les cloisons de séparation et dans toute application analogue, ou les systèmes de chemin de câbles, les systèmes d'échelle à câble, les systèmes de conduits-profilés de câble et les systèmes de goulottes de câble, ou encore dans tout mobilier conforme à l'IEC 60364-7-713.

Le présent document peut être utilisé comme guide pour les coupleurs d'installation avec contacts supplémentaires pour des tensions autres que la tension d'alimentation du réseau.

Des exigences particulières pour des coupleurs d'installation destinés par exemple à un usage à des températures ambiantes supérieures ou inférieures, avec des résistances mécaniques plus élevées (par exemple, en enveloppe métallique), avec une résistance au feu plus importante, et des coupleurs d'installation pour les circuits de commande (par exemple, TBTS) sont à l'étude.

Les règles nationales peuvent comporter des exigences concernant l'accessibilité des coupleurs d'installation.

Les règles nationales peuvent spécifier qui est autorisé à effectuer le branchement et le débranchement des coupleurs d'installation.

Les règles nationales peuvent comporter des exigences concernant les coupleurs d'installation avec des conduits métalliques.

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COUPLEURS D'INSTALLATION POUR CONNEXIONS PERMANENTES DANS LES INSTALLATIONS FIXES

1 Domaine d'application

Le présent document s'applique aux coupleurs d'installation qui comportent deux à cinq conducteurs, avec ou sans contact de terre (le cas échéant), de tension continue ou alternative assignée jusqu'à 500 V inclus et de capacité assignée de connexion jusqu'à 10 mm² inclus, avec un courant assigné qui ne dépasse pas 32 A, pour connexion permanente dans les installations électriques. Les coupleurs d'installation avec des contacts supplémentaires pour des tensions autres que la tension d'alimentation du réseau ne relèvent pas du domaine d'application du présent document.

Un coupleur d'installation est constitué d'un connecteur femelle d'installation et d'un connecteur mâle d'installation pour connexion permanente non destinés à être connectés ou déconnectés en charge ni destinés à être connectés ou déconnectés autrement que pendant la première installation ou au cours de la reconfiguration ou de la maintenance des canalisations dans lesquelles les coupleurs d'installation ont été installés. Cela signifie que les coupleurs d'installation sont prévus pour un usage non fréquent uniquement.

Les coupleurs d'installation ne sont pas adaptés pour être utilisés en remplacement des systèmes de prises de courant. Les coupleurs d'installation ne sont pas adaptés pour être utilisés pour remplacer les dispositifs de connexion pour luminaires (DCL) selon l'IEC 61995 (toutes les parties) ou pour remplacer les dispositifs de suspension pour luminaires (LSC).

Les coupleurs d'installation conformes au présent document conviennent à une utilisation aux températures ambiantes qui ne dépassent normalement pas +40 °C, mais dont la moyenne sur une période de 24 h ne dépasse pas +35 °C, avec une limite basse de la température ambiante de -5 °C, que ce soit pour une utilisation à l'intérieur ou à l'extérieur.

NOTE 1 Des essais supplémentaires pour une utilisation dans les climats froids sont fournis à l'Annexe F, qui est normative dans le pays suivant: Finlande. Les informations nécessaires peuvent être consultées dans les instructions d'installation du fabricant.

NOTE 2 Pour d'autres températures, les informations nécessaires peuvent être indiquées dans les instructions d'installation du fabricant.

Dans les endroits où des conditions spéciales prédominent, comme dans les navires, les véhicules et endroits analogues et dans les lieux à risques, par exemple où des explosions sont susceptibles de se produire, des constructions spéciales peuvent être exigées.

NOTE 3 Les coupleurs d'installation sont prévus pour être installés par des personnes averties ou qualifiées.

NOTE 4 A titre de guide d'utilisation des systèmes coupleurs d'installation, voir l'Annexe D.

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60068-2-31:2008, *Essais d'environnement – Partie 2-31: Essais – Essai Ec: Choc lié à des manutentions brutales, essai destiné en premier lieu aux matériels*

IEC 60112, *Méthode de détermination des indices de résistance et de tenue au cheminement des matériaux isolants solides*

IEC 60529:1989, *Degrés de protection procurés par les enveloppes (code IP)*
IEC 60529:1989/AMD1:1999
IEC 60529:1989/AMD2:2013

IEC 60664-1:2020, *Coordination de l'isolement des matériels dans les réseaux d'énergie électrique à basse tension – Partie 1: Principes, exigences et essais*

IEC 60695-2-11, *Essais relatifs aux risques du feu – Partie 2-11: Essais au fil incandescent/chauffant – Méthode d'essai d'inflammabilité pour produits finis (GWEPT)*

IEC 60998-2-3, *Dispositifs de connexion pour circuits basse tension pour usage domestique et analogue – Partie 2-3: Règles particulières pour dispositifs de connexion en tant que parties séparées avec organes de serrage à perçage d'isolant*

IEC 60999-1:1999, *Dispositifs de connexion – Conducteurs électriques en cuivre – Prescriptions de sécurité pour organes de serrage à vis et sans vis – Partie 1: Prescriptions générales et particulières pour les organes de serrage pour les conducteurs de 0,2 mm² à 35 mm² (inclus)*

IEC 61032:1997, *Protection des personnes et des matériels par les enveloppes – Calibres d'essai pour la vérification*

3 Termes et définitions

Pour les besoins du présent document, les termes et définitions suivants s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse <https://www.electropedia.org/>
- ISO Online browsing platform: disponible à l'adresse <https://www.iso.org/obp>

Sauf spécification contraire, lorsque les termes "tension" et "courant" sont utilisés dans le présent document, ils décrivent des valeurs efficaces.

3.1

tension assignée

tension assignée au coupleur d'installation par le fabricant

3.2

courant assigné

courant maximal assigné au coupleur d'installation par le fabricant

Note 1 à l'article: Le courant assigné se réfère au coupleur d'installation lui-même et non à un circuit électrique.

3.3

capacité assignée de connexion

section du ou des plus grands conducteurs susceptibles d'être connectés, comme cela est indiqué par le fabricant du coupleur d'installation

3.4

connexion permanente

méthode de connexion dans une installation qui est seulement ouverte pour la maintenance ou la reconfiguration des canalisations

Note 1 à l'article: L'expression "connexion permanente" doit être comprise comme une connexion qui est maintenue aussi longtemps que l'installation existe.

3.5

coupleur d'installation

dispositif de connexion équipé d'un dispositif de retenue et prévu pour une connexion permanente, qui comprend un connecteur femelle d'installation et un connecteur mâle d'installation et qui n'est destiné ni à être connecté ou déconnecté en charge ni à être connecté ou déconnecté autrement que lors de la première installation, pendant la maintenance ou pendant la reconfiguration des canalisations

3.6

connecteur mâle d'installation

partie du coupleur d'installation, du côté de la charge, qui porte les contacts mâles

3.7

connecteur femelle d'installation

partie du coupleur d'installation, du côté de l'alimentation, qui porte les contacts femelles

3.8

système coupleurs d'installation

famille de coupleurs d'installation qui comprend un ou plusieurs connecteurs femelles d'installation compatibles par des caractéristiques de codification mécaniques avec un ou plusieurs connecteurs mâles d'installation de mêmes caractéristiques assignées et produite selon la spécification d'un fabricant

Note 1 à l'article: Dans le cas présent, "un fabricant" signifie "un seul et même fabricant".

3.9

canalisations

ensemble constitué d'un câble ou de câbles ou de jeux de barres et d'éléments sécurisant, et si nécessaire enveloppant les câbles ou les jeux de barres

[SOURCE: IEC 60364-5-52:2009, 520.3.1, modifié – "de conducteurs nus ou isolés" a été remplacé par "d'un câble", et "barres omnibus" a été remplacé par "jeux de barres".]

3.10

coupleur d'installation démontable

coupleur d'installation fabriqué de manière à pouvoir remplacer le câble

3.11

coupleur d'installation non démontable

coupleur d'installation fabriqué de manière à former une entité complète avec le câble après connexion et assemblage par le fabricant

Note 1 à l'article: Voir également 12.15.

3.12

coupleur d'installation non démontable surmoulé

coupleur d'installation non démontable fabriqué de manière que les contacts, les bornes ou les connexions et les extrémités de câbles qui y sont fixées soient entourés de matériau isolant par un procédé de moulage

3.13

coupleur d'installation non démontable non surmoulé

coupleur d'installation non démontable fabriqué de manière que les contacts, les bornes ou les connexions et les extrémités de câbles qui y sont fixées soient entourés par des parties séparées en matériau isolant

3.14

bloc de distribution

dispositif prévu pour le branchement de circuits

3.15

dispositif de retenue

assemblage par lequel un connecteur femelle d'installation et un connecteur mâle d'installation sont maintenus en position lorsqu'ils sont correctement branchés et qui empêche leur débranchement non intentionnel

Note 1 à l'article: Le débranchement peut être réalisé à la main ou à l'aide d'un outil.

3.16

couvercle

barrière amovible qui empêche l'accès à un connecteur femelle d'installation non utilisé

3.17

essai individuel de série

essai auquel chaque appareil est soumis pendant et/ou après la fabrication afin de s'assurer qu'il remplit certains critères

3.18

essai de type

essai d'un ou de plusieurs appareils réalisés selon une conception donnée pour prouver que celle-ci satisfait à certaines exigences

3.19

aisément accessible, adj

accessible au toucher entre tout point de la surface où les personnes se tiennent et circulent habituellement et la limite qu'une personne peut atteindre avec la main, dans toutes les directions, sans moyen auxiliaire

Note 1 à l'article: Voir l'IEC 60364-4-41:2005, Annexe B.

3.20

borne

partie d'un appareil à laquelle un conducteur est fixé pour réaliser une connexion réutilisable

3.21

sortie

partie d'un appareil à laquelle un conducteur est fixé de manière permanente

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

3.22

partie active

partie conductrice destinée à être sous tension dans des conditions normales, y compris le conducteur de neutre ou le conducteur de point milieu, mais par convention, excepté le conducteur PEN, le conducteur PEM ou le conducteur PEL

Note 1 à l'article: Cette notion n'implique pas nécessairement un risque de choc électrique.

[SOURCE: IEC 61140:2016, 3.4]

4 Exigences générales

Les coupleurs d'installation doivent être conçus et fabriqués de sorte que, lors d'une utilisation normale, leur performance soit fiable et sans danger pour l'utilisateur et sans dommage pour leur environnement.

La conformité est vérifiée en réalisant tous les essais correspondants spécifiés dans le présent document.

NOTE Dans certains pays, il n'est pas admis d'utiliser les coupleurs d'installation lorsqu'ils ne sont pas visibles après installation: Canada, États-Unis.

5 Conditions pour les essais

5.1 Généralités

Les essais doivent être réalisés pour vérifier la conformité aux exigences correspondantes du présent document.

Seuls les connecteurs (mâles et femelles) d'un système coupleurs d'installation conforme à la spécification d'un seul et même fabricant doivent être engagés ensemble pour réaliser les essais.

Les essais sont les suivants:

- les essais de type doivent être réalisés sur des échantillons représentatifs de chaque type de coupleur d'installation;
- les essais individuels de série doivent être réalisés sur chaque coupleur d'installation, comme cela est exigé dans le présent document.

Les essais du 5.2 au 5.6 s'appliquent aux essais de type; les essais du 5.7 s'appliquent aux essais individuels de série.

NOTE Au Royaume-Uni, lorsque les coupleurs d'installation disposent de plus de 5 conducteurs, ils doivent satisfaire aux exigences de l'IEC 61535 comme cela est prévu par le domaine d'application et doivent être soumis aux essais de sorte que toutes les broches de la tension d'alimentation du réseau soient soumises au même niveau d'essai.

5.2 Conditions d'essai

Sauf spécification contraire, les essais doivent être réalisés sur des échantillons en l'état de livraison et dans des conditions d'utilisation normale à une température ambiante comprise entre 15 °C et 35 °C.

Lorsque la valeur de la température est d'importance, les essais doivent être réalisés à 20 °C ± 5 °C.

5.3 Essais sur les coupleurs d'installation non démontables

Pour les besoins des essais, et sauf spécification contraire dans le présent document, les coupleurs d'installation non démontables doivent être équipés de câbles d'une longueur d'au moins 1 m.

5.4 Ordre des essais

Sauf spécification contraire dans le présent document, les essais doivent être réalisés dans l'ordre des articles/paragraphe, comme cela est spécifié dans le Tableau C.1 de l'Annexe C.

5.5 Spécification des essais

Les connecteurs mâles d'installation, les couvercles, les connecteurs femelles d'installation et les blocs de distribution doivent être soumis à l'essai avec leurs parties complémentaires correspondantes conformes au présent document.

Les lots d'échantillons doivent être soumis aux essais spécifiés dans le Tableau C.1 de l'Annexe C.

5.6 Exigences de conformité

Les échantillons sont jugés non conformes au présent document s'il y a plus d'un échantillon défectueux pendant l'un des essais.

Si un échantillon d'un lot donné ne satisfait pas à un essai en raison d'un défaut d'assemblage ou de fabrication, cet essai et les essais précédents, qui peuvent avoir influencé le résultat de cet essai, sont répétés sur un autre lot d'échantillons du même nombre, comme cela est spécifié dans le Tableau C.1 de l'Annexe C; ces derniers doivent alors tous satisfaire aux essais répétés.

NOTE Le demandeur peut soumettre, en même temps que le nombre d'échantillons spécifié, le lot supplémentaire d'échantillons qui peut être exigé en cas de défaut d'un échantillon. Le laboratoire d'essai soumet alors aux essais, sans autre demande, les échantillons supplémentaires et ne procède à un rejet que si un nouvel échec se produit. Si le lot d'échantillons supplémentaire n'est pas fourni en même temps que le nombre spécifié d'échantillons, l'échec d'un seul échantillon entraîne un rejet.

5.7 Essais individuels de série pour les coupleurs d'installation non démontables

Les essais individuels de série pour les coupleurs d'installation non démontables sont spécifiés à l'Annexe A.

6 Caractéristiques assignées

6.1 Tension assignée

Il convient que les coupleurs d'installation aient de préférence une tension assignée choisie soit dans le Tableau 1 pour une application en tension alternative, soit dans le Tableau 2 pour une application en tension continue.

Tous les composants d'un même système coupleurs d'installation doivent avoir la même valeur de tension assignée phase-neutre.

Tableau 1 – Tension assignée des coupleurs d'installation dans une application en tension alternative

Tension nominale du système d'alimentation V	Tension assignée V	Tension de choc assignée kV
100	125	2,5
100/200	125/250	2,5
230	250	4,0
230/400	250/400	4,0
277/480	320/500	4,0

**Tableau 2 – Tension assignée des coupleurs
d'installation dans une application en tension continue**

Tension nominale du système d'alimentation V	Tension assignée V	Tension de choc assignée kV
12	12	0,8
60	60	1,5
120 ^a à 240 ^b	125/250	2,5
220 ^a à 440 ^b	250/500	4,0
NOTE Pour les applications en tension continue jusqu'à 60 V, en raison de la commutation de charge, des tensions beaucoup plus élevées que la tension assignée sont également possibles; le circuit complet peut donc être pris en compte lors de la définition de la valeur assignée pour la tension de choc. ^a Tension du conducteur actif par rapport à un conducteur de référence/une terre. ^b Tension du conducteur actif (polarité +/-).		

6.2 Courant assigné

Il convient que les coupleurs d'installation aient de préférence un courant assigné choisi parmi les valeurs suivantes:

- 10 A;
- 13 A;
- 16 A;
- 20 A;
- 25 A;
- 32 A.

6.3 Capacité assignée de connexion

Il convient que les coupleurs d'installation aient de préférence une capacité assignée de connexion choisie parmi les valeurs suivantes:

- 1,5 mm²;
- 2,5 mm²;
- 4 mm²;
- 6 mm²;
- 10 mm².

6.4 Essais

La conformité aux 6.1, 6.2 et 6.3 est vérifiée par examen des marquages selon l'Article 8.

7 Classification

Les coupleurs d'installation sont classés selon le Tableau 3.

Tableau 3 – Classes de coupleurs d'installation

Critères de classification	
7.1 Tension de choc assignée	7.1.1 2,5 kV
	7.1.2 4 kV
7.2 Méthode de connexion du câble	7.2.1 Démontable
	7.2.2 Non démontable
	7.2.2.1 Non démontables surmoulés
	7.2.2.2 Non démontables non surmoulés
7.3 Degré de protection contre la pénétration de corps solides étrangers et contre la pénétration d'eau selon l'IEC 60529 (code IP)	
7.4 Emplacement où les coupleurs d'installation sont installés	7.4.1 Aisément accessible ^a
	7.4.2 Non aisément accessible
7.5 Existence d'un contact de terre	7.5.1 Avec contact de terre
	7.5.2 Sans contact de terre
7.6 Type de conducteurs à connecter	7.6.1 Massif
	7.6.2 Rigide (massif et multibrins)
	7.6.3 Souple
	7.6.4 Rigide (massif et multibrins) et souple à la fois
7.7 Type de bornes pour les coupleurs d'installation démontables seulement	7.7.1 Coupleurs d'installation avec bornes à vis
	7.7.2 Coupleurs d'installation avec bornes sans vis
	7.7.3 Coupleurs d'installation avec bornes à perçage d'isolant
7.8 Application	7.8.1 Tension alternative
	7.8.2 Tension continue
^a Les coupleurs d'installation pour zones aisément accessibles peuvent également être utilisés dans des zones non aisément accessibles.	

8 Marquage et documentation

8.1 Généralités

Les coupleurs d'installation doivent porter les marquages suivants:

- le courant assigné en ampères (A);
- la tension assignée en volts (V);
- le nom, la marque commerciale ou l'identification du fabricant ou du vendeur responsable;
- le code IP si celui-ci est supérieur à IP43, comme suit:

Le premier chiffre caractéristique pour le degré de protection contre l'accès aux parties dangereuses et contre les effets nuisibles de la pénétration de corps solides étrangers doit être marqué s'il est déclaré supérieur à 4, auquel cas le second chiffre caractéristique doit aussi être marqué.

Le second chiffre caractéristique pour le degré de protection contre les effets nuisibles de la pénétration de l'eau doit être marqué s'il est déclaré supérieur à 3, auquel cas le premier chiffre caractéristique doit aussi être marqué;

- la référence du type;
- la capacité assignée de connexion pour les coupleurs d'installation démontables en mm²;

- g) la taille du conducteur connecté en mm² pour les coupleurs d'installation non démontables;
- h) DC, lorsqu'ils sont construits pour une utilisation dans les systèmes en tension continue;
- i) un symbole d'avertissement conforme à l'Annexe E, lorsqu'ils sont construits pour une utilisation dans un système en tension continue. Pour les connecteurs trop petits pour disposer d'un marquage, une étiquette distincte avec ce symbole d'avertissement doit être disponible pour les coupleurs d'installation pour tension continue.

8.2 Utilisation de symboles ou de lettres

Lorsqu'il est fait usage de symboles ou de lettres, il doit s'agir des suivants:

- capacité assignée de connexion en millimètres carrés mm² ou □
- volts V
- ampères A
- tension alternative ~ ou AC
- tension continue ≡ ou DC
- pôle positif (dans les systèmes en tension continue) +
- pôle négatif (dans les systèmes en tension continue) -
- neutre N
- point milieu M
- terre de protection  ou
PE (IEC 60417-5019:2006-08)

8.3 Marquage

Le marquage du coupleur d'installation et l'étiquette selon 8.1 doivent être aisément visibles avant installation.

Le marquage des bornes pour une application en tension alternative doit être L1, L2, L3 ou 1, 2, 3 ou équivalent. Les bornes de neutre doivent être marquées de la lettre N. Le marquage des bornes pour une application en tension continue doit être L+, L-, +, - ou équivalent. Les bornes de point milieu doivent être marquées de la lettre M. Les bornes de terre de protection doivent porter le marquage approprié. Ces marquages ne doivent pas être placés sur des vis, des rondelles démontables ou toute autre partie facilement amovible.

Si les bornes sont conçues pour accepter un seul type de conducteur, par exemple conducteur souple ou conducteur rigide (multibrins ou massif), cela doit apparaître clairement sur le coupleur d'installation par la lettre "f" pour un conducteur souple, "r" pour un conducteur rigide ou "s" pour un conducteur massif, ou bien cela doit être indiqué sur le plus petit emballage ou dans les informations techniques et le catalogue.

Le marquage et les étiquettes doivent être durables et clairement lisibles avec une vision normale ou corrigée, sans grossissement supplémentaire.

La conformité est vérifiée par examen et par l'essai suivant.

Le marquage est frotté à la main pendant 15 s avec un chiffon imbibé d'eau et de nouveau pendant 15 s avec un chiffon imbibé d'essence minérale.

Les marquages réalisés par impression, moulage, pressage ou gravure, etc. ne sont pas soumis à cet essai.

Une étiquette d'avertissement pour une utilisation en tension continue "Ne pas connecter ou déconnecter en charge" conforme à l'Annexe E doit être fournie.

8.4 Documentation

Le catalogue du fabricant ou les instructions d'installation doivent contenir les informations suivantes:

- a) coupleurs d'installation prévus uniquement pour le branchement et le débranchement en l'absence de toute charge;
- b) types de câble prévus pour être raccordés dans les coupleurs d'installation;
- c) si le coupleur d'installation n'est pas approprié pour une installation dans des zones aisément accessibles;
- d) si des éléments supplémentaires ou si des précautions particulières sont nécessaires pour une utilisation dans des zones aisément accessibles;
- e) un marquage approprié qui indique la longueur de l'isolant à enlever avant l'insertion du conducteur dans la borne sans vis;
- f) longueur de "mou" du conducteur PE pour les coupleurs d'installation démontables (voir 12.14);
- g) avertissement qui indique à l'installateur que la compatibilité dangereuse entre des systèmes coupleurs d'installation de différents fabricants n'est pas automatiquement empêchée par la conformité à l'IEC 61535;
- h) énoncé précisant que les systèmes coupleurs d'installation ne sont pas destinés à remplacer le système national de prises de courant domestiques;
- i) si un repiquage est prévu, des instructions de câblage doivent être spécifiées dans la documentation technique du fabricant;
- j) pour une utilisation en tension continue, une étiquette d'avertissement "Ne pas connecter ou déconnecter en charge" conforme à l'Annexe E doit être fournie par le fabricant. Des instructions pour que l'installateur fixe l'étiquette d'avertissement aussi près que possible du coupleur d'installation pour tension continue doivent être fournies dans les instructions d'installation;
- k) énoncé précisant que les coupleurs d'installation doivent être utilisés avec les dispositifs de retenue fournis par les fabricants (voir 12.10).

Toute documentation peut en outre être disponible sur plusieurs supports.

NOTE Par exemple, QR codes avec référence à Internet, catalogues électroniques, lien web sur l'unité d'emballage ou dans les documents de livraison, etc.

Les instructions d'installation doivent être données dans le catalogue du fabricant, dans la documentation technique ou à l'intérieur du plus petit emballage du produit ou sur cet emballage.

9 Compatibilité dangereuse

9.1 Connexion fortuite ou incorrecte

Un système coupleurs d'installation doit être conçu et construit de façon à empêcher une connexion incorrecte ou fortuite.

Un système coupleurs d'installation doit être conçu et construit de façon à empêcher une connexion entre tension alternative et continue.

NOTE Une connexion fortuite ou incorrecte comprend la connexion unipolaire, excepté entre les contacts de terre.

La conformité est vérifiée par examen et par l'essai suivant.

Il ne doit pas être possible d'insérer le connecteur mâle d'installation dans le connecteur femelle d'installation et de provoquer une situation dangereuse.

Une tentative d'engager le connecteur mâle d'installation dans le connecteur femelle d'installation est effectuée dans n'importe quelle configuration non intentionnelle avec une force de 80 N pour les coupleurs d'installation marqués "10 A", "13 A", "16 A" et "20 A" ou de 120 N pour les coupleurs d'installation marqués "25 A" et "32 A". La force doit être appliquée dans l'axe de la connexion pendant 1 min. Pendant cet intervalle, les contacts du connecteur mâle d'installation et du connecteur femelle d'installation ne doivent pas s'engager.

Lorsque des matériaux élastomères ou thermoplastiques susceptibles d'influencer les résultats de l'essai sont utilisés, l'essai doit être réalisé à une température ambiante de $35\text{ °C} \pm 2\text{ °C}$, toutes les parties du coupleur d'installation étant à cette température.

Pendant l'essai, aucun contact ne doit se produire.

9.2 Engagement

Il ne doit pas être possible, à l'intérieur d'un système coupleurs d'installation donné, de brancher un connecteur mâle d'installation avec un connecteur femelle d'installation:

- avec un nombre différent de pôles actifs, des exceptions peuvent être admises pour les connecteurs femelles d'installation spécialement conçus pour accepter le branchement de connecteurs mâles d'installation d'un nombre inférieur de pôles, sous réserve qu'aucune situation dangereuse ne puisse survenir;
- sans contact de mise à la terre si le connecteur mâle d'installation comporte un contact de mise à la terre;
- avec des valeurs assignées différentes de tension phase-neutre ou avec des courants assignés différents.

La conformité est vérifiée par l'essai selon 9.1.

9.3 Compatibilité de différents systèmes coupleurs d'installation

Les coupleurs d'installation de différents systèmes du même fabricant ne doivent pas être dangereusement compatibles.

La conformité est vérifiée par l'essai selon 9.1.

9.4 Compatibilité avec des systèmes normalisés

Les coupleurs d'installation conformes aux exigences du présent document ne doivent pas être compatibles avec les systèmes spécifiés dans les feuilles de normes de l'IEC 60309 (toutes les parties), de l'IEC 60320 (toutes les parties) et de l'IEC 60906 (toutes les parties), ni avec le système national de prises de courant domestiques du pays où le produit est placé sur le marché.

NOTE Des systèmes nationaux de prises de courant sont représentés dans l'IEC TR 60083.

La conformité est vérifiée par un essai manuel et, en cas de doute, par examen des dessins.

10 Protection contre les chocs électriques

10.1 Degré de protection contre la pénétration de corps solides étrangers

Un coupleur d'installation branché doit être conforme aux exigences pour IP 2XC. Le coupleur d'installation doit être conçu de sorte que les parties actives ne soient pas accessibles lorsque le connecteur mâle d'installation et le connecteur femelle d'installation sont partiellement ou complètement engagés. Le connecteur femelle d'installation doit être conçu de manière que les parties actives ne soient pas accessibles lorsqu'il est débranché et doit satisfaire aux exigences pour IP 2X. Le contact de mise à la terre et toute partie métallique connectée au contact de mise à la terre ne doivent pas être accessibles lorsque le coupleur d'installation est complètement engagé, sauf pour les coupleurs d'installation dans des conduits métalliques (lorsque les règles d'installation exigent une telle pratique).

NOTE 1 Les règles nationales peuvent comporter des exigences concernant les coupleurs d'installation avec des conduits métalliques.

NOTE 2 Les parties actives décrites dans le présent document sont considérées comme des parties dangereuses conformément à l'IEC 60529.

Les coupleurs d'installation utilisés dans des zones aisément accessibles doivent satisfaire aux exigences pour IP 2XD, qu'ils soient branchés ou non.

Si la face d'engagement du connecteur femelle d'installation pour zones aisément accessibles ne satisfait pas aux exigences pour IP 2XD, le fabricant doit fournir des couvercles. Ces couvercles ne doivent être démontables qu'à l'aide d'un outil.

La conformité est vérifiée après enlèvement des parties qui peuvent être retirées sans l'aide d'un outil par l'utilisation du calibre d'essai C selon la Figure 3 de l'IEC 61032:1997, du calibre d'essai D selon la Figure 4 de l'IEC 61032:1997 et du calibre d'essai 11 selon la Figure 7 de l'IEC 61032:1997. Les calibres d'essai sont appliqués selon l'IEC 60529.

10.2 Accès aux parties actives

Il ne doit pas être possible d'accéder aux parties actives sans l'aide d'un outil.

Les manchons éventuels dans les orifices d'entrée pour les broches doivent être fixés correctement et il ne doit pas être possible de les retirer sans démonter le coupleur d'installation.

La conformité est vérifiée par examen et par un essai manuel.

10.3 Parties externes

Les parties externes des coupleurs d'installation, à l'exception des vis d'assemblage ou analogues, doivent être en matériau isolant.

NOTE Les règles nationales peuvent comporter des exigences concernant les coupleurs d'installation avec des enveloppes métalliques.

La conformité est vérifiée par examen.

11 Bornes, sorties et conducteurs raccordables

11.1 Bornes et sorties

11.1.1 Généralités

Pour les coupleurs d'installation avec organes de serrage, l'IEC 60999-1:1999 s'applique, le cas échéant, à l'exception de l'essai décrit en 9.10 de IEC 60999-1:1999.

NOTE 1 L'essai décrit en 9.10 de l'IEC 60999-1:1999 est couvert par l'essai de vieillissement cyclique conformément au 21.5 du présent document.

NOTE 2 L'essai décrit en 9.8 de l'IEC 60999-1:1999 est couvert par l'essai de résistance de contact conformément au 15.2 du présent document.

11.1.2 Bornes des coupleurs d'installation démontables

Les coupleurs d'installation démontables doivent être équipés de bornes à vis, de bornes sans vis ou de bornes à perçage d'isolant réutilisables.

Les bornes à vis doivent permettre la connexion de conducteur sans préparation spéciale, mais doivent aussi permettre la connexion de conducteurs préparés si cela est spécifié.

Les bornes à perçage d'isolant doivent être conformes à l'IEC 60998-2-3.

11.1.3 Sorties des coupleurs d'installation non démontables

Les coupleurs d'installation non démontables doivent être équipés de sorties soudées, brasées ou serties, ou de moyens pour perçage d'isolant ou d'organes de serrage sans vis ou de moyens permanents de même efficacité.

Les bornes sans vis et les bornes à perçage d'isolant ne sont pas admises pour les coupleurs d'installation non démontables surmoulés, à moins que des moyens soient présents pour empêcher le matériau de moulage de pénétrer dans les organes de serrage.

Les sorties soudées doivent être équipées de moyens qui sont indépendants de la soudure qui permet la fixation mécanique du conducteur en position.

La conformité est vérifiée par examen.

11.2 Conducteurs raccordables

Les bornes pour les connecteurs femelles d'installation et les connecteurs mâles d'installation démontables ne doivent pas avoir une valeur de capacité assignée de connexion inférieure à:

- 1,5 mm² pour les coupleurs d'installation marqués 10 A selon la valeur de courant maximale;
- 1,5 mm² pour les coupleurs d'installation marqués 13 A selon la valeur de courant maximale;
- 1,5 mm² pour les coupleurs d'installation marqués 16 A selon la valeur de courant maximale;
- 2,5 mm² pour les coupleurs d'installation marqués 20 A selon la valeur de courant maximale;
- 4 mm² pour les coupleurs d'installation marqués 25 A selon la valeur de courant maximale;
- 6 mm² pour les coupleurs d'installation marqués 32 A selon la valeur de courant maximale.

NOTE Les règles nationales d'installation déterminent la valeur assignée du circuit dans lequel le coupleur d'installation adéquat peut être utilisé.

La conformité est vérifiée par l'essai suivant.

Les conducteurs de section et de type indiqués doivent être connectés et les vis doivent être serrées aux valeurs de couple spécifiées dans le Tableau 6. Pour les coupleurs d'installation classés selon 7.6.3 et 7.6.4 dans le Tableau 3, l'essai est effectué conjointement à l'essai du 12.8.

12 Construction

12.1 Connexion entre les contacts de terre

Les coupleurs d'installation doivent être construits de manière que, lors de l'insertion du connecteur mâle d'installation, la connexion entre les contacts de terre, le cas échéant, soit réalisée au moins 1 mm avant la mise sous tension des contacts qui transportent le courant du connecteur mâle d'installation.

Lors du retrait du connecteur mâle d'installation, les broches qui transportent le courant doivent se séparer avant la rupture de la connexion entre les contacts de terre.

La conformité est vérifiée par examen des dessins de fabrication, en prenant en compte l'effet des tolérances et les positions les plus défavorables, et par examen des échantillons par rapport à ces dessins et/ou par un essai manuel.

12.2 Verrouillage contre la rotation

Les contacts des connecteurs mâles d'installation doivent être verrouillés contre la rotation si les broches peuvent être touchées sans l'aide d'un outil.

La conformité est vérifiée par les essais suivants.

Un couple de serrage d'une valeur de 0,4 Nm est appliqué sur les contacts pendant 60 s dans une direction puis pendant 60 s dans la direction opposée. Les pièces de contact ne doivent pas tourner de plus de 30° au total.

NOTE Les vis des bornes peuvent être utilisées pour empêcher une éventuelle rotation.

12.3 Résistance mécanique des contacts

Les contacts doivent être fixés de façon sûre et doivent avoir une résistance mécanique suffisante. Ils ne doivent pas être amovibles sans l'aide d'un outil.

Cette exigence n'exclut pas les contacts flottants.

La conformité est vérifiée par examen et par l'essai suivant.

Le coupleur d'installation doit être monté comme en utilisation normale et avec tous les contacts installés. Tous les accessoires ou les couvercles qui ne sont pas essentiels pour le dispositif de retenue des contacts peuvent être desserrés ou retirés.

Le coupleur d'installation doit être placé dans une étuve pendant 1 h à une température de $(70 \pm 2)^\circ\text{C}$.

Immédiatement après la période d'échauffement, une force axiale de 40 N doit être appliquée à chaque contact du connecteur femelle d'installation et du connecteur mâle d'installation dans les deux directions de façon consécutive. Cette force doit être atteinte par une augmentation progressive qui ne dépasse pas 20 N/s jusqu'à atteindre la valeur spécifiée.

La valeur maximale doit être maintenue pendant 60 s.

Après l'essai, laisser le coupleur d'installation refroidir à la température de la pièce; aucun contact ne doit s'être déplacé dans le corps du coupleur d'installation de plus de 1 mm.

12.4 Enveloppe des coupleurs d'installation démontables

L'enveloppe des coupleurs d'installation démontables doit complètement envelopper les bornes et les extrémités des gaines de câbles. Il doit être possible de disposer chaque conducteur de sorte que son isolation ne puisse venir en contact avec des parties actives de polarité différente.

La conformité est vérifiée par examen et par un essai manuel.

12.5 Enveloppe des coupleurs d'installation non démontables

L'enveloppe des coupleurs d'installation non démontables doit complètement envelopper les sorties et les extrémités des gaines de câbles. Les conducteurs doivent être disposés de sorte que leur isolation ne puisse pas venir en contact avec des parties actives de polarité différente.

La conformité est vérifiée par examen et par un essai manuel.

12.6 Démontage et ouverture des coupleurs d'installation démontables

L'enveloppe des coupleurs d'installation démontables doit être fixée de façon sûre et il ne doit pas être possible de démonter le coupleur d'installation sans l'aide d'un outil.

Pour les coupleurs d'installation démontables, il doit y avoir des moyens indépendants pour fixer et positionner les parties du coupleur d'installation les unes par rapport aux autres; au moins l'une d'entre elles doit être actionnée à l'aide d'un outil pour être ouverte.

La conformité est vérifiée par examen et par un essai manuel.

12.7 Contact de mise à la terre et borne de mise à la terre

Si le contact de mise à la terre et la borne de mise à la terre ne sont pas en une pièce, les différentes parties doivent être connectées de façon fiable.

Pour les organes de serrage conformes à l'IEC 60999-1:1999, le rivetage et le soudage sont considérés comme un moyen fiable.

Les vis des organes de serrage et les ressorts des organes de serrage sans vis ne sont pas considérés comme des parties du contact.

La conformité est vérifiée par examen et par un essai selon l'Article 16.

12.8 Brins détachés du conducteur

12.8.1 Généralités

Les coupleurs d'installation démontables classés selon 7.6.3 ou 7.6.4 du Tableau 3 doivent être conçus de sorte que des brins détachés de conducteur dans le coupleur d'installation ne présentent pas de risque de choc électrique.

Pour les coupleurs d'installation non démontables, des moyens doivent être prévus pour empêcher des brins détachés de conducteur de réduire les distances dans l'air et les lignes de fuite minimales exigées ainsi que l'isolation solide entre les conducteurs et toutes les surfaces externes accessibles du coupleur d'installation, à l'exception de la face d'engagement du connecteur mâle d'installation du coupleur.

La conformité est vérifiée comme suit:

- *pour les coupleurs d'installation démontables, par l'essai du 12.8.2;*
- *pour les coupleurs d'installation non démontables non surmoulés, par l'essai du 12.8.3;*
- *pour les coupleurs d'installation non démontables surmoulés, par vérification et examen selon 12.8.4.*

12.8.2 Essais des brins pour les coupleurs d'installation démontables

Une longueur d'isolant de 6 mm est retirée de l'extrémité d'un conducteur souple de section minimale spécifiée par le fabricant. Un brin du conducteur souple est laissé libre, les brins restants sont complètement insérés et serrés dans la borne, comme en utilisation normale.

Le brin libre est plié, sans déchirer l'isolant, dans toutes les directions possibles, mais sans faire de pliages à angles aigus autour des cloisons.

NOTE L'interdiction d'exécuter des pliages à angles aigus autour des cloisons n'implique pas que le brin libre doive être maintenu rectiligne pendant l'essai. En outre, ces pliages à angles aigus sont exécutés s'il est jugé probable que de tels pliages puissent se produire pendant l'assemblage normal du coupleur d'installation, par exemple lorsque le couvercle est posé dessus.

Il ne doit pas être possible pour un brin libre d'un conducteur relié à une borne sous tension de venir en contact avec une quelconque partie métallique accessible, de pouvoir sortir de l'enveloppe ou de toucher une borne de mise à la terre lorsque le coupleur d'installation a été assemblé.

Il ne doit pas être possible pour un brin libre d'un conducteur connecté à une borne de mise à la terre de venir en contact avec une partie active.

Si nécessaire, l'essai est répété en positionnant le brin libre dans une autre position.

12.8.3 Essais des brins pour les coupleurs d'installation non démontables non surmoulés

Une longueur d'isolant équivalente à la longueur de dénudage maximale déclarée par le fabricant +2 mm est retirée de l'extrémité d'un conducteur souple de la section adaptée. Un brin du conducteur souple est laissé libre dans la position la plus défavorable alors que les extrémités des brins restants sont connectées d'une manière semblable à celle utilisée dans la construction du coupleur d'installation.

Le brin libre est plié, sans déchirer l'isolant, dans toutes les directions possibles, mais sans faire de pliages à angles aigus autour des cloisons.

NOTE L'interdiction d'exécuter des pliages à angles aigus autour des cloisons n'implique pas que le brin libre doive être maintenu rectiligne pendant l'essai. En outre, ces pliages à angles aigus sont exécutés s'il est jugé probable que de tels pliages puissent se produire pendant l'assemblage normal du coupleur d'installation, par exemple lorsque le couvercle est posé dessus.

Il ne doit pas être possible pour un brin libre d'un conducteur relié à une borne sous tension de venir en contact avec une quelconque partie métallique accessible, de toucher une borne de mise à la terre ou de réduire la distance dans l'air ou la ligne de fuite à travers un quelconque espace de construction jusqu'à la surface externe au-dessous de 1,5 mm.

Il ne doit pas être possible pour un conducteur libre connecté à une borne de mise à la terre de venir en contact avec une partie active.

12.8.4 Essais des brins pour les coupleurs d'installation non démontables surmoulés

Les coupleurs d'installation non démontables surmoulés doivent être examinés pour vérifier qu'il existe des moyens pour empêcher que des brins libres d'un conducteur et/ou des parties actives touchent une borne de mise à la terre ou réduisent la distance minimale à travers l'isolation aux surfaces externes accessibles, à l'exception de la face d'engagement d'un connecteur mâle d'installation, au-dessous de 1,5 mm.

La vérification des "moyens" peut exiger la vérification de la construction du produit ou de la méthode d'assemblage du produit.

12.9 Intégration des dispositifs électriques

Les coupleurs d'installation ne doivent pas comporter d'autres dispositifs électriques tels que des interrupteurs, des fusibles, des relais, des thermostats, des dispositifs de protection contre les surtensions et des dispositifs thermiques de limitation de courant.

L'utilisation de coupleurs d'installation pour le raccordement des dispositifs électriques énumérés ci-dessus est admise.

12.10 Dispositif de retenue

Les coupleurs d'installation doivent être équipés d'un dispositif de retenue qui s'engage automatiquement lorsque le coupleur d'installation ou le couvercle est connecté et qui est capable de se désengager lors de la déconnexion. Il ne doit être possible de désengager le dispositif de retenue que par une action intentionnelle ou délibérée. Pour les coupleurs d'installation classés selon les 7.4.1 et 7.8.2 du Tableau 3 pour le désengagement, le dispositif de retenue doit être ouvert uniquement à l'aide d'une clé ou d'un outil.

La conformité est vérifiée par l'essai suivant.

Le coupleur d'installation complètement engagé doit être soumis à une force de traction axiale régulière de 80 N pendant 1 min, durant laquelle le dispositif de retenue doit être complètement engagé. Le coupleur d'installation ne doit pas se desserrer ni se déconnecter.

12.11 Blocs de distribution

Le bloc de distribution ne doit comporter qu'un seul connecteur mâle d'installation pour chaque circuit. Les blocs de distribution prévus pour être montés de manière fixe doivent disposer de moyens destinés à la fixation, tels que des trous pour des vis.

La conformité est vérifiée par examen.

12.12 Jupés

Les connecteurs mâles d'installation doivent comporter une jupe, qui doit être au moins aussi longue que la broche la plus longue.

La conformité est vérifiée par examen.

12.13 Câblage en usine

Les coupleurs d'installation non démontables doivent être câblés en usine.