

# INTERNATIONAL STANDARD



**Installation couplers intended for permanent connection in fixed installations**

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**Installation couplers intended for permanent connection in fixed installations**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

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**INSTALLATION COUPLERS INTENDED FOR PERMANENT  
CONNECTION IN FIXED INSTALLATIONS**

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

This second edition cancels and replaces the first edition published in 2009 and Amendment 1:2012. This edition constitutes a technical revision.

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

- a) enlargement of the scope to DC application;
- b) addition of further requirements as regards DC application (marking, etc.), no additional test procedures were deemed necessary; however some modifications were necessary in the normative text;
- c) changes and enhancement of the field of application of installation couplers into outdoor applications;
- d) addition of a suitable temperature range;
- e) updating of the list of normative references, modified to undated references, where possible.

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

CDV	Report on voting
23/792/CDV	23/848/RVC

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

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.

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

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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 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, if provided, with a rated voltage up to and including 500 V AC or DC and a rated connecting capacity up to and including 10 mm<sup>2</sup> for permanent connection in indoor electrical installations. Installation couplers with additional contacts for voltages other than mains voltages are outside the scope of this document.

~~NOTE 1 Installation couplers according to this standard are used e.g. in prefabricated buildings, installation cavities, such as suspended floors and ceilings, or cable tray systems, cable ladder systems, cable ducting systems and cable trunking systems or in commercial show rooms, in partition walls and in any similar application or in furniture complying with IEC 60364-7-713.~~

~~NOTE 2 This standard may be used as a guide for installation couplers with additional contacts for voltages other than mains voltages.~~

~~NOTE 3 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.~~

~~NOTE 4 In the USA, these installation couplers are not permitted to be used where they will not be visible after installation.~~

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 only intended for infrequent use.

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 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.~~

~~NOTE 2 For lower limits of in-service other temperatures, necessary information is 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 may can be required.

~~NOTE 6 Particular requirements for installation couplers e.g. for use at higher 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.~~

~~NOTE 7 National rules may have requirements concerning the accessibility of installation couplers.~~

~~NOTE 8 3 Installation couplers are intended to be installed by instructed or skilled persons.~~

~~NOTE 9 National rules may specify who is allowed to carry out the connection and disconnection of installation couplers.~~

## 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:~~2003~~, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

~~IEC 60364 (all parts), *Electrical installations of buildings*~~

IEC 60529:~~2004~~1989, *Degrees of protection provided by enclosures (IP Code)*  
IEC 60529:1989/AMD1:1999  
IEC 60529:1989/AMD2:2013

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

IEC 60695-2-11:~~2000~~, *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:~~2002~~, *Connecting devices for low-voltage circuits for household and similar purposes – Part 2-3: Particular requirements for connecting devices as separate entities with insulation-piercing clamping units*

IEC 60999-1:1999, *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 1: General requirements and particular requirements for clamping units for conductors from 0,2 mm<sup>2</sup> up to 35 mm<sup>2</sup> (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 terminological databases for use in standardization at the following addresses:

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

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 is in this case of 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

~~NOTE – See IEC 60364-5-52.~~

[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 12.4514.

**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**

accessibility 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]

## 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.*

NOTE In the USA, these installation couplers are not permitted to be used where they will not be visible after installation.

## 5 ~~General notes on~~ 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  $20\text{ °C} \pm 5\text{ °C}$ .

### 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 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 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, which may have influenced the result of that test, are repeated on another set of specimens of the same set number as specified in Table C.1, all of which shall then comply with the repeated tests.

NOTE The applicant ~~may~~ can submit, together with the specified number of specimens, the additional set of specimens which ~~may~~ can be required should one specimen fail. 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	Rated voltage	Rated impulse voltage
V	V	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	Rated voltage	Rated impulse voltage
V	V	kV
12	12	to be defined
60	60	to be defined
120 <sup>a</sup> to 240 <sup>b</sup>	125/250	2,5
220 <sup>a</sup> to 440 <sup>b</sup>	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 be considered when defining the rating for impulse voltage.

<sup>a</sup> Voltage live conductor against reference conductor / earth.

<sup>b</sup> 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 mm<sup>2</sup>
- 2,5 mm<sup>2</sup>
- 4 mm<sup>2</sup>
- 6 mm<sup>2</sup>
- 10 mm<sup>2</sup>.

## 6.4 Tests

~~The preferred values for rated connecting capacities are 1,5 mm<sup>2</sup>, 2,5 mm<sup>2</sup>, 4 mm<sup>2</sup>, 6 mm<sup>2</sup>, 10 mm<sup>2</sup>.~~

*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 the~~

### ~~7.1 rated impulse voltage:~~

~~7.1.1 rated impulse voltage of 2,5 kV;~~

~~7.1.2 rated impulse voltage of 4 kV.~~

### ~~7.2 method of connecting the cable:~~

~~7.2.1 rewirable installation couplers;~~

~~7.2.2 non-rewirable installation couplers.~~

~~7.3 — degree of protection against ingress of foreign solid 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 installation couplers;~~

~~7.4.2 non-readily accessible installation couplers.~~

NOTE 1— Installation couplers for readily accessible areas can also be used in non-readily accessible areas.

~~7.5 — existence of an earthing contact:~~

~~7.5.1 installation couplers with earthing contact;~~

~~7.5.2 installation couplers without earthing contact.~~

~~7.6 — type of conductor to be connected:~~

~~7.6.1 solid conductor only;~~

~~7.6.2 rigid (solid and stranded) conductor only;~~

~~7.6.3 flexible conductor only;~~

~~7.6.4 both rigid (solid and stranded) and flexible conductors.~~

~~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.~~

Installation couplers are classified according to Table 3.

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**Table 3 – Classes of installation couplers**

Criterion	Possible classes of installation couplers
<b>7.1 Rated impulse voltage</b>	7.1.1 2,5 kV
	7.1.2 4 kV
<b>7.2 Method of connecting the cable</b>	7.2.1 Rewirable
	7.2.2 Non-rewirable
<b>7.3 Degree of protection against ingress of solid foreign objects and ingress of water according to IEC 60529 (IP-Code)</b>	
<b>7.4 Location where installation couplers will be installed</b>	7.4.1 Readily accessible <sup>a</sup>
	7.4.2 Non-readily accessible
<b>7.5 Existence of an earthing contact</b>	7.5.1 With earthing contact
	7.5.2 Without earthing contact
<b>7.6 Type of conductors to be connected</b>	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
<b>7.7 Type of terminals for rewirable installation couplers only</b>	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
<b>7.8 Application</b>	7.8.1 AC
	7.8.2 DC
<sup>a</sup> 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, trade mark 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 mm<sup>2</sup>;
- g) connected conductor size in mm<sup>2</sup> 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<sup>2</sup> 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)

## 8.3 Markings

Markings on the installation coupler 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. Earthing terminals ~~in rewirable installation couplers~~ 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/cm<sup>3</sup>.

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 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 (refer to 12.10).

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.

*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", "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 °C ± 2 °C, all parts 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), ~~and~~ 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 National rules can have requirements concerning installation couplers with metal conduits.

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.

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 mm<sup>2</sup> for installation couplers marked 10 A according to the maximum current rating;
- 1,5 mm<sup>2</sup> for installation couplers marked 16 A according to the maximum current rating;
- 2,5 mm<sup>2</sup> for installation couplers marked 20 A according to the maximum current rating;
- 4 mm<sup>2</sup> for installation couplers marked 25 A according to the maximum current rating;
- 4 6 mm<sup>2</sup> 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

Installation couplers shall be so constructed that when inserting the installation male connector, the earth connection, 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 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 ~~may~~ 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  $(70 \pm 2)$  °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 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 ~~worst~~ 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, 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 to touch 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.

NOTE 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 ~~any~~ 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 ~~render~~ disengage the retaining means ~~of retention ineffective~~ by a deliberate or intentional act. For installation couplers classified in accordance with 7.4.1 ~~intended for installation in a readily accessible location the means of disengagement shall only be made by the use of a key or tool~~ 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 ~~they~~ 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 ~~must~~ 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 original 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 ~~solid~~ 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 ~~solid~~ 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 IEC 60529. 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  $\pm 1$  °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 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 1 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.*

**NOTE 2** 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.

**NOTE 3** Care should be taken so that the RMS value of the test voltage applied is measured within  $\pm 3\%$ .

NOTE 42 Glow discharges without a drop in voltage are neglected.

NOTE 53 An appropriate impulse test is under consideration.

## 15 Construction of contacts

### 15.1 Resiliency

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

*Compliance is checked by the tests according to Clauses 16 to 18.*

### 15.2 Resistance of connections

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

The contact resistance across the installation coupler is measured and it shall not exceed 1 mΩ 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 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. 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. 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 <sup>2</sup>	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	4,0 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 ~~a minimum~~ 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.

*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 8.64.

*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**

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.*

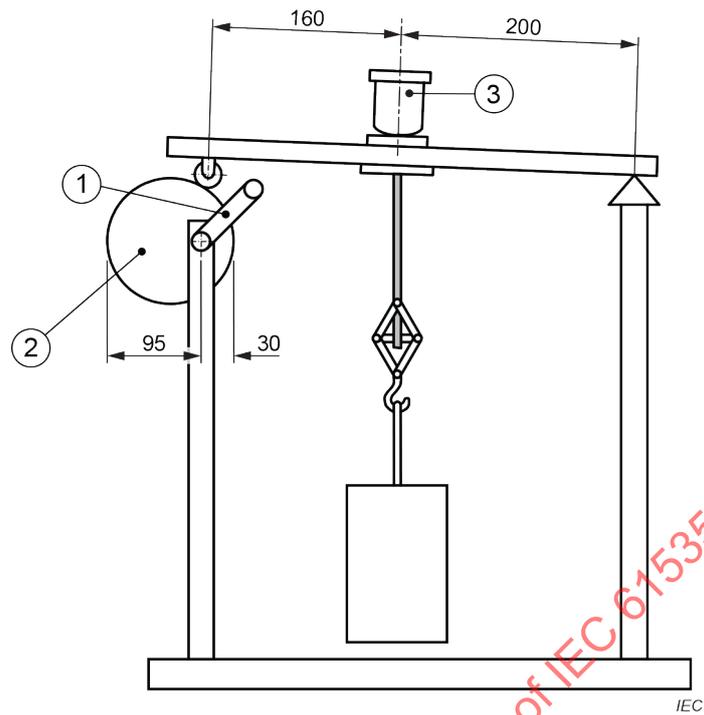
*After the test, the displacement of the mark on the cable in relation to the installation coupler or the cable anchorage is measured while the cable is no longer subjected to the pull force.*

*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.*

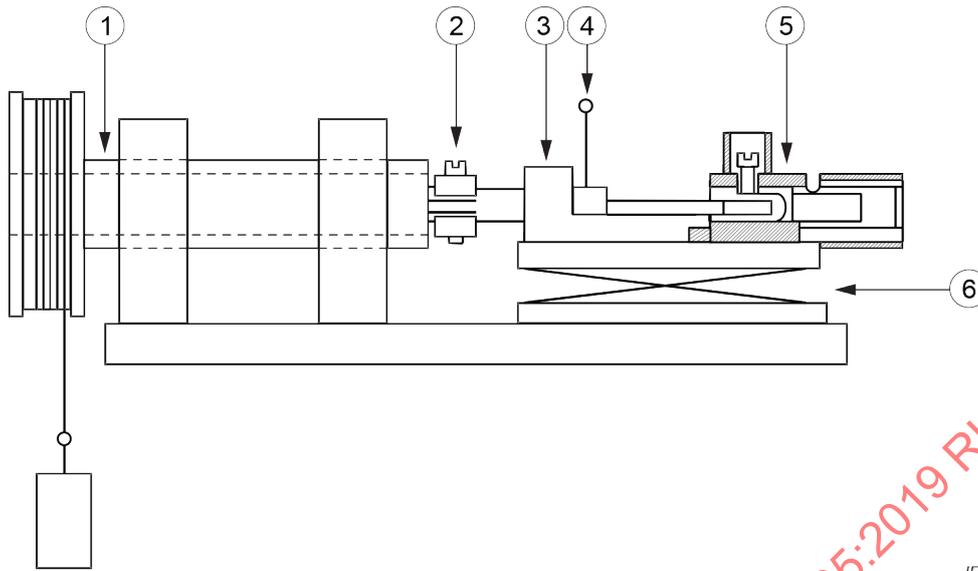
Dimensions in millimetres

**Key**

- 1 Crank
- 2 Eccentric
- 3 Sample

**Figure 1 – Apparatus for testing the cable anchorage**

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**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.*

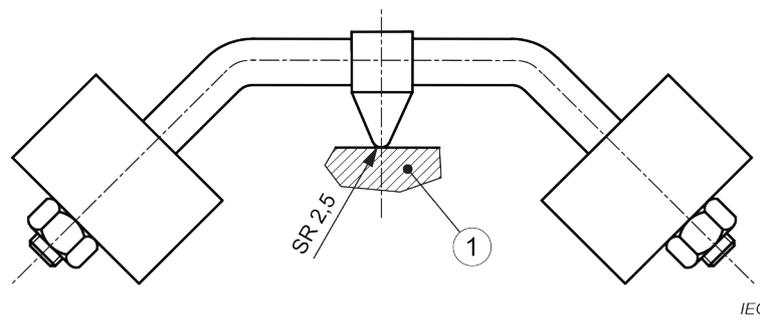
*A current-carrying part or a part of the earthing circuit retained by a mechanical means is considered to be retained in position. The use of grease or the like is not considered to be mechanical means.*

*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 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.*

Dimensions in millimetres



Key	
1	Sample
2	Spherical R = 2,5 mm

**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 °C ± 2 °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 earth 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 maximum current rating~~ 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.

**NOTE 1** 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 2 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 may can provide satisfactory locking.

NOTE 2 For rivets, a non-circular shank or an appropriate notch may 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 Tables 7 to 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 <sup>c</sup> 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 <sup>a</sup>	3,0	3,0	----		
– inaccessible external screws or the like <sup>b</sup>	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 <sup>b</sup>	1,0	1,0	----		
<sup>a</sup> The accessible external surface includes a metal foil in contact with the external surfaces of insulating material. <sup>b</sup> Inaccessible external screws are those which cannot be touched with the test probe B of IEC 61032:1997. <sup>c</sup> Values for creepage distances are adapted to clearances because creepage distances cannot be smaller than the corresponding clearances.					

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**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 <sup>c</sup> 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 <sup>a</sup>	5,5	5,5	5,5	5,5	6,4	----			----			
– inaccessible external screws or the like <sup>b</sup>	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 <sup>b</sup>	1,5	1,5	1,5	1,5	1,5	----			----			
<sup>a</sup> The accessible external surface includes a metal foil in contact with the external surfaces of insulating material. <sup>b</sup> Inaccessible external screws are those which cannot be touched with the test probe B of IEC 61032:1997. <sup>c</sup> Values for creepage distances are adapted to clearances because creepage distances cannot be smaller than the corresponding clearances.												

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**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 <sup>c</sup> 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 <sup>a</sup>	0,5		1,2	1,7	2,4	-	-	-
– inaccessible external screws or the like <sup>b</sup>	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 <sup>b</sup>	0,2		0,6	0,85	1,2	-	-	-
NOTE The values of the creepage distances in Table 9 are also applicable for a rated impulse voltage of 1,5 kV.								
<sup>a</sup> The accessible external surface includes a metal foil in contact with the external surfaces of insulating material.								
<sup>b</sup> Inaccessible external screws are those which cannot be touched with the test probe B of IEC 61032:1997.								
<sup>c</sup> Values for creepage distances are adapted to clearances because creepage distances cannot be smaller than the corresponding clearances.								

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**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 <sup>c</sup> 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 <sup>a</sup>	3,0	3,0	3,0	3,6	5,0
– inaccessible external screws or the like <sup>b</sup>	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 <sup>b</sup>	1,0	1,0	1,0	1,0	1,0
<sup>a</sup> The accessible external surface includes a metal foil in contact with the external surfaces of insulating material. <sup>b</sup> Inaccessible external screws are those which cannot be touched with the test probe B of IEC 61032:1997. <sup>c</sup> Values for creepage distances are adapted to clearances because creepage distances cannot be smaller than the corresponding clearances.					

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**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 <sup>c</sup> 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 <sup>a</sup>	5,5	5,5	5,5	5,6	8,0	5,5	7,2	10,0
– inaccessible external screws or the like <sup>b</sup>	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 <sup>b</sup>	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5
<sup>a</sup> The accessible external surface includes a metal foil in contact with the external surfaces of insulating material. <sup>b</sup> Inaccessible external screws are those which cannot be touched with the test probe B of IEC 61032:1997. <sup>c</sup> 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 ~~them~~ 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 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 disregarded.

NOTE 2 The glow-wire test is applied to ensure that an electrically heated test wire under defined test conditions does not cause ignition of insulating parts or to ensure that a part made of insulating material, which might 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.*

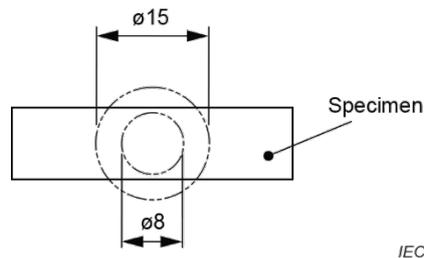
*The tip of the glow-wire shall be applied to the specified surface of the test specimen taking into account the conditions of the intended use under which a hot part may come into contact with the specimen.*

*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.*

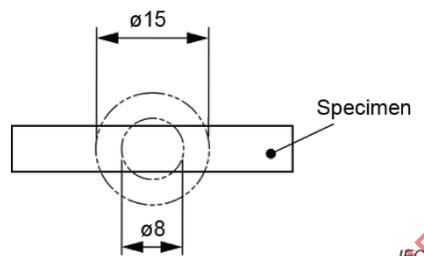
*There shall be no ignition of the tissue paper or scorching of the board.*

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 ≥ 400 V (material group II) or PTI ≥ 600 V (material group I), the reduced creepage distances of Tables 7, 8, 9, 10 and 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. 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 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 °C ± 5 °C.*

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

*After the parts have been dried for 10 min in a heating cabinet at a temperature of  $100\text{ °C} \pm 5\text{ °C}$  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 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 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 ~~may~~ can be reduced or other type of voltages ~~may~~ 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.

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**Annex B**  
(normative)

**Test circuits for temperature rise test ~~(see Clause 16)~~**

For test circuits for temperature rise according to Clause 16, see Figure B.1 to Figure B.6.

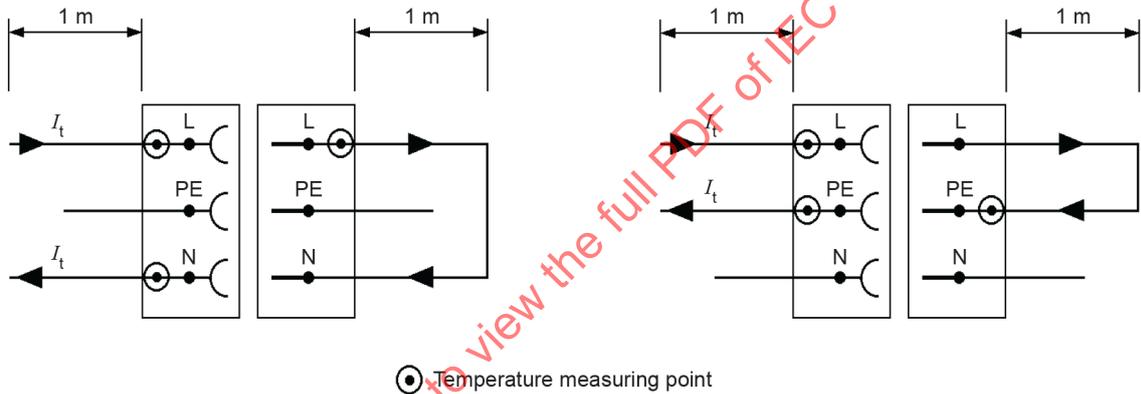
All non-rewirable installation couplers shall be subjected to the following test. This test does not apply to distribution blocks for which incorrect wiring is reliably prevented by design.

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.

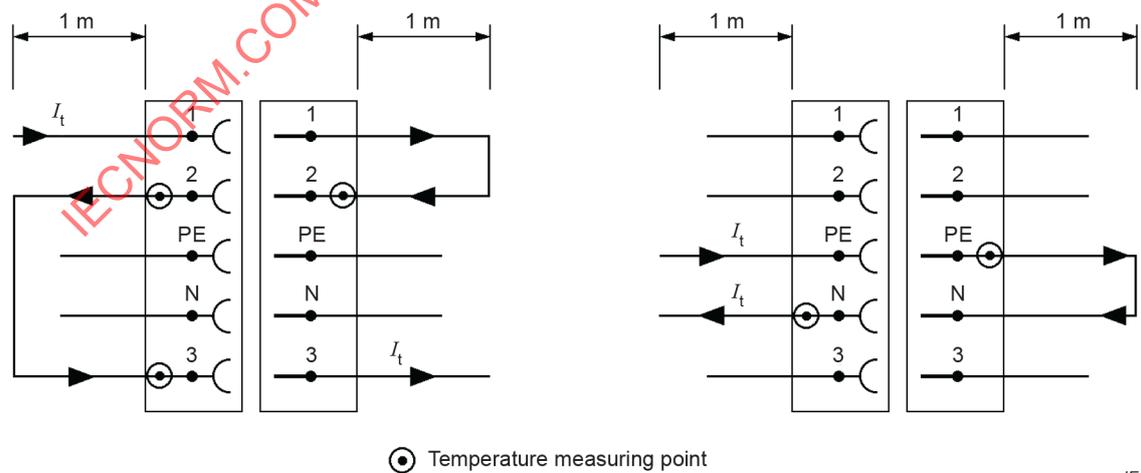
NOTE 1 The period of 2 s can be reduced or other type of voltages can be used if correct results can be guaranteed with automatic timing.

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)**

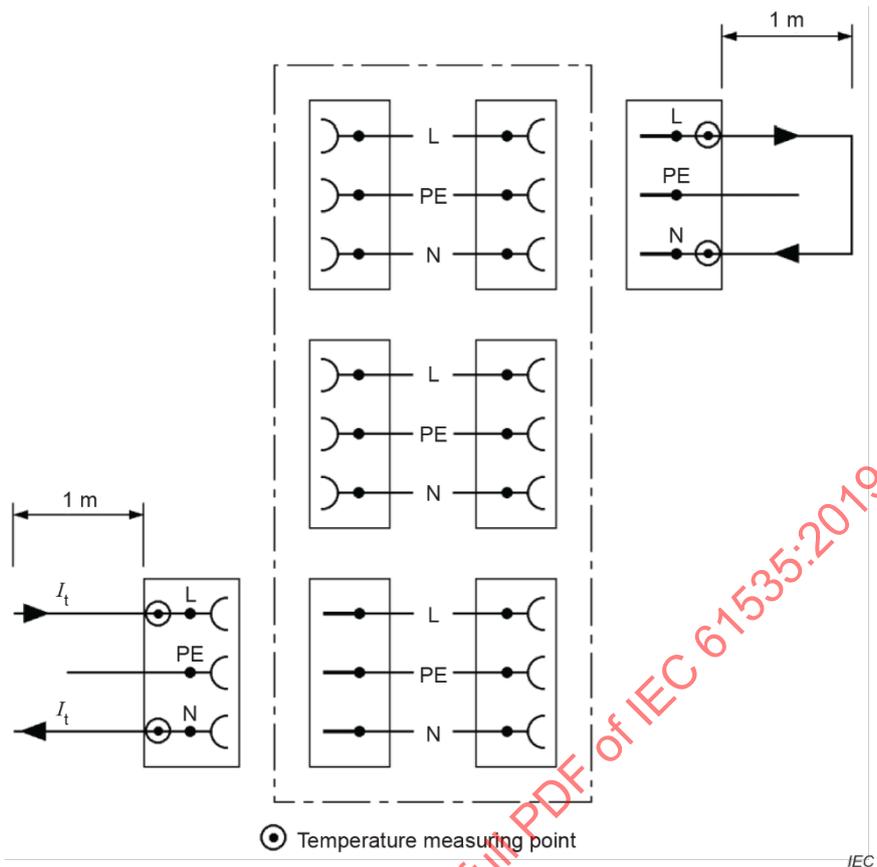


Figure B.3 – 1P + N + PE distribution block, phase and N loaded

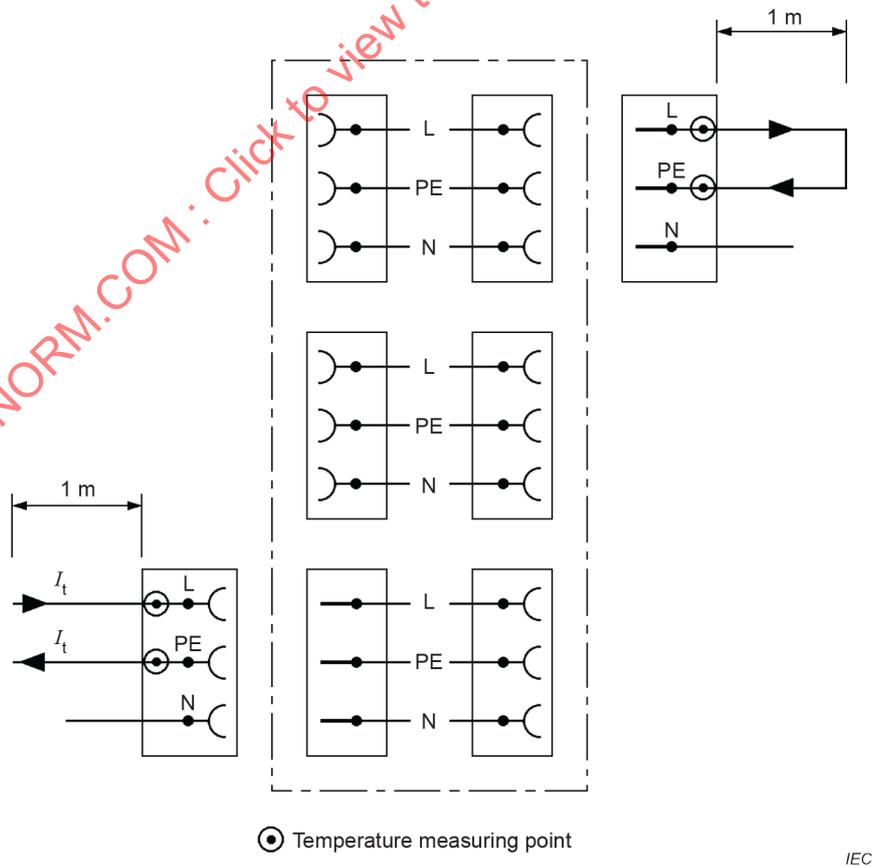
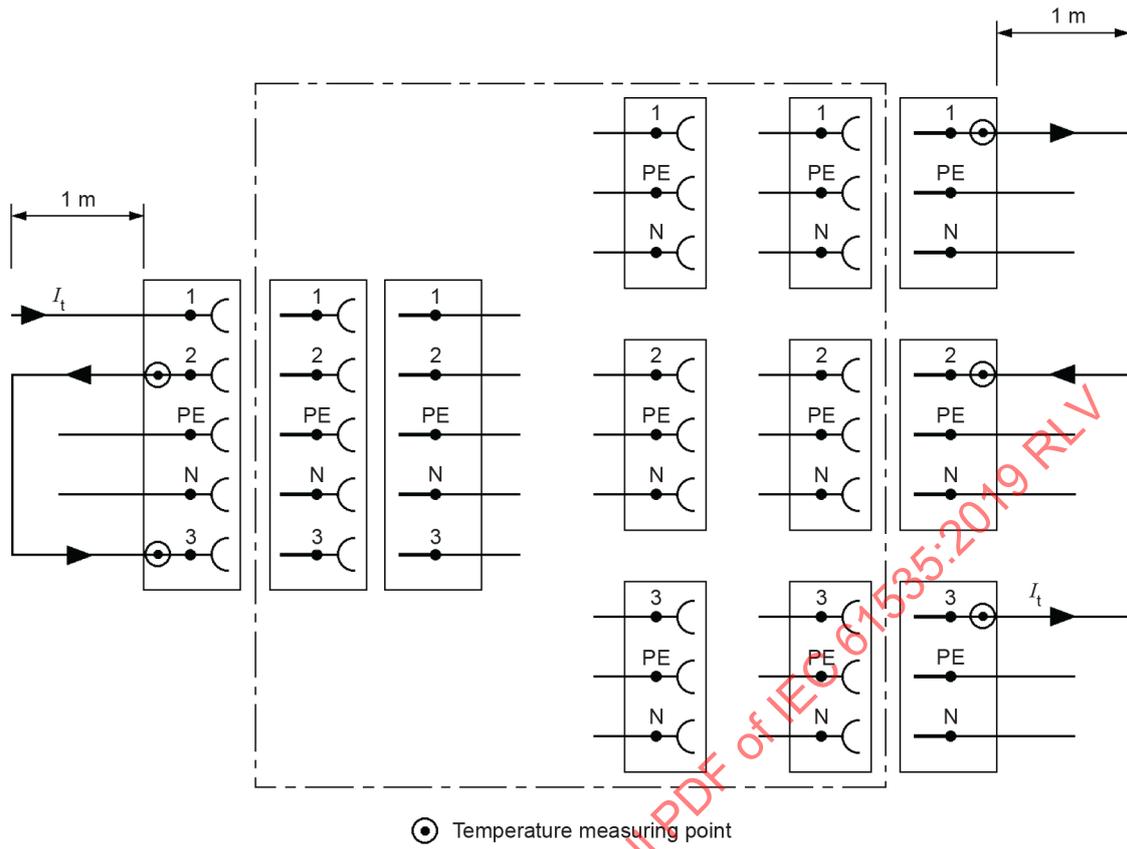
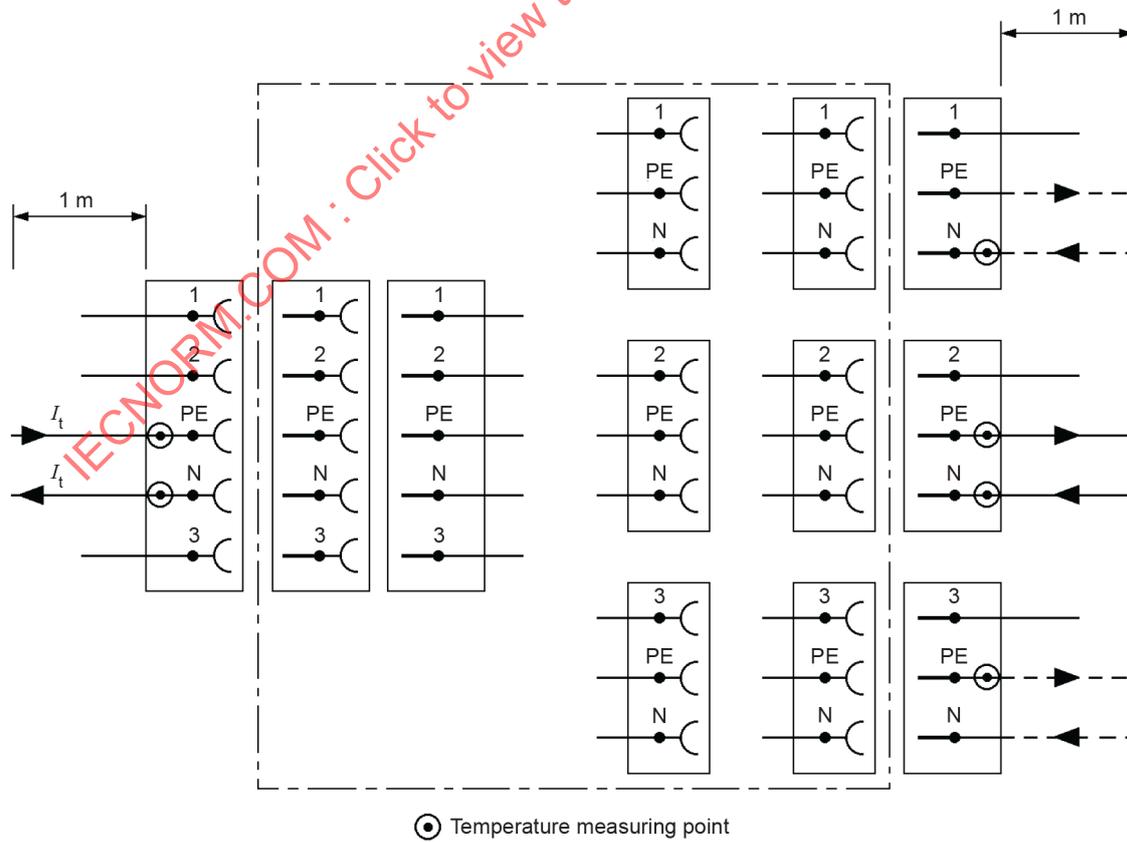


Figure B.4 – 1P + N + PE distribution block, phase and PE loaded



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



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Figure B.6 – 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

Subclause	Title	Set number	Number of samples
8	Marking and documentation	No. 1	3
9	Dangerous compatibility	x	
10	Protection against electric shock	x	
11	Terminals and terminations	x	
12	Construction	x	
19	Cables and their connection	x	
23	Clearances, creepage distances and distances through solid insulation	x	
12.3	Mechanical strength of contacts	No. 2	3
13.2	Protection against harmful ingress of water	No. 3	3
13.1	Protection against harmful ingress of foreign solid objects	x	
14	Insulation resistance and electric strength	No. 4	3
15	Construction of contacts	x	
16	Temperature rise	x	
17	Breaking capacity (separate test set)	No. 5	3
18	Forces necessary to disengage the parts of the IC <sup>a</sup>	No. 6	3
21.4	Resistance to ageing	x	
20	Mechanical strength	No. 7	3
22	Screws, current-carrying parts and connections	x	
21.5	Current cycling ageing test	No. 8	3 (6) <sup>b</sup>
24.1	Resistance to abnormal heat (Glow wire test)	No. 9	3
24.2	Resistance to tracking	(Separate test probe) <sup>b</sup>	
21.3	Resistance to heat (Ball pressure test)	(Separate test probe) <sup>c</sup>	
21.2	Static heating test	x	
25	Resistance against corrosion	x	
<sup>a</sup> IC = Installation coupler <sup>b</sup> One additional set of 3 samples may be necessary for testing with conductors of the smallest and largest cross section. See Subclause 9.8 of IEC 60999-1.			

~~<sup>c</sup>—An additional set of 3 samples is necessary, if applicable, or separate test probes, produced by a similar molding process and tool, shall be used.~~

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 <sup>c</sup>	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	No. 8	3 (6) <sup>a</sup>
21.5	Current cycling test		
24.1	Resistance to abnormal heat		
21.2	Dry heat storage	No. 9	3
25	Resistance to rusting		
24.2	Resistance to tracking	(Separate test specimen) <sup>b</sup>	
21.3	Resistance to heat (ball pressure test)	(Separate test specimen) <sup>b</sup>	

<sup>a</sup> 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.

<sup>b</sup> An additional set of 3 samples is necessary, if applicable, or separate test probes, produced by a similar molding process and tool, shall be used.

<sup>c</sup> 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. 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.

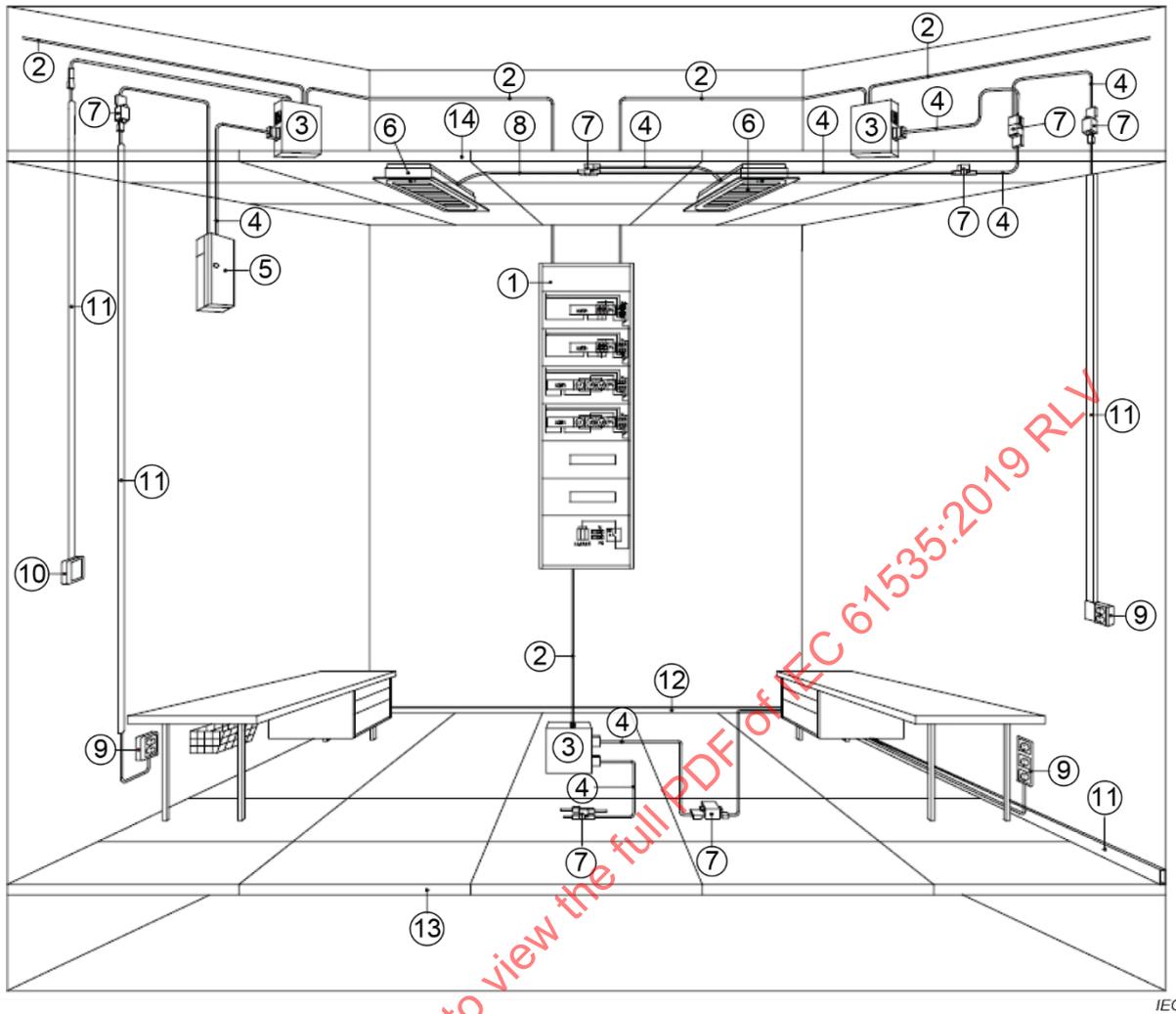
Installation couplers can be a part or a component of equipment; not just a method of connecting cables. Separate luminaires are a typical group of electrical equipment which can be easily linked to a comprehensive lighting system by using installation couplers. Machinery commonly consists of different 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 Use of installation couplers**

Use and the initial verification of installation couplers should 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.



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**Key**

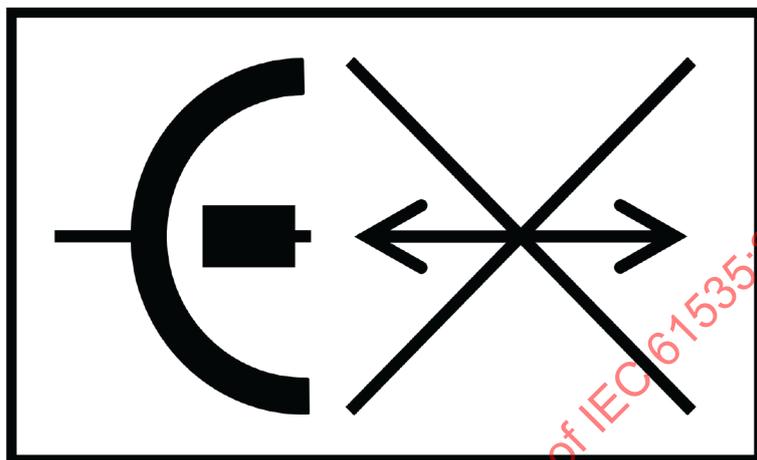
- 1 Distribution board
- 2 Mains cables (fixed installation)
- 3 Junction box
- 4 Factory wired cable set
- 5 Small distribution board
- 6 Lighting fixture
- 7 Distribution block
- 8 Factory wired cable set
- 9 Socket-outlet for office desk
- 10 Switch
- 11 Pillar
- 12 Trunking/ducting
- 13 Suspended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

**Figure D.1 – Examples of use of installation couplers**

## 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"

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IEC 60309 (all parts), *Plugs, socket-outlets and couplers for industrial purposes*

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IEC 60364-7-713, *Low-voltage electrical installations ~~of buildings~~ – Part 7-713: Requirements for special installations ~~and~~ or locations – Furniture*

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IEC 60906 (all parts), *IEC system of plugs and socket-outlets for household and similar purposes*

IEC 61995 (all parts), *Devices for the connection of luminaires for household and similar purposes*

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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**

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

This second edition cancels and replaces the first edition published in 2009 and Amendment 1:2012. This edition constitutes a technical revision.

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

- a) enlargement of the scope to DC application;
- b) addition of further requirements as regards DC application (marking, etc.), no additional test procedures were deemed necessary; however some modifications were necessary in the normative text;
- c) changes and enhancement of the field of application of installation couplers into outdoor applications;
- d) addition of a suitable temperature range;

- e) updating of the list of normative references, modified to undated references, where possible.

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

CDV	Report on voting
23/792/CDV	23/848/RVC

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

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.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://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.

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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 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, if provided, with a rated voltage up to and including 500 V AC or DC and a rated connecting capacity up to and including 10 mm<sup>2</sup> 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 only intended for infrequent use.

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 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.

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.

### 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, *Insulation coordination for equipment within low-voltage 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 mm<sup>2</sup> up to 35 mm<sup>2</sup> (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 terminological databases for use in standardization at the following addresses:

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

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 is in this case of 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 12.14.

### 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**

accessibility 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]

## **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.*

NOTE In the USA, these installation couplers are not permitted to be used where they will not be visible after installation.

## **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 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 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, which may have influenced the result of that test, are repeated on another set of specimens of the same set number as specified in 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 one specimen fail. 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	Rated voltage	Rated impulse voltage
V	V	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	Rated voltage	Rated impulse voltage
V	V	kV
12	12	to be defined
60	60	to be defined
120 <sup>a</sup> to 240 <sup>b</sup>	125/250	2,5
220 <sup>a</sup> to 440 <sup>b</sup>	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 be considered when defining the rating for impulse voltage.

<sup>a</sup> Voltage live conductor against reference conductor / earth.

<sup>b</sup> 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 mm<sup>2</sup>
- 2,5 mm<sup>2</sup>
- 4 mm<sup>2</sup>
- 6 mm<sup>2</sup>
- 10 mm<sup>2</sup>.

## 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 of installation couplers**

Criterion	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
7.3 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 <sup>a</sup>
	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
<sup>a</sup> 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:

- rated current in amperes (A);
- rated voltage in volts (V);
- manufacturer's or responsible vendor's name, trade mark or identification mark;
- 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 mm<sup>2</sup>;
- g) connected conductor size in mm<sup>2</sup> 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 <sup>2</sup> 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)

## 8.3 Markings

Markings on the installation coupler 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. Earthing 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/cm<sup>3</sup>.

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 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 (refer to 12.10).

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.

*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", "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 °C ± 2 °C, all parts 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 National rules can have requirements concerning installation couplers with metal conduits.

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.

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 mm<sup>2</sup> for installation couplers marked 10 A according to the maximum current rating;
- 1,5 mm<sup>2</sup> for installation couplers marked 16 A according to the maximum current rating;
- 2,5 mm<sup>2</sup> for installation couplers marked 20 A according to the maximum current rating;
- 4 mm<sup>2</sup> for installation couplers marked 25 A according to the maximum current rating;
- 6 mm<sup>2</sup> 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

Installation couplers shall be so constructed that when inserting the installation male connector, the earth connection, 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 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  $(70 \pm 2)$  °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 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, 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 to touch 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 original 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 IEC 60529. 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  $\pm 1$  °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 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 M $\Omega$ .*

#### **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 1 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  $\pm 3\%$ .

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 resiliency to ensure adequate contact pressure on installation male connector pins.

*Compliance is checked by the tests according to Clauses 16 to 18.*

### 15.2 Resistance of connections

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

The contact resistance across the installation coupler is measured and it shall not exceed 1 m $\Omega$  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 m $\Omega$ .*

### 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 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. 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. 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 <sup>2</sup>	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.

*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

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.*

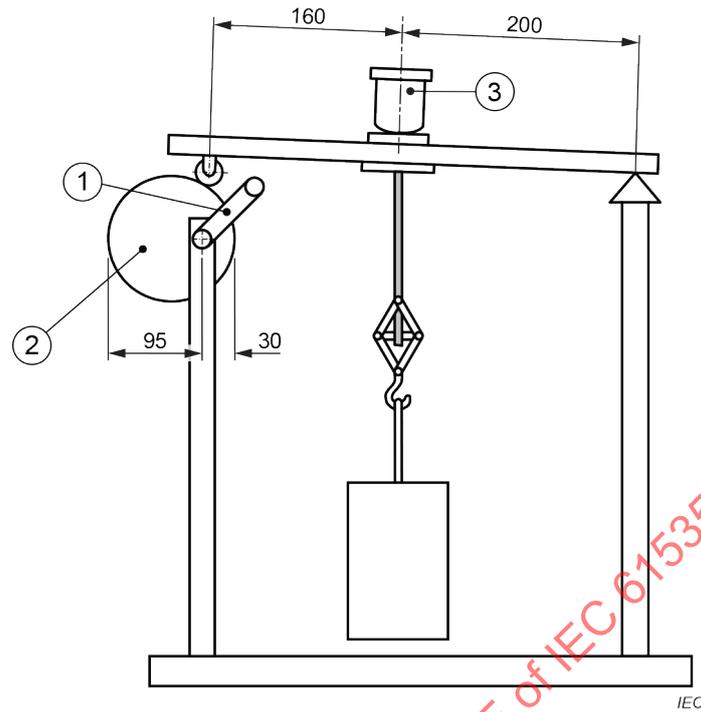
*After the test, the displacement of the mark on the cable in relation to the installation coupler or the cable anchorage is measured while the cable is no longer subjected to the pull force.*

*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

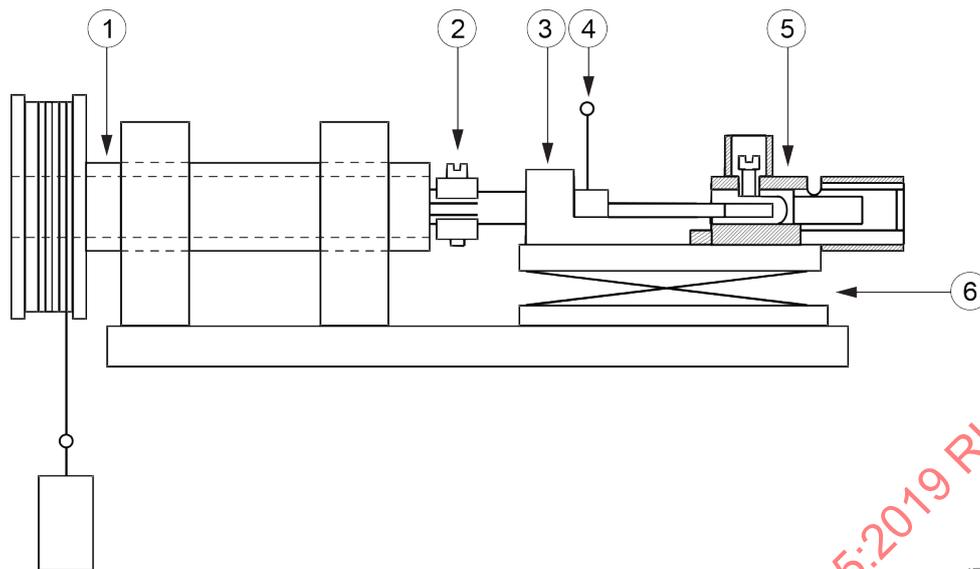


**Key**

- 1 Crank
- 2 Eccentric
- 3 Sample

**Figure 1 – Apparatus for testing the cable anchorage**

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**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:*

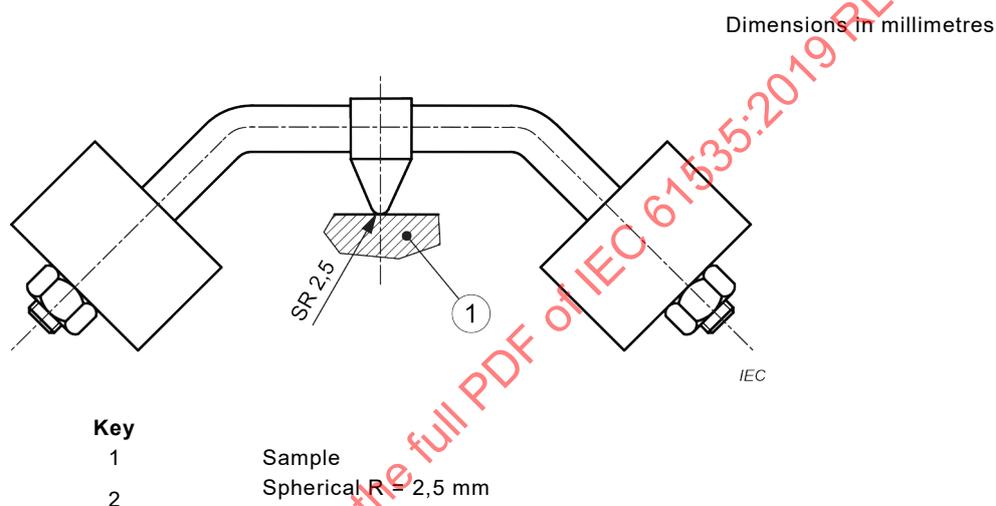
- $125\text{ °C} \pm 2\text{ °C}$  for those parts of installation couplers which retain current-carrying parts and parts of the earthing circuit in position;*
- $70\text{ °C} \pm 2\text{ °C}$  for other parts of installation couplers.*

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 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.



**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 earth 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 Tables 7 to 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 <sup>c</sup> mm			
		Rated insulation voltage			
		All material groups ≤ 125 V AC	Material group		
			I	II	III
Between:					
Live parts of different polarity	1,5	1,5	1,5	1,8	2,5
Live parts and					
– accessible external surface <sup>a</sup>	3,0	3,0	----		
– inaccessible external screws or the like <sup>b</sup>	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 <sup>b</sup>	1,0	1,0	----		
<sup>a</sup> The accessible external surface includes a metal foil in contact with the external surfaces of insulating material. <sup>b</sup> Inaccessible external screws are those which cannot be touched with the test probe B of IEC 61032:1997. <sup>c</sup> 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 <sup>c</sup> 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 <sup>a</sup>	5,5	5,5	5,5	5,5	6,4	---			---		
– inaccessible external screws or the like <sup>b</sup>	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 <sup>b</sup>	1,5	1,5	1,5	1,5	1,5	---			---		
<sup>a</sup> The accessible external surface includes a metal foil in contact with the external surfaces of insulating material. <sup>b</sup> Inaccessible external screws are those which cannot be touched with the test probe B of IEC 61032:1997. <sup>c</sup> 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 <sup>c</sup> 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 <sup>a</sup>	0,5		1,2	1,7	2,4	-	-	-			
– inaccessible external screws or the like <sup>b</sup>	0,2		0,60	0,85	1,2	-	-	-			

	Clearance mm	Creepage distances <sup>c</sup> mm					
		Rated insulation voltage					
		Material group			Material group		
		I	II	III	I	II	III
≤ 50 V DC			≤ 63 V DC				
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 <sup>b</sup>	0,2	0,6	0,85	1,2			
NOTE The values of the creepage distances in Table 9 are also applicable for a rated impulse voltage of 1,5 kV.							
<sup>a</sup> The accessible external surface includes a metal foil in contact with the external surfaces of insulating material.							
<sup>b</sup> Inaccessible external screws are those which cannot be touched with the test probe B of IEC 61032:1997.							
<sup>c</sup> 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 <sup>c</sup> 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 <sup>a</sup>	3,0	3,0	3,0	3,6	5,0
– inaccessible external screws or the like <sup>b</sup>	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 <sup>b</sup>	1,0	1,0	1,0	1,0	1,0
<sup>a</sup> The accessible external surface includes a metal foil in contact with the external surfaces of insulating material.					
<sup>b</sup> Inaccessible external screws are those which cannot be touched with the test probe B of IEC 61032:1997.					
<sup>c</sup> 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 <sup>c</sup> 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 <sup>a</sup>	5,5	5,5	5,5	5,6	8,0	5,5	7,2	10,0
– inaccessible external screws or the like <sup>b</sup>	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 <sup>b</sup>	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5
<sup>a</sup> The accessible external surface includes a metal foil in contact with the external surfaces of insulating material. <sup>b</sup> Inaccessible external screws are those which cannot be touched with the test probe B of IEC 61032:1997. <sup>c</sup> 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 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 disregarded.

NOTE 2 The glow-wire test is applied to ensure that an electrically heated test wire under defined test conditions does not cause ignition of insulating parts or to ensure that a part 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.*

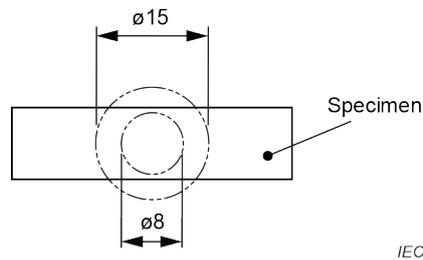
*The tip of the glow-wire shall be applied to the specified surface of the test specimen taking into account the conditions of the intended use under which a hot part may come into contact with the specimen.*

*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.*

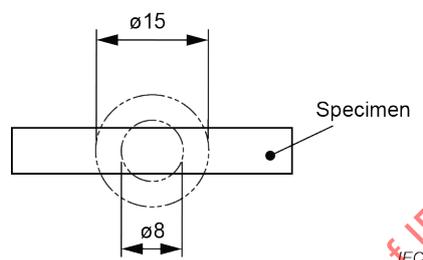
*There shall be no ignition of the tissue paper or scorching of the board.*

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 ≥ 400 V (material group II) or PTI ≥ 600 V (material group I), the reduced creepage distances of Tables 7, 8, 9, 10 and 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. 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 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  $20\text{ °C} \pm 5\text{ °C}$ .*

*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  $20\text{ °C} \pm 5\text{ °C}$ .*

*After the parts have been dried for 10 min in a heating cabinet at a temperature of  $100\text{ °C} \pm 5\text{ °C}$  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 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 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.

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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.6.

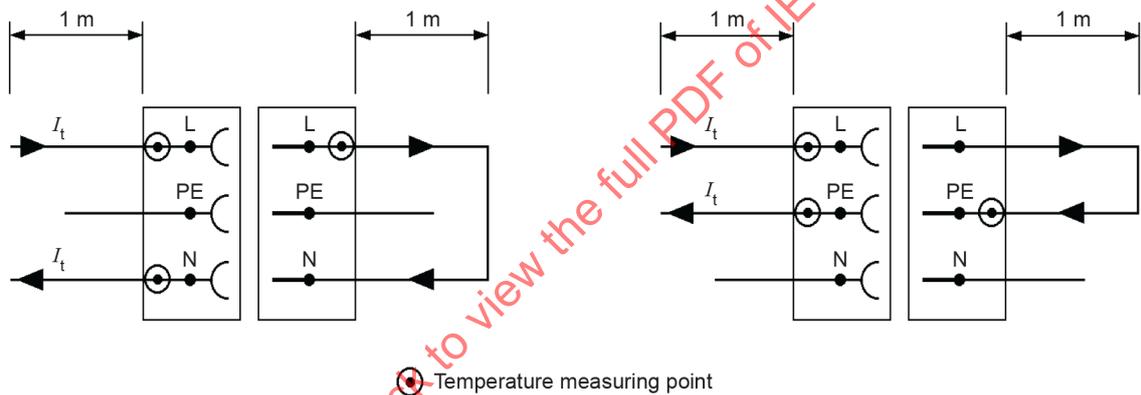
All non-rewirable installation couplers shall be subjected to the following test. This test does not apply to distribution blocks for which incorrect wiring is reliably prevented by design.

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.

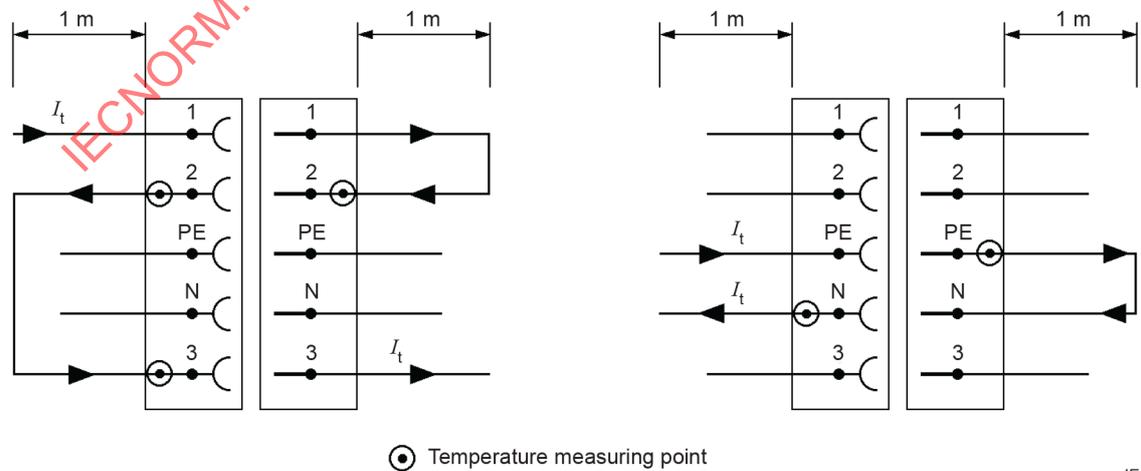
NOTE 1 The period of 2 s can be reduced or other type of voltages can be used if correct results can be guaranteed with automatic timing.

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)**

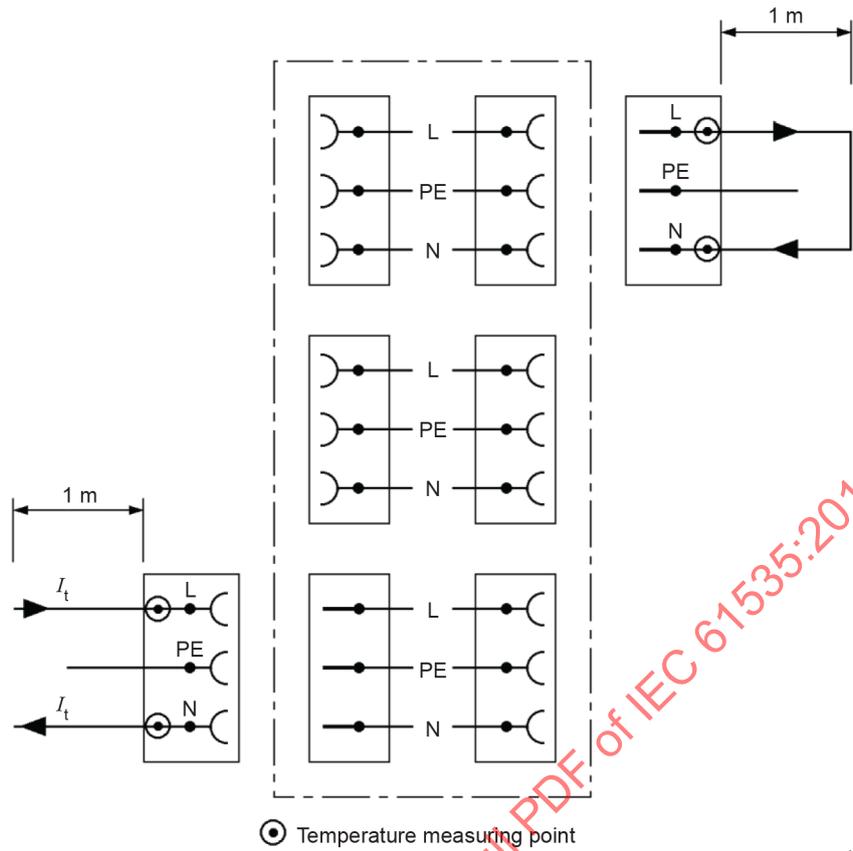


Figure B.3 – 1P + N + PE distribution block, phase and N loaded

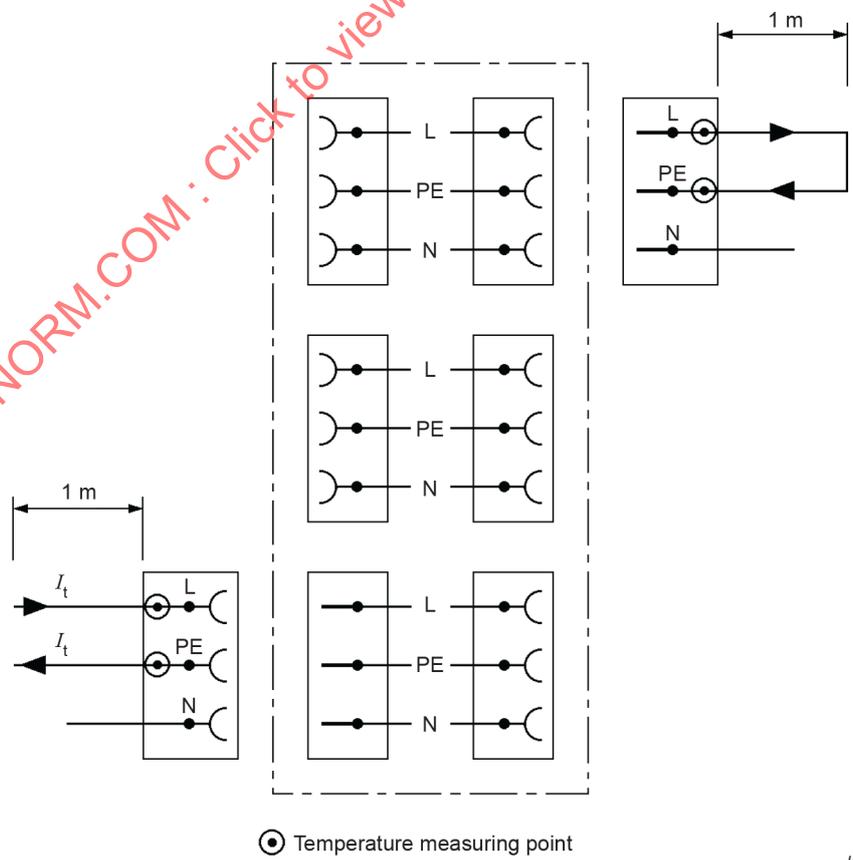
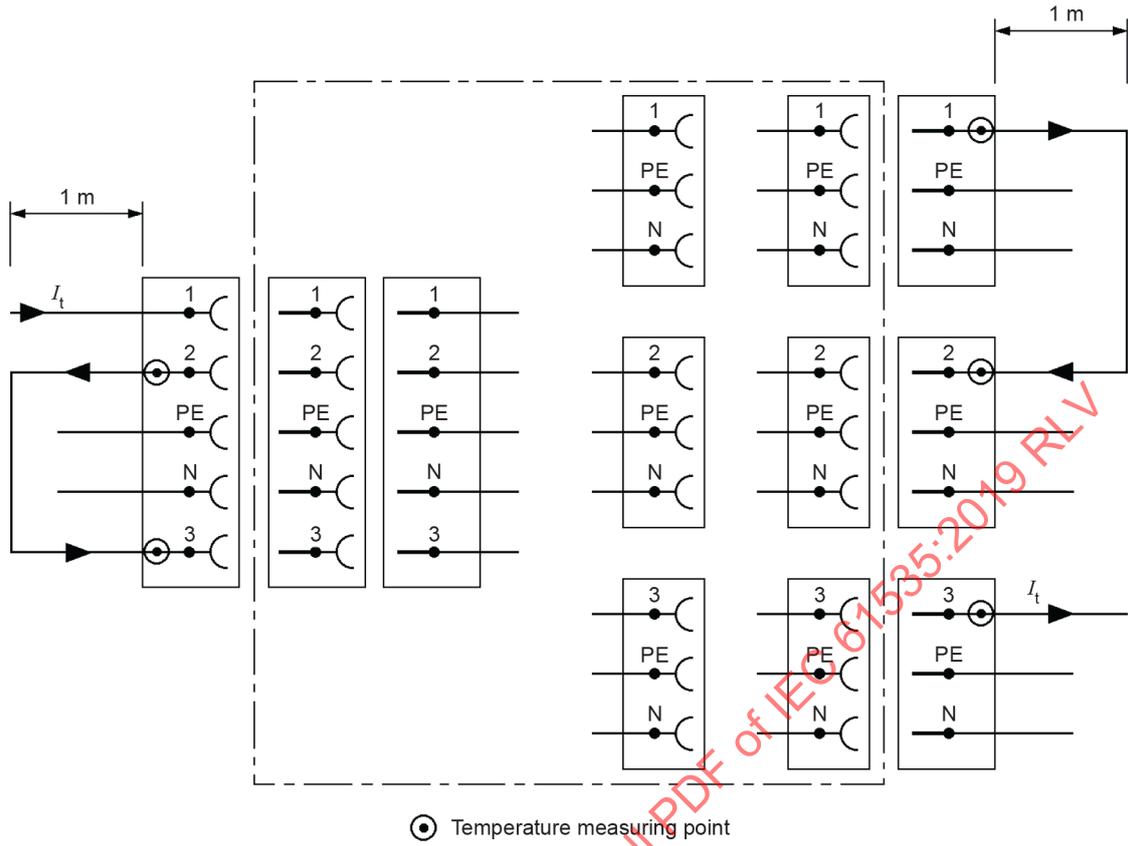
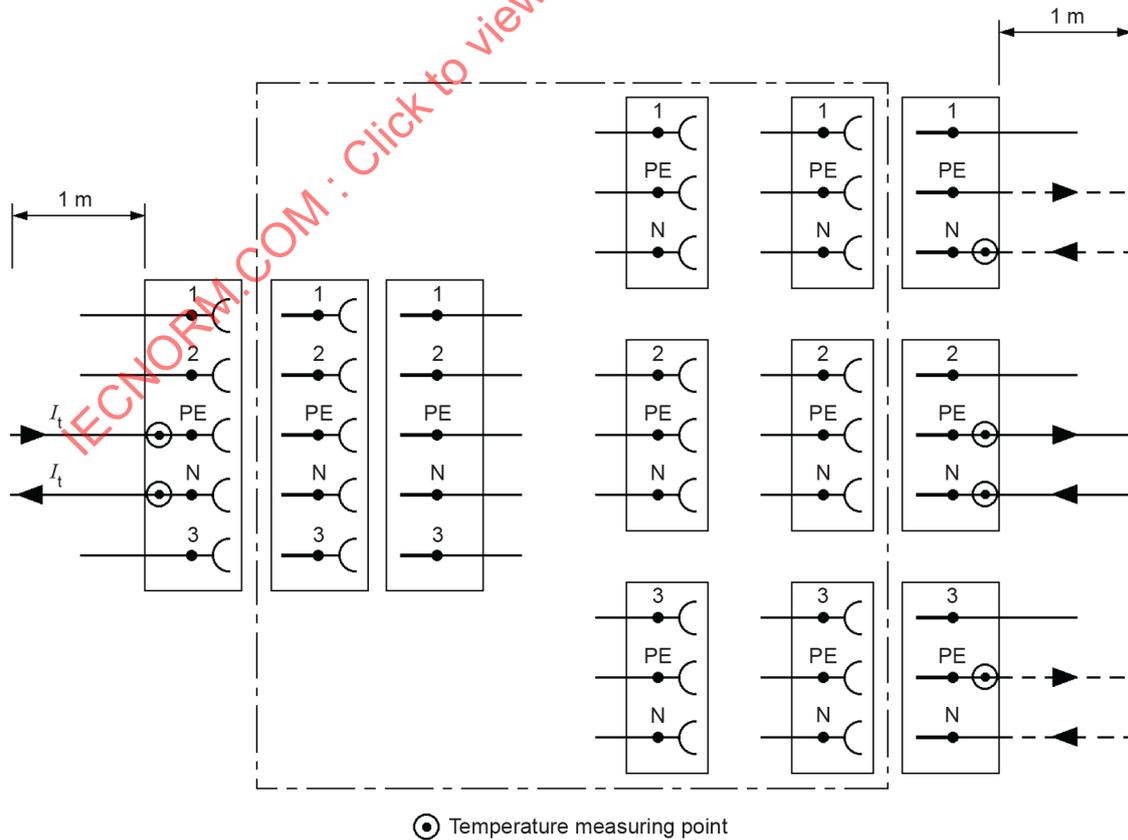


Figure B.4 – 1P + N + PE distribution block, phase and PE loaded



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



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Figure B.6 – 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 <sup>c</sup>	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) <sup>a</sup>
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) <sup>b</sup>	
21.3	Resistance to heat (ball pressure test)	(Separate test specimen) <sup>b</sup>	
<p><sup>a</sup> 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.</p> <p><sup>b</sup> An additional set of 3 samples is necessary, if applicable, or separate test probes, produced by a similar molding process and tool, shall be used.</p> <p><sup>c</sup> Does not apply for DC application.</p>			

## **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. 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.

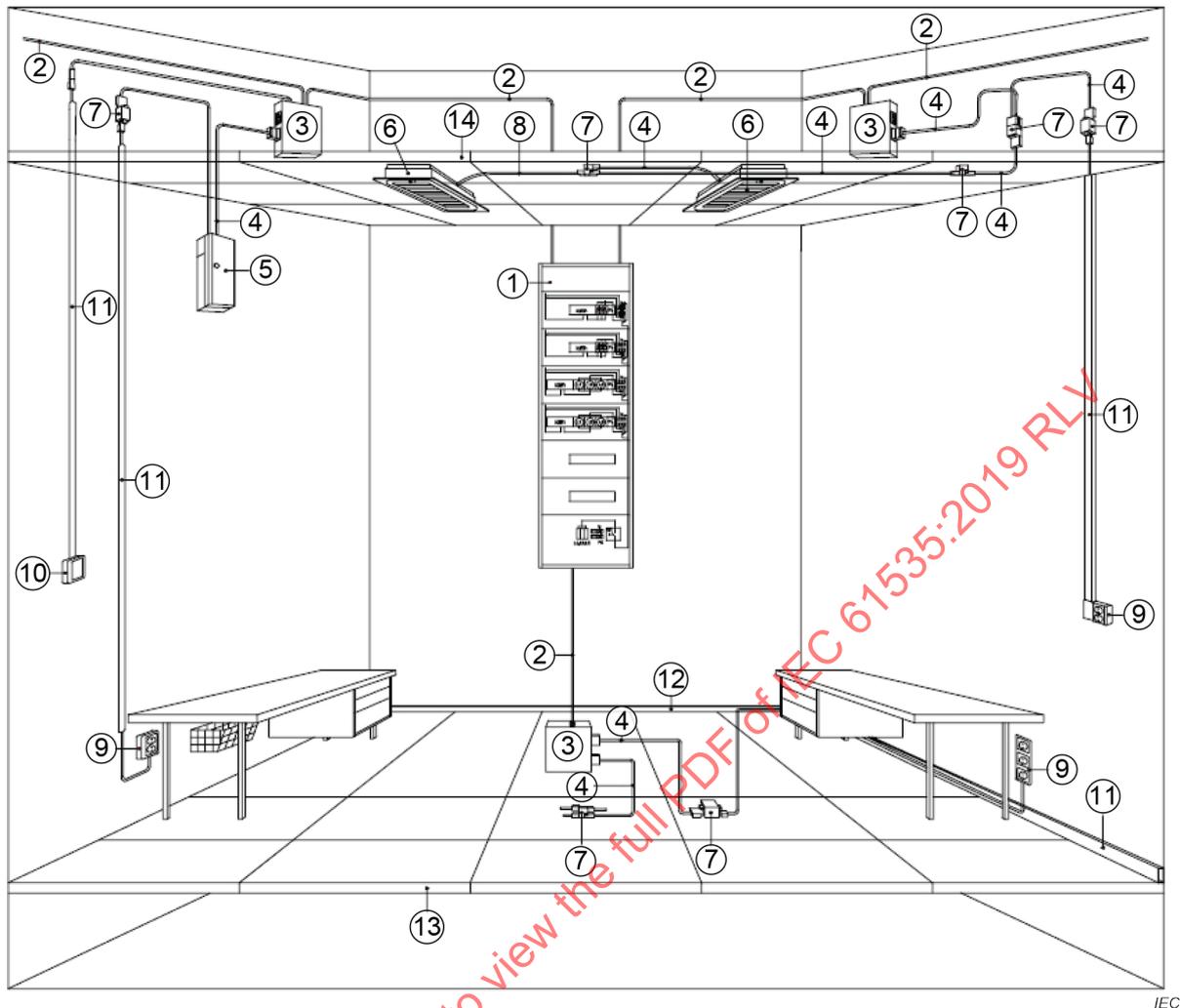
Installation couplers can be a part or a component of equipment; not just a method of connecting cables. Separate luminaires are a typical group of electrical equipment which can be easily linked to a comprehensive lighting system by using installation couplers. Machinery commonly consists of different 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 Use of installation couplers**

Use and the initial verification of installation couplers should 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.



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**Key**

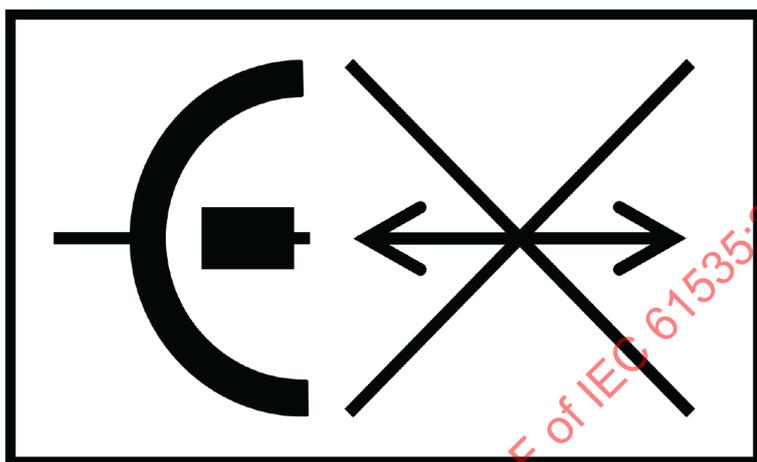
- |    |                                   |
|----|-----------------------------------|
| 1  | Distribution board                |
| 2  | Mains cables (fixed installation) |
| 3  | Junction box                      |
| 4  | Factory wired cable set           |
| 5  | Small distribution board          |
| 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                 |

**Figure D.1 – Examples of use of installation couplers**

**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"

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## COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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### COUPLEURS D'INSTALLATION POUR CONNEXIONS PERMANENTES DANS LES INSTALLATIONS FIXES

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La Norme internationale IEC 61535 a été établie par le comité d'études 23 de l'IEC: Petit appareillage.

Cette deuxième édition annule et remplace la première édition parue en 2009 et l'Amendement 1:2012. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

- a) extension du domaine d'application à l'application en courant continu;
- b) ajout des exigences supplémentaires en matière d'application en courant continu (marquage, etc.), aucune procédure d'essai supplémentaire n'a été jugée nécessaire; toutefois, certaines modifications du texte normatif étaient nécessaires;
- c) modifications et amélioration du champ d'application des coupleurs d'installation aux applications extérieures;

- d) ajout d'une plage de températures appropriée;
- e) mise à jour de la liste des références normatives, modifiée pour inclure des références non datées, lorsque cela était possible.

Le texte de cette Norme internationale est issu des documents suivants:

CDV	Rapport de vote
23/792/CDV	23/848/RVC

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette Norme internationale.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2.

Dans la présente norme, les caractères d'imprimerie suivants sont utilisés:

- exigences: caractères romains;
- *modalités d'essais: caractères italiques;*
- indication de nature informative: petits caractères romains.

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## INTRODUCTION

Les coupleurs d'installation en courant alternatif et en courant continu 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 similaire, ou les systèmes de chemin de câbles, les systèmes d'échelle à câble, les systèmes de conduits-profilés et les systèmes de goutte 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 plus élevées, 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 d'installation nationales peuvent comporter des exigences concernant l'accessibilité des coupleurs d'installation.

Les règles nationales d'installation 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 comportant de deux à cinq conducteurs, y compris le conducteur de terre (le cas échéant), de tension assignée jusqu'à 500 V inclus en courant alternatif ou en courant continu et de capacité de connexion assignée jusqu'à 10 mm<sup>2</sup> inclus, 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 de la canalisation dans laquelle les coupleurs d'installation ont été installés. Cela signifie que les coupleurs d'installation sont prévus uniquement pour un usage non fréquent.

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 ne dépassant normalement pas +40 °C, mais dont la moyenne sur une certaine période ne dépasse pas +35 °C, avec une limite inférieure de température de l'air ambiant 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 à l'étude.

NOTE 2 Pour d'autres températures, les informations nécessaires peuvent être données dans les instructions d'installation du fabricant.

Dans les endroits où des conditions spéciales prédominent, comme dans les navires, les véhicules et 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.

### 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 60664-1:2007, *Coordination de l'isolement des matériels dans les systèmes (réseaux) 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 mm<sup>2</sup> à 35 mm<sup>2</sup> (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 <http://www.electropedia.org/>
- ISO Online browsing platform: disponible à l'adresse <http://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 par le fabricant au coupleur d'installation

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 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 d'une canalisation

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, comprenant un connecteur femelle d'installation et un connecteur mâle d'installation et ne devant ni être branché ou débranché en charge ni être branché ou débranché autrement que lors de la première installation, pendant l'entretien ou pendant la reconfiguration de la canalisation

### 3.6

#### **connecteur mâle d'installation**

partie du coupleur d'installation, du côté de la charge, qui porte les broches

### 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 comprenant 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: "Un fabricant" signifie dans le cas présent un et le même fabricant.

### 3.9

#### **canalisation**

ensemble constitué d'un câble ou de plusieurs 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 – "conducteurs nus ou isolés" a été remplacé par "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 12.14.

### 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 rattachés 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 rattachés 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 empêchant leur débranchement fortuit

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 empêchant l'accessibilité à un connecteur femelle d'installation non utilisé

### **3.17**

#### **essai individuel de série**

essai auquel chaque appareil est soumis pendant et/ou après fabrication afin de s'assurer qu'il remplit certains critères

### **3.18**

#### **essai de type**

essai d'un ou plusieurs appareils fait selon une conception donnée pour prouver qu'elle satisfait à certaines exigences

### **3.19**

#### **volume d'accessibilité au toucher**

zone s'étendant 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]

## **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.*

NOTE Aux Etats-Unis, il n'est pas permis d'utiliser ces coupleurs d'installation lorsqu'ils ne sont pas visibles une fois installés.

## **5 Conditions pour les essais**

### **5.1 Généralités**

Les essais doivent être réalisés pour vérifier la conformité avec les exigences correspondantes du présent document.

Seuls les connecteurs (mâles et femelles) d'un système coupleur d'installation conforme à la spécification d'un et du même fabricant doivent être engagés ensemble pour réaliser l'essai.

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 exigé dans le présent document.

Les essais de 5.2 à 5.6 s'appliquent aux essais de type; les essais de 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 prévu par le domaine d'application et doivent être soumis à essai 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.

Quand 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 la réalisation des essais, et sauf spécification contraire dans le présent document, les coupleurs d'installation non démontables doivent être équipés de câbles d'au moins 1 m de longueur.

## 5.4 Ordre des essais

Sauf spécification contraire dans le présent document, les essais doivent être réalisés dans l'ordre des articles/paragraphes comme spécifié dans le Tableau C.1.

## 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 essai avec leurs contreparties correspondantes conformes au présent document.

Les lots d'échantillons d'essai doivent subir les essais spécifiés dans le Tableau C.1.

## 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 quelconque 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 ses précédents, qui pourraient avoir influencé le résultat de cet essai, sont répétés sur un autre lot d'échantillons du même numéro comme spécifié au Tableau C.1; ils doivent alors tous être conformes aux essais répétés.

NOTE Le demandeur peut soumettre, en même temps que le nombre d'échantillons spécifié, le lot supplémentaire d'échantillons qui peuvent être exigés 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 le rejet.

### 5.7 Essais de routine 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 une tension assignée choisie soit dans le Tableau 1 pour une application en courant alternatif, soit dans le Tableau 2 pour une application en courant continu.

Tous les composants d'un même système coupleur d'installation doivent avoir la même valeur de tension assignée phase-neutre.

**Tableau 1 – Tension assignée des coupleurs d'installation dans une application en courant alternatif**

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 courant continu**

Tension nominale du système d'alimentation V	Tension assignée V	Tension de choc assignée kV
12	12	à définir
60	60	à définir
120 <sup>a</sup> à 240 <sup>b</sup>	125/250	2,5
220 <sup>a</sup> à 440 <sup>b</sup>	250/500	4,0

NOTE Pour les applications en courant continu 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 doit donc être considéré lors de la définition de la valeur assignée pour la tension de choc.

<sup>a</sup> Tension du conducteur actif par rapport à un conducteur de référence/une terre.

<sup>b</sup> Tension du conducteur actif (polarité + / -).

## 6.2 Courant assigné

Il convient que les coupleurs d'installation aient de préférence une valeur de courant assigné choisie parmi l'une des 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 l'une des valeurs suivantes:

- 1,5 mm<sup>2</sup>,
- 2,5 mm<sup>2</sup>,
- 4 mm<sup>2</sup>,
- 6 mm<sup>2</sup>,
- 10 mm<sup>2</sup>.

## 6.4 Essais

La conformité à 6.1, 6.2 et 6.3 est vérifiée par examen du marquage selon l'Article 8.

## 7 Classification

Les coupleurs d'installation sont classés selon le Tableau 3.

**Tableau 3 – Classes de coupleurs d'installation**

Critère	Classes possibles de coupleurs d'installation
<b>7.1 Tension de choc assignée</b>	7.1.1 2,5 kV
	7.1.2 4 kV
<b>7.2 Méthode de connexion du câble</b>	7.2.1 Démontable
	7.2.2 Non démontable
<b>7.3 Degré de protection contre la pénétration de corps solides étrangers et contre la pénétration d'eau selon l'IEC 60529 (code IP)</b>	
<b>7.4 Emplacement où les coupleurs d'installation sont installés</b>	7.4.1 Aisément accessible <sup>a</sup>
	7.4.2 Non aisément accessible
<b>7.5 Existence d'un contact de terre</b>	7.5.1 Avec contact de terre
	7.5.2 Sans contact de terre
<b>7.6 Type de conducteurs à connecter</b>	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

Critère	Classes possibles de coupleurs d'installation
<b>7.7 Type de bornes pour les coupleurs d'installation démontables seulement</b>	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
<b>7.8 Application</b>	7.8.1 Courant alternatif
	7.8.2 Courant continu
<sup>a</sup> Les coupleurs d'installation pour des 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 être marqués avec:

- le courant assigné en ampères (A);
- la tension assignée en volts (V);
- le nom du fabricant ou du vendeur responsable, marque commerciale ou marque d'identification;
- le code IP si supérieur à IP43 comme suit.

Le premier chiffre caractéristique pour le degré de protection contre l'accès aux parties dangereuses et contre les effets dangereux 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 dangereux 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 de connexion assignée pour les coupleurs d'installation démontables en mm<sup>2</sup>;
- la taille du conducteur connecté en mm<sup>2</sup> pour les coupleurs d'installation non démontables;
- DC, lorsqu'ils sont construits pour une utilisation dans les systèmes en courant continu;
- un symbole d'avertissement conforme à l'Annexe E, lorsqu'ils sont construits pour une utilisation dans un système en courant continu. 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 courant continu.

### 8.2 Utilisation de symboles ou de lettres

Lorsqu'il est fait usage de symboles, ils doivent être les suivants:

- capacité assignée de connexion en millimètres carrés      mm<sup>2</sup> ou □
- volts      V
- ampères      A
- courant alternatif      ~ ou AC
- courant continu      = ou DC
- pôle positif (dans les systèmes en courant continu)      +
- pôle négatif (dans les systèmes en courant continu)      -
- neutre      N
- point milieu      M

- terre



ou PE

(IEC 60617-S00200:2001-07)

### 8.3 Marquage

Le marquage du coupleur d'installation selon les points de 8.1 doit être aisément visible avant installation.

Le marquage des bornes pour une application en courant alternatif doit être L1, L2, L3 ou 1, 2, 3 ou équivalent. Les bornes de neutre doivent être marquées par N. Le marquage des bornes pour une application en courant continu doit être L+, L-, +, - ou équivalent. Les bornes de point milieu doivent être marquées par M. Les bornes de mise à la terre doivent porter le marquage approprié. Ces marques ne doivent pas être placées 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 être indiqué sur le plus petit emballage ou dans l'information technique 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.*

NOTE L'essence minérale est définie comme étant un solvant aliphatique hexane avec une teneur maximale en carburants aromatiques de 0,1 % en volume, une teneur en kauributanol de 29, une température initiale d'ébullition d'environ 65 °C, une température finale d'ébullition d'environ 69 °C et une masse volumique d'environ 0,68 g/cm<sup>3</sup>.

Les marquages faits par impression, moulage, pressage ou gravure, etc. ne sont pas soumis à cet essai.

Une étiquette d'avertissement pour une utilisation en courant continu "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 une zone aisément accessible;
- d) si des éléments supplémentaires ou si des précautions particulières sont nécessaires pour une utilisation dans des zones aisément accessibles;
- e) un marquage approprié indiquant 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 indiquant 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) information que les systèmes coupleurs d'installation ne constituent pas un remplacement du système national de fiches et prises de courant domestiques;
- i) si un repiquage est prévu, des instructions de câblage doivent être précisées dans la documentation technique du fabricant;
- j) pour une utilisation en courant continu, 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 le courant continu doivent être fournies dans les instructions d'installation;
- k) information que les coupleurs d'installation doivent être utilisés avec les dispositifs de retenue tels que fournis par les fabricants (en référence au 12.10).

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 courant alternatif et courant continu.

NOTE Une connexion fortuite ou incorrecte comprend la connexion unipolaire, excepté la connexion terre à 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.*

*L'engagement du connecteur mâle d'installation dans le connecteur femelle d'installation est tenté dans n'importe quelle configuration non intentionnelle avec une force de 80 N pour les coupleurs d'installation marqués "10 A", "16 A" et "20 A" ou une force de 120 N pour les coupleurs d'installation marqués "25 A" et "32 A". La force doit être appliquée pendant 1 min dans l'axe de la connexion, durée pendant laquelle 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 amenées à cette température.*

*Pendant l'essai, aucun contact électrique 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:

- ayant un nombre de pôles actifs différent, à l'exception éventuelle des connecteurs femelles d'installation spécialement conçus pour accepter le branchement de connecteurs

mâles d'installation d'un nombre inférieur de pôles, pourvu 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 de tension phase-neutre différentes 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 standard**

Les coupleurs d'installation conformes aux exigences du présent document ne doivent pas être compatibles avec les systèmes spécifiés dans les feuilles de normes des IEC 60309 (toutes les parties), IEC 60320 (toutes les parties) et IEC 60906 (toutes les parties), ou avec le système national de fiches et socles de prises de courant domestiques du pays où le produit est placé sur le marché.

NOTE Quelques systèmes nationaux de fiches et socles 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 schémas.*

## **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 de IP 2XC. Le coupleur d'installation doit être conçu de manière que les parties sous tension ne soient pas accessibles lorsque le connecteur mâle d'installation et le connecteur femelle d'installation sont partiellement ou totalement branchés. Le connecteur femelle d'installation doit être conçu de manière que les parties sous tension ne soient pas accessibles quand elles sont débranchées 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 requièrent une telle pratique).

NOTE Les règles nationales peuvent comporter des exigences concernant les coupleurs d'installation avec des conduits métalliques.

Les coupleurs d'installation utilisés dans une zone facilement accessible doivent satisfaire aux exigences pour IP 2XD, qu'ils soient branchés ou non.

Si la face d'engagement du connecteur femelle d'installation pour zone aisément accessible ne satisfait pas aux exigences pour IP 2XD, le fabricant doit fournir des couvercles. Ces couvercles ne doivent pouvoir être démontés qu'avec l'aide d'un outil.

*La conformité est vérifiée après enlèvement des parties qui peuvent être retirées sans l'usage 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 sous tension

Il ne doit pas être possible d'accéder aux parties sous tension 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 essai manuel.*

## 10.3 Parties externes

Les parties externes des coupleurs d'installation, exception faite 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 de 9.10 de celle-ci.

NOTE 1 L'essai décrit en 9.10 de l'IEC 60999-1:1999 est couvert par l'essai de vieillissement cyclique selon 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 selon 15.2 du présent document.

#### 11.1.2 Bornes des coupleurs d'installation démontables

Les coupleurs d'installation démontables doivent être fournis avec des bornes à vis, avec des bornes sans vis ou des 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 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 dotés 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 surmoulés non démontables 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 permettant la fixation mécanique du conducteur en position.

*La conformité est vérifiée par examen, mesures et par l'essai de 22.1.*

## 11.2 Conducteurs pouvant être raccordés

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 mm<sup>2</sup> pour les coupleurs d'installation marqués 10 A selon la valeur de courant maximale;
- 1,5 mm<sup>2</sup> pour les coupleurs d'installation marqués 16 A selon la valeur de courant maximale;
- 2,5 mm<sup>2</sup> pour les coupleurs d'installation marqués 20 A selon la valeur de courant maximale;
- 4 mm<sup>2</sup> pour les coupleurs d'installation marqués 25 A selon la valeur de courant maximale;
- 6 mm<sup>2</sup> 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 autorisé.

*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 conformément à 7.6.3 et 7.6.4 dans le Tableau 3, l'essai est effectué conjointement à l'essai de 12.8.*

## 12 Construction

### 12.1 Connexion à la terre

Les coupleurs d'installation doivent être construits de manière que, lors de l'insertion du connecteur mâle d'installation, la connexion de terre éventuelle soit réalisée au moins 1 mm avant que les contacts transportant le courant du connecteur mâle d'installation soient sous tension.

Lors du retrait du connecteur mâle d'installation, les broches transportant le courant doivent se séparer avant que la liaison de terre ne soit rompue.

*La conformité est vérifiée par examen des schémas de construction, prenant en compte l'effet des tolérances, les positions les plus défavorables et par l'examen des échantillons par rapport à ces schémas et/ou par 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 pendant 60 s sur les contacts 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 avoir une résistance mécanique suffisante. Ils ne doivent pas pouvoir être retirés sans l'aide d'outils.

NOTE 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 usage normal 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  $(70 \pm 2)$  °C.*

*Tout de suite 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 consécutivement. Cette force doit être atteinte par une augmentation progressive n'excédant pas 20 N/s jusqu'à ce que la valeur spécifiée soit atteinte.*

*La valeur maximale doit être maintenue pendant 60 s.*

*Après l'essai, on laisse 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 des câbles. Il doit être possible de disposer chaque conducteur de sorte que son isolation ne puisse venir en contact avec des parties sous tension de polarité différente.

*La conformité est vérifiée par examen et par 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 sous tension de polarité différente.

*La conformité est vérifiée par examen et par 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 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.

NOTE 1 Pour les organes de serrage conformes à l'IEC 60999-1:1999, le rivetage et le soudage sont considérés comme un moyen fiable.

NOTE 2 Les vis des organes de serrage et les ressorts des organes de serrage sans vis ne sont pas considérés comme des parties de contact.

*La conformité est vérifiée par examen et par 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 du 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 12.8.2;*
- *pour les coupleurs d'installation non démontables non surmoulés, par l'essai 12.8.3;*
- *pour les coupleurs d'installation surmoulés non démontables 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 ayant la 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 pour une 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 aigus autour des cloisons n'implique pas que le brin libre soit maintenu rectiligne pendant l'essai. En outre, ces pliages aigus sont exécutés si l'on considère comme probable que de tels pliages peuvent se produire pendant l'assemblage normal du coupleur d'installation, par exemple quand le couvercle est posé dessus.

*Le brin libre d'un conducteur relié à une borne sous tension ne doit pas venir en contact avec une quelconque partie métallique accessible ou être susceptible de sortir de l'enveloppe ou de toucher une borne de mise à la terre lorsque le coupleur d'installation a été assemblé.*

*Le brin libre d'un conducteur connecté à une borne de mise à la terre ne doit pas venir en contact avec une partie sous tension.*

*Si nécessaire, l'essai est répété avec le brin libre dans une position différente.*

### **12.8.3 Essais des brins pour les coupleurs d'installation non démontables**

*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 ayant 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.*