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Interested committees:

Title: Draft BS EN IEC 62752 In-cable control and protection device for mode 2 charging of electric road vehicles (IC-CPD)

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



23E/1162/CD

COMMITTEE DRAFT (CD)

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SECRETARIAT:

Italy

SECRETARY:

Mr Giovanni Cassinelli

OF INTEREST TO THE FOLLOWING COMMITTEES:

SC 23B, SC 23H, TC 64, TC 69

PROPOSED HORIZONTAL STANDARD:



Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.

FUNCTIONS CONCERNED:

☒ EMC

☐ ENVIRONMENT

☐ QUALITY ASSURANCE

☒ SAFETY

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TITLE:

In-cable control and protection device for mode 2 charging of electric road vehicles (IC-CPD)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**IN-CABLE CONTROL AND PROTECTION DEVICE FOR MODE 2
CHARGING OF ELECTRIC ROAD VEHICLES (IC-CPD)****FOREWORD**

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International Standard IEC 62752 has been prepared by subcommittee 23E: Circuit-breakers and similar equipment for household use, of IEC technical committee 23: Electrical accessories, in co-operation with ISO TC 22/SC 37 Electrically propelled vehicles.

It is published as a double logo standard.

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

In this standard, the following print types are used:

- 428 – Requirements proper, in roman type;
- 429 – *Test specifications, in italic type;*
- 430 – NOTES, in smaller roman type.

431 The committee has decided that the contents of the base publication and its amendment will
432 remain unchanged until the stability date indicated on the IEC web site under
433 "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the
434 publication will be

- 435 • reconfirmed,
- 436 • withdrawn,
- 437 • replaced by a revised edition, or
- 438 • amended.

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INTRODUCTION

The essential purpose of this standard is safe and reliable access of electric vehicles to a supply system. The definition for mode 2 charging of electric vehicle is described in IEC 61851-1.

For all charging modes, protection against electric shock in case of failure of basic protection and/or fault protection is provided, at least by a type A RCD (see IEC 60364-7-722 and IEC 61851-1).

For mode 2 charging including the situation where it cannot be guaranteed that the installation is equipped with RCDs, for example charging the electric vehicle at an unknown installation, a dedicated protection is used for the connected electric vehicle. The intention of this standard is to describe the relevant requirements for an in-cable control and protection device (IC-CPD) to be used for mode 2 charging.

This version of IEC 62752 covers also the content of the former IEC 62355.

Secretariats Note:

After discussions it was agreed by WG7 to cover technical content and requirements of SCNs of Edition 1.1 as much as possible by modifications of the normative text. Therefore, for preparation of Edition 2.0 all SCNs of Edition 1.1 were not taken into the draft.

IN-CABLE CONTROL AND PROTECTION DEVICE FOR MODE 2 CHARGING OF ELECTRIC ROAD VEHICLES (IC-CPD)

1 Scope

This International Standard applies to in-cable control and protection devices (IC-CPDs) for mode 2 charging of electric road vehicles, hereafter referred to as IC-CPD including control and safety functions.

This standard applies to portable devices performing simultaneously the functions of detection of the residual current, of comparison of the value of this current with the residual operating value and of opening of the protected circuit when the residual current exceeds this value.

The IC-CPD according to this standard

- has a control pilot function controller in accordance with IEC 61851-1:2017, Annex A;
- checks supply conditions and prevents charging in case of supply faults under specified conditions;
- may have a switched protective conductor.

These IC-CPDs are intended for use in TN-, and TT-systems.

The use of IC-CPDs in IT systems may be limited.

Residual currents with frequencies different from the rated frequency, d.c. residual currents and specific environmental situation are considered.

This standard is applicable to IC-CPDs performing the safety and control functions as required in IEC 61851-1 for mode 2 charging of electric vehicles.

This standard is applicable to IC-CPDs for single-phase circuits not exceeding 250 V or multi-phase circuits not exceeding 480 V, their maximum rated current being 32 A.

This standard is applicable to IC-CPDs to be used in a.c. circuits only, with preferred values of rated frequency 50 Hz, 60 Hz or 50/60 Hz. IC-CPDs according to this standard are not intended to be used to supply electric energy towards the connected grid.

This standard is applicable to IC-CPDs having a rated residual operating current not exceeding 30 mA and are intended to provide additional protection for the circuit downstream of the IC-CPD in situations where it cannot be guaranteed that the installation is equipped with an RCD with $I_{\Delta n} \leq 30$ mA.

The IC-CPD consists of:

- a plug for connection to a socket-outlet in the fixed installation;
- one or more subassemblies containing the control and protection features;
- a cable between the plug and the subassemblies (optional);
- a cable between the subassemblies and the vehicle connector (optional);
- a vehicle connector for connection to the electric vehicle.

For plugs for household and similar use the respective requirements of the national standard and specific requirements defined by the national committee of the country where the product

is placed on the market apply. If no national requirements exist, IEC 60884-1 may be used. For industrial plugs IEC 60309-2 applies. For specific applications and areas non interchangeable industrial plugs may be used. In this case IEC 60309-1 applies

Plugs, connectors and cables which are part of the IC-CPD are not tested according to this standard. These parts are tested separately according to their specific product standard.

The switching contacts of the IC-CPD are not required to provide isolation, as isolation can be ensured by disconnecting the plug.

The IC-CPD may have a non-replaceable integral fuse in the phase(s) and/or neutral current path.

The IC-CPD is not considered to be a protective device for use in fixed installations.

2 Normative references

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

IEC 60065, *Audio, video and similar electronic apparatus – Safety requirements*

IEC 60068-2-1, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-5:2018, *Environmental testing – Part 2-5: Tests – Test S: Simulated solar radiation at ground level and guidance for solar radiation testing and weathering*

IEC 60068-2-11, *Basic environmental testing procedures – Part 2-11: Tests – Test Ka: Salt mist*

IEC 60068-2-27, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60068-2-30, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

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

IEC 60068-2-64, *Environmental testing – Part 2-64: Tests – Test Fh: Vibration, broadband random and guidance*

IEC 60068-3-4, *Environmental testing – Part 2-34: Supporting documentation and guidance – Damp heat tests*

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

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

IEC 60245 (all parts), *Rubber insulated cables – Rated voltages up to and including 450/750V*

- 535 IEC 60309 (all parts), *Plugs, socket-outlets and couplers for industrial purposes*
- 536 IEC 60309-1:1999, *Plugs, socket-outlets and couplers for industrial purposes – Part 1:*
537 *General requirements*
538 IEC 60309-1:1999/AMD1:2005
539 IEC 60309-1:1999/AMD2:2012
- 540 IEC 60309-2, *Plugs, socket-outlets and couplers for industrial purposes – Part 2: Dimensional*
541 *interchangeability requirements for pin and contact-tube accessories*
- 542 IEC 60364-4-44:2007, *Low-voltage electrical installations – Part 4-44: Protection for safety –*
543 *Protection against voltage disturbances and electromagnetic disturbances*
- 544 IEC 60384-14 (all parts), *Fixed capacitors for use in electronic equipment – Part 14:*
545 *Sectional specification – Fixed capacitors for electromagnetic interference suppression and*
546 *connection to the supply mains*
- 547 IEC 60417, *Graphical symbols for use on equipment* (available at: <[http://www.graphical-](http://www.graphical-symbols.info/equipment)
548 [symbols.info/equipment](http://www.graphical-symbols.info/equipment)>)
- 549 IEC 60529:1989, *Degrees of protection provided by enclosures (IP Code)*
- 550 IEC 60664-1:2007, *Insulation coordination for equipment within low-voltage systems –*
551 *Part 1: Principles, requirements and tests*
- 552 IEC 60664-3, *Insulation coordination for equipment within low-voltage systems – Part 3: Use*
553 *of coating, potting or moulding for protection against pollution*
- 554 IEC 60695-2-10, *Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods –*
555 *Glow-wire apparatus and common test procedure*
- 556 IEC 60695-2-11, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods –*
557 *Glow-wire flammability test method for end-products (GWEPT)*
- 558 IEC 60884-1:2002, *Plugs and socket-outlets for household and similar purposes – Part 1:*
559 *General requirements*¹
560 IEC 60884-1:2002/AMD1:2006
561 IEC 60884-1:2002/AMD2:2013
- 562 IEC 61249-2 (all parts), *Materials for printed boards and other interconnecting structures*
- 563 IEC TS 61439-7:2014, *Low-voltage switchgear and controlgear assemblies – Part 7:*
564 *Assemblies for specific applications such as marinas, camping sites, market squares, electric*
565 *vehicles charging stations*
- 566 IEC 61540, *Electrical accessories – Portable residual current devices without integral*
567 *overcurrent protection for household and similar use (PRCDs)*
- 568 IEC 61543:1995, *Residual current-operated protective devices (RCDs) for household and*
569 *similar use – Electromagnetic compatibility*
570 IEC 61543:1995/AMD1:2004
571 IEC 61543:1995/AMD2:2005

¹ A consolidated edition (3.2) exists including IEC 60884-1 (2002) and its Amendment 1 (2006) and Amendment 2 (2013).

572 IEC 61851-1:2017, *Electric vehicle conductive charging system – Part 1: General*
573 *requirements*

574 IEC 62196 (all parts), *Plugs, socket-outlets, vehicle connectors and vehicle inlets –*
575 *Conductive charging of electric vehicles*

576 IEC 62196-1, *Plugs, socket-outlets, vehicle connectors and vehicle inlets – Conductive*
577 *charging of electric vehicles – Part 1: General requirements*

578 IEC 62196-2, *Plugs, socket-outlets, vehicle connectors and vehicle inlets – Conductive*
579 *charging of electric vehicles – Part 2: Dimensional compatibility and interchangeability*
580 *requirements for a.c. pin and contact-tube accessories*

581 CISPR 14 (all parts), *Electromagnetic compatibility – Requirements for household appliances,*
582 *electric tools and similar apparatus*

583 CISPR 14-1, *Electromagnetic compatibility – Requirements for household appliances, electric*
584 *tools and similar apparatus – Part 1: Emission*

585 ISO 178, *Plastics – Determination of flexural properties*

586 ISO 179 (all parts), *Plastics – Determination of Charpy impact properties*

587 ISO 179-1, *Plastics – Determination of Charpy impact properties – Part 1: Non-instrumented*
588 *impact test*

589 ISO 2409, *Paints and varnishes – Cross-cut test*

590 ISO 4628-3, *Paints and varnishes – Evaluation of degradation of coatings – Designation of*
591 *quantity and size of defects, and of intensity of uniform changes in appearance – Part 3:*
592 *Assessment of degree of rusting*

593 ISO 4892-2:2013, *Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-*
594 *arc lamps*

595 ISO 16750-5:2010, *Road vehicles – Environmental conditions and testing for electrical and*
596 *electronic equipment – Part 5: Chemical loads*

597 ISO 17409:2015, *Electrically propelled road vehicles – Connection to an external electric*
598 *power supply – Safety requirements*

599 **3 Terms and definitions**

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

601 NOTE 1 Where the terms "voltage" and "current" are used, they imply r.m.s. values, unless otherwise specified.

602 NOTE 2 Throughout this standard, the word "earthing" is used for "protective earthing".

603 NOTE 3 The term "accessory" is used as a general term covering plugs, socket-outlets, vehicle connectors and
604 vehicle couplers.

3.1 Terms and definitions relating to plugs and socket-outlets**3.1.1****plug**

accessory intended for frequent use by ordinary persons, having pins designed to engage with the contacts of a socket-outlet, also incorporating means for the electrical connection and mechanical retention of one flexible cable

Note 1 to entry: For special purposes such as lighting chains (see also IEC 60598-2-20), two or three single-core cables can be connected within the plug.

[SOURCE: IEC 60884-1:2002/AMD2:2013, 3.1]

3.1.2**socket-outlet**

accessory intended for frequent use by ordinary persons, having socket contacts designed to engage with the pins of a plug and having terminals or terminations for the connection of cable

[SOURCE: IEC 60884-1:2002/AMD2:2013, 3.2]

3.1.3**non-rewirable plug****non-rewirable vehicle connector**

accessory so constructed that it forms a complete unit with the flexible cable or cord after connection and assembly by the manufacturer of the accessory

Note 1 to entry: See also 14.1 of IEC 60884-1:2002.

3.1.4**rewirable accessory by manufacturer**

accessory so constructed that the flexible cable can be replaced

Note 1 to entry: The accessory is so constructed that it can only be rewired, repaired or replaced by the manufacturer's authorized personnel, its agent or similar qualified person.

3.1.5**vehicle coupler****electric vehicle coupler**

means enabling the connection at will of a flexible cable to an electric vehicle

Note 1 to entry: It consists of two parts: a vehicle connector and a vehicle inlet

[SOURCE: IEC 62196-1:2014, 3.3]

3.1.6**vehicle connector****electric vehicle connector**

part of a vehicle coupler integral with, or intended to be attached to, one flexible cable

[SOURCE: IEC 62196-1:2014, 3.3.1]

3.1.7**vehicle inlet****electric vehicle inlet**

part of a vehicle coupler incorporated in, or fixed to, the electric vehicle

[SOURCE: IEC 62196-1:2014, 3.3.2]

3.1.8**pluggable**

electrical connection which is intended to be plugged or unplugged by the end-user

3.1.9**portable equipment**

cord and plug connected equipment, cable assembly, adaptors or other accessories that are capable to be carried by one person and may be carried within the EV

3.1.10**adaptor**

portable accessory constructed as an integral unit incorporating both a plug portion and one socket-outlet portion

3.2 Terms and definitions relating to terminals**3.2.1****clamping unit**

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

[SOURCE: IEC 60999-1:1999, 3.1]

3.2.2**terminal**

conductive part of one pole, composed of one or more clamping unit(s) and insulation if necessary

[SOURCE: IEC 60999-1:1999, 3.2]

3.2.3**termination**

a part of an accessory to which a conductor is permanently attached

3.2.4**screw-type terminal**

terminal for the connection and subsequent disconnection of a conductor or for the interconnection of two or more conductors capable of being dismantled, the connection being made, directly or indirectly, by means of screws or nuts of any kind

3.2.5**screw terminal**

screw-type terminal in which the conductor is clamped under the head of the screw at which the clamping pressure may be applied directly by the head of the screw or through an intermediate part, such as a washer, clamping plate or anti-spread device

3.2.6**screwless terminal**

connecting terminal for the connection and subsequent disconnection of one conductor or the dismantlable interconnection of two or more conductors capable of being dismantled, the connection being made, directly or indirectly, by means of springs, wedges, eccentrics or cones, etc., without special preparation of the conductor other than removal of insulation

[SOURCE: IEC 61008-1:2010, 3.6.8]

3.3 Terms and definitions relating to residual current functions**3.3.1 Terms and definitions relating to currents flowing from live parts to earth****3.3.1.1****earth fault current**

current flowing to earth due to an insulation fault

[SOURCE: IEC 61008-1:2010, 3.1.1]

3.3.1.2**earth leakage current**

current flowing from the live parts of the installation to earth in the absence of an insulation fault

[SOURCE: IEC 61008-1:2010, 3.1.2]

3.3.1.3**pulsating direct current**

current of pulsating waveform which assumes, in each period of the rated power frequency, the value 0 or a value not exceeding 0,006 A d.c. during one single interval of time, expressed in angular measure, of at least 150°

[SOURCE: IEC 61008-1:2010, 3.1.3]

3.3.1.4**current delay angle α**

time, expressed in angular measure, by which the starting instant of current conduction is delayed by phase control

[SOURCE: IEC 61008-1:2010, 3.1.4]

3.3.1.5**supply failure**

– open neutral;

– open line(s).

Note 1 to entry: See 3.3.3.16 for hazardous live protective conductor.

[SOURCE: IEC 62335:2008, 3.2.1.6, modified – "open protective earth" has been deleted.]

3.3.1.6**smooth direct current**

direct current which is ripple free

[SOURCE: IEC 62423:2009, 3.1]

3.3.1.7**composite current**

current which consists of more than one significant sinusoidal frequency

3.3.2 Terms and definitions relating to the energization of the residual current function

3.3.2.1 residual current

I_{Δ}

vector sum of the instantaneous values of the current flowing in the main circuit of the residual current function (expressed as r.m.s. value)

[SOURCE: IEC 61008-1:2010, 3.2.3, modified – “RCCB” has been replaced by “residual current function”]

3.3.2.2 residual operating current

value of residual current which causes the residual current function to operate under specified conditions

[SOURCE: IEC 61008-1:2010, 3.2.4, modified – replacement of “RCCB” by “residual current function”]

3.3.2.3 residual non-operating current

value of residual current at and below which the residual current function does not operate under specified conditions

[SOURCE: IEC 61008-1:2010, 3.2.5, modified – replacement of “RCCB” by “residual current function”]

3.3.3 Terms and definitions relating to the operation and to the functions of the IC-CPD

3.3.3.1 residual current function

function incorporating the means of detection of a residual current, of comparison of its value to the residual current operating value and of opening the protected circuit when the residual current exceeds this value

3.3.3.2 IC-CPD in-cable control and protection device

assembly of linked parts or components including cables, plug and vehicle connector for supplying electric vehicles in charging mode 2, which performs control functions and safety functions

Note 1 to entry: For the use of the IC-CPD, see Figure 30.

Note 2 to entry: This note applies to the French language only.

3.3.3.3 switching device

device designed to make or break the current in one or more electric circuits

[SOURCE: IEC 61008-1:2010, 3.3.6]

3.3.3.4 break-time

time which elapses between the instant when the residual operating current is suddenly attained and the instant of arc extinction in all poles of an IC-CPD

3.3.3.5**closed position**

position in which the predetermined continuity of the main circuit of the IC-CPD is secured

[SOURCE: IEC 61008-1:2010, 3.3.12, modified – "RCCB" has been replaced by "IC-CPD".]

3.3.3.6**open position**

position in which the predetermined clearance between open contacts in the main circuit of the IC-CPD is secured

[SOURCE: IEC 61008-1:2010, 3.3.13, modified – replacement of "RCCB" by "IC-CPD".]

3.3.3.7**pole**

part of an IC-CPD associated exclusively with one electrically separated conducting path of its main circuit provided with contacts intended to connect and disconnect the main circuit itself and excluding those portions which provide means for mounting and operating the poles together

[SOURCE: IEC 61008-1:2010, 3.3.14, modified – replacement of "RCCB" by "IC-CPD".]

3.3.3.8**main circuit**

all conductive parts of an IC-CPD included in the current paths

3.3.3.9**control circuit**

circuit (other than a path of the main circuit) intended for the closing operation or the opening operation, or both, of an IC-CPD

Note 1 to entry: See Figure E.1.

3.3.3.10**test device**

device incorporated in the IC-CPD simulating the residual current conditions for the operation of the IC-CPD under specified conditions

3.3.3.11**IC-CPD type LNSE/LLSE**

device with a switched protective conductor that is used on a line (phase) to neutral supply (L, N, PE) and used on a line (phase) to line (phase) supply (L1, L2, PE)

Note 1 to entry: See Annex D for examples.

3.3.3.12**IC-CPD type LLLNSE**

device with a switched protective conductor that is used on a multiphase supply (L1, L2, L3, N, PE)

Note 1 to entry: A type LLLNSE IC-CPD uses one or more phases of a multiphase supply.

3.3.3.13**IC-CPD type LNE/LLE**

device with a non-switched protective conductor that is used on a line (phase) to neutral supply (L, N, PE) and on a line (phase) to line (phase) supply (L1, L2, PE)

3.3.3.14**IC-CPD type LLLNE**

device with a non-switched protective conductor that is used on a multiphase supply (L1, L2, L3, N, PE)

Note 1 to entry: A type LLLNE IC-CPD uses one or more phases of a multiphase supply.

3.3.3.15**protective conductor****PE (identification)**

conductor provided for purposes of safety, for example protection against electric shock

[SOURCE: IEC 60050-195, 195-02-09:1998]

3.3.3.16**hazardous live protective conductor**

miswiring or fault condition where the protective contact of the socket outlet is live

Note 1 to entry: See 3.3.1.5 for supply failure.

3.3.3.17**control pilot function controller**

function controller which generates a PWM-signal and detects a charging state

Note 1 to entry: See Figure E.1

3.3.3.18**switching function**

device to switch power and / or protective conductor to the EV to provide charging

Note 1 to entry: See Figure E.1.

3.3.4 Terms and definitions relating to values and ranges of energizing quantities**3.3.4.1****non-operating overcurrent**

maximum value of overcurrent of a single-phase load in the main circuit which, in the absence of any fault to frame or to earth, and in the absence of an earth leakage current, can flow through a two-pole IC-CPD without causing the IC-CPD to open the circuit

3.3.4.2**residual short-circuit withstand current**

maximum value of the residual current for which the operation of the IC-CPD is ensured under specified conditions and above which the device may be damaged

[SOURCE: IEC 61008-1:2010, 3.4.3, modified – replacement of "RCCB" by "IC-CPD", and "undergo irreversible alterations" by "be damaged".]

3.3.4.3**prospective current**

current that would flow in the circuit, if each main current path of the IC-CPD and of the overcurrent protective device (if any) were replaced by a conductor of negligible impedance

Note 1 to entry: This definition applies also in the same manner as an actual current, for example prospective breaking current, prospective peak current, prospective residual current.

[SOURCE: IEC 61008-1:2010, 3.4.4, modified – replacement of "RCCB" by "IC-CPD", and replacement of the note to entry.]

3.3.4.4**making capacity**

value of the a.c. component of a prospective current that an IC-CPD is capable of making at a stated voltage under prescribed conditions of use and behaviour

[SOURCE: IEC 61008-1:2010, 3.4.7, modified – replacement of "RCCB" by "IC-CPD"]

3.3.4.5**breaking capacity**

value of the a.c. component of a prospective current that an IC-CPD is capable of breaking at a stated voltage under prescribed conditions of use and behaviour

[SOURCE: IEC 61008-1:2010, 3.4.8, modified – replacement of "RCCB" by "IC-CPD"]

3.3.4.6**residual making and breaking capacity**

value of the a.c. component of a residual prospective current which an IC-CPD can make, carry for its opening time and break under specified conditions of use and behaviour

[SOURCE: IEC 61008-1:2010, 3.4.9, modified – replacement of "RCCB" by "IC-CPD"]

3.3.4.7**conditional short-circuit current**

value of the a.c. component of a prospective current, which an IC-CPD protected by a suitable short-circuit protective device (hereinafter referred to as SCPD) in series, can withstand under specified conditions of use and behaviour

[SOURCE: IEC 61008-1:2010, 3.4.10, modified – replacement of "RCCB" by "IC-CPD"]

3.3.4.8**conditional residual short-circuit current**

value of the a.c. component of a residual prospective current which an IC-CPD, protected by a suitable SCPD in series, can withstand under specified conditions of use and behaviour

[SOURCE: IEC 61008-1:2010, 3.4.11, modified – replacement of "RCCB" by "IC-CPD"]

3.3.4.9 **U_x**

limiting value U_x of the line voltage for IC-CPDs to perform its intended functions as declared by the manufacturer for IC-CPDs

3.3.4.10 **I^2t** **joule integral**

integral of the square of the current, over a given time interval (t_0 , t_1):

$$I^2t = \int_{t_0}^{t_1} I^2 dt$$

3.3.4.11**recovery voltage**

voltage which appears across the supply connections of an IC-CPD after the breaking of the current

Note 1 to entry: This voltage comprises two successive intervals of time, one during which a transient voltage exists, followed by a second one during which power-frequency voltage alone exists.

894 [SOURCE: IEC 61008-1:2010, 3.4.14, modified – replacement of "a pole of an RCCB" by "the
895 supply connections of an IC-CPD" and replacement of the note to entry.]

896 **3.3.4.11.1**

897 **transient recovery voltage**

898 recovery voltage during the time in which it has a significant transient character

899 Note 1 to entry: The transient voltage is an oscillatory or non-oscillatory or a combination of these depending on
900 the characteristics of the circuit and of the IC-CPD.

901 [SOURCE: IEC 61008-1:2010, 3.4.14.1, modified – replacement of "RCCB" by "IC-CPD" and
902 deletion of the last sentence of the note to entry.]

903 **3.3.4.11.2**

904 **power-frequency recovery voltage**

905 recovery voltage after the transient voltage phenomena have subsided

906 [SOURCE: IEC 61008-1:2010, 3.4.14.2]

907 **3.3.5 Terms and definitions relating to values and ranges of influencing quantities**

908 **3.3.5.1**

909 **influencing quantity**

910 any quantity likely to modify the specified behaviour of an IC-CPD

911 **3.3.5.2**

912 **ambient air temperature**

913 temperature, determined under the prescribed conditions, of the air surrounding the IC-CPD

914 [SOURCE: IEC 61008-1:2010, 3.5.6, modified – replacement of "RCCB (for an enclosed
915 RCCB it is the air outside the enclosure)" by "IC-CPD".]

916 **3.3.6 Conditions of operation**

917 **3.3.6.1**

918 **operation**

919 transfer of the moving contact(s) from the open position to the closed position or vice versa

920 Note 1 to entry: If distinction is necessary, an operation in the electrical sense (e.g. make or break) is referred to
921 as a switching operation and an operation in the mechanical sense (e.g. close or open) is referred to as a
922 mechanical operation.

923 [SOURCE: IEC 61008-1:2010, 3.7.1]

924 **3.3.6.2**

925 **closing operation**

926 operation by which the IC-CPD is brought from the open position to the closed position

927 [SOURCE: IEC 61008-1:2010, 3.7.2, modified – replacement of "RCCB" by "IC-CPD".]

928 **3.3.6.3**

929 **opening operation**

930 operation by which the IC-CPD is brought from the closed position to the open position

931 [SOURCE: IEC 61008-1:2010, 3.7.3, modified – replacement of "RCCB" by "IC-CPD".]

932 **3.3.6.4**

933 **operating cycle**

934 succession of operations from one position to another and back to the first position

935 [SOURCE: IEC 61008-1:2010, 3.7.4, modified – deletion of "through all other positions, if
936 any".]

937 **3.3.6.5**

938 **sequence of operation**

939 succession of specified operations with specified time intervals

940 [SOURCE: IEC 61008-1:2010, 3.7.5]

941 **3.3.7 Terms and definitions relating to control functions between electric vehicle and** 942 **IC-CPD**

943 **3.3.7.1**

944 **pilot function**

945 any means, electronic or mechanical, that ensures the conditions related to the safety or the
946 transmission of data required for the mode of operation

947 [SOURCE: IEC 61851-1:2010, 3.17]

948 **3.3.7.2**

949 **system state**

950 state that indicates different states during the charging process according to
951 IEC 61851-1:2017, Annex A

952 EXAMPLE Connected, ready to charge, charging.

953 **3.4 Terms and definitions relating to tests**

954 **3.4.1**

955 **type test**

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

958 [SOURCE: IEC 61008-1:2010, 3.8.1]

959 **3.4.2**

960 **routine test**

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

963 [SOURCE: IEC 61008-1:2010, 3.8.2]

964 **3.4.3**

965 **self test**

966 automatically initiated verification of the ability of the IC-CPD to detect a residual current

967 **3.5 Terms and definitions relating to construction**

968 **3.5.1**

969 **function box**

970 control functions and / or safety functions integrated in appropriate enclosures which are part
971 of the IC-CPD

972 Note 1 to entry: The function box is located in a detachable cable assembly or connector or plug that is not part of
973 the fixed installation.

3.5.2**class I equipment**

equipment with basic insulation as provision for basic protection and protective bonding as provision for fault protection

4 Classification**4.1 According to the supply****4.1.1 General**

An IC-CPD can be classified to be compatible with more than one supply system.

4.1.2 IC-CPD supplied from one phase and neutral and from two phases (LNSE/LLSE or LNE/LLE)

IC-CPDs according to this classification are supplied from one phase and neutral and from two phases.

4.1.3 IC-CPD supplied from three phases and neutral (LLLNSE or LLLNE)

IC-CPDs according to this classification are supplied from three phase and neutral.

NOTE This classification covers IC-CPDs using one or more phases of a multiphase supply.

4.2 According to the construction**4.2.1 General**

An IC-CPD can be classified according to one of the following constructions.

4.2.2 IC-CPD including the function box separated from the plug and connector

Residual current function, switching device and control pilot function controller integrated into a function box between the plug and the vehicle connector (see Figure F.1)

4.2.3 Modular IC-CPD

A modular IC-CPD can be one of the following constructions:

- a) residual current function and switching device integrated into the plug and control pilot function controller integrated into a separate function box between the plug and the vehicle connector (see Figure F.2);
- b) residual current function and switching device integrated into the plug and control pilot function controller integrated into the vehicle connector (see Figure F.3).

4.3 According to the method of connecting the cable(s)**4.3.1 General**

Cables in-between different components of the IC-CPD can be connected to these components by different methods. If in one cord set different connection methods are used the IC-CPD shall be classified to all methods used and the different parts shall be declared separately.

4.3.2 Non-rewirable IC-CPDs

The IC-CPD or the declared part is provided as a full functional cord set including all components. Cables in-between plug, in-cable housing (if any) and vehicle connector are not

1011 intended to be replaced or exchanged by the user or others after connection and assembly by
1012 the manufacturer.

1013 **4.3.3 IC-CPDs wired by the manufacturer**

1014 A connection to the IC-CPD or the declared part such that any replacement can be made only
1015 by the manufacturer, its service agent or similar qualified person using a special tool.

1016 The IC-CPD is provided as a full functional cord set or only the unit(s) containing the
1017 residual current function and control pilot function controller are provided (see 3.1.4).

1018 **4.3.4 Pluggable IC-CPD**

1019 The IC-CPD or the declared part includes at least one pluggable electrical connection which is
1020 intended to be plugged or unplugged by the end-user or others to fit, replace or exchange
1021 components of the IC-CPD cable assembly.

1022 **4.4 Classification according to the protective conductor path**

1023 **4.4.1 General**

1024 An IC-CPD can be classified to have a switched or a non-switched protective conductor.

1025 **4.4.2 IC-CPDs with switched protective conductor**

1026 This classification covers IC-CPDs which have a switched protective conductor.

1027 **4.4.3 IC-CPDs with non-switched protective conductor**

1028 This classification covers IC-CPDs which have a non-switched protective conductor.

1029 **4.5 Classification according to behaviour in case of open protective conductor**

1030 **4.5.1 General**

1031 An IC-CPD can be classified according to the behaviour related to the availability of the
1032 upstream protective conductor.

1033 **4.5.2 IC-CPD with verification of the availability of the upstream protective conductor**

1034 IC-CPD detecting the presence and continuity of the protective conductor upstream of the
1035 socket-outlet. In IT-systems it may happen that these devices cannot be used as the
1036 protective conductor verification will not be successful.

1037 An IC-CPD classified according to 4.5.2 can have a function to deactivate the verification
1038 check of the availability of the upstream protective conductor. After plugging into a socket
1039 outlet, it shall be indicated for at least 30 s by a visual or audible signal that the detection
1040 function is deactivated.

1041 **4.5.3 IC-CPD without verification of the availability of the upstream protective 1042 conductor**

1043 IC-CPD not detecting the presence and continuity of the protective conductor upstream of the
1044 socket-outlet. These devices are also suitable for use in IT-systems.

1045 **4.6 Classification according to the usage**

1046 **4.6.1 IC-CPD for portable use**

1047 IC-CPD that can be used as mobile device.

4.6.2 IC-CPD for wall mounting

IC-CPD designed to be used only when hung in the intended operating position. Such devices can be easily removed from their hanging location.

NOTE This classification includes all positions in a height giving the same degree of protection as wall mounting, for example mounted on ceiling, pillars, etc.

4.6.3 IC-CPD for portable use and for wall mounting

IC-CPD that can be used both as a mobile device and when hung in the intended operating position. Such devices can be easily removed from their hanging location.

5 Characteristics of IC-CPDs

5.1 Summary of characteristics

IC-CPDs are provided with switching contacts for line(s) and neutral, if applicable. IC-CPDs according to 4.4.2 are provided with a switching contact for the protective conductor.

IC-CPDs have a defined residual current operation function. This function provides protection against electric shock for the connected electric vehicle in case of failure of basic protection and / or fault protection in accordance with IEC 61851-1.

The residual current function of the IC-CPD shall be ensured

- for residual sinusoidal alternating currents and residual pulsating direct currents;
- for a residual pulsating direct current superimposed on a smooth d.c. residual current up to 6 mA;
- for composite residual currents intended for circuit supplied between phase and neutral;
- with or without phase angle control, independent of polarity, whether suddenly applied or slowly rising.

In addition IC-CPDs shall have a defined behaviour in case of supply failures or miswiring according to 9.7.6.

In addition the IC-CPD:

- checks by means of the pilot signal that the protective conductor is connected to the electric vehicle,
- trips if the d.c. residual currents exceeds 6 mA.
NOTE 1 Regarding this characteristic see also the Foreword.
- verify that the electric vehicle is connected,
NOTE 2 The connection to the electric vehicle is checked by the pilot signal.
- switches on or off in response to the system states according to IEC 61851-1:2017, Annex A.

5.2 Rated quantities and other characteristics

5.2.1 Rated voltages

5.2.1.1 Rated operational voltage (U_e)

The value of voltage or the voltage range, assigned by the manufacturer, to which the performance of the IC-CPD is referred.

1087 NOTE The same IC-CPD can be assigned to more than one rated voltage.

1088 **5.2.1.2 Rated insulation voltage (U_i)**

1089 The value of voltage, assigned by the manufacturer, to which dielectric test voltages and
1090 creepage distances of the IC-CPD are referred.

1091 Unless otherwise stated, the rated insulation voltage is the value of the maximum rated
1092 voltage of the IC-CPD. In no case shall the maximum rated voltage exceed the rated
1093 insulation voltage.

1094 **5.2.2 Rated current (I_n)**

1095 The value of current, assigned to the IC-CPD by the manufacturer, which the IC-CPD can
1096 carry under permanent load conditions.

1097 **5.2.3 Rated residual operating current ($I_{\Delta n}$)**

1098 The value of residual operating current (see 3.3.2.2), assigned to the IC-CPD by the manu-
1099 facturer, at which the IC-CPD shall operate under specified conditions.

1100 **5.2.4 Rated residual non-operating current ($I_{\Delta no}$)**

1101 The value of residual non-operating current (see 3.3.2.3), assigned to the IC-CPD by the
1102 manufacturer, at which the IC-CPD does not operate under specified conditions.

1103 **5.2.5 Rated frequency**

1104 The power frequency for which the IC-CPD is designed and to which the values of the other
1105 characteristics correspond.

1106 The same IC-CPD may be assigned to more than one rated frequency.

1107 **5.2.6 Rated making and breaking capacity (I_m)**

1108 The r.m.s. value of the a.c. component of prospective current (see 3.3.4.3), assigned by the
1109 manufacturer, which an IC-CPD can make, carry and break under specified conditions.

1110 The conditions are those specified in 9.9.2.2.

1111 **5.2.7 Rated residual making and breaking capacity ($I_{\Delta m}$)**

1112 The r.m.s. value of the a.c. component of residual prospective current (see 3.3.2.1 and
1113 3.3.4.3), assigned by the manufacturer, which an IC-CPD can make, carry and break under
1114 specified conditions.

1115 The conditions are those specified in 9.9.2.3.

1116 **5.2.8 Operating characteristics in case of residual currents comprising a d.c.
1117 component**

1118 The operating characteristics of an IC-CPD are such that tripping is ensured for residual
1119 sinusoidal alternating currents, residual pulsating direct currents and smooth residual direct
1120 currents exceeding 6mA, whether suddenly applied or slowly rising.

1121 **5.2.9 Insulation coordination including creepage distances and clearances**

1122 Creepage and clearance distances are given in 8.4.3.

5.2.10 Coordination with short-circuit protection devices (SCPDs)

5.2.10.1 General

Coordination between IC-CPDs and SCPDs shall be verified under the general conditions of 9.9.2.1, by means of the tests described in 9.9.2.4 which verify that there is adequate protection against currents up to the rated conditional short-circuit current I_{nc} and up to the rated conditional residual short-circuit current $I_{\Delta c}$.

5.2.10.2 Rated conditional short-circuit current (I_{nc})

The r.m.s. value of prospective current, assigned by the manufacturer, which an IC-CPD protected by an SCPD can withstand under specified conditions without undergoing alterations impairing its functions. The conditions are those specified in 9.9.2.4a).

5.2.10.3 Rated conditional residual short-circuit current ($I_{\Delta c}$)

The value of residual prospective current, assigned by the manufacturer, which an IC-CPD, protected by an SCPD, can withstand under specified conditions without undergoing damage. The conditions are those specified in 9.9.2.4c).

5.3 Standard and preferred values

5.3.1 Preferred values of rated operational voltage (U_e)

Preferred values of rated voltage are 120 V, 230 V, 400 V and 480 V.

Wherever in this standard there is a reference to 230 V or 400 V, they may be read as 220 V or 240 V, 380 V or 415 V, respectively.

Wherever in this standard there is a reference to 120 V or 120/240 V or 240 V, they may be read as 100 V or 100/200 V or 200 V, respectively.

Wherever in this standard there is a reference to 240 V three phases, it may be read as 100 V or 120/208 V.

5.3.2 Preferred values of rated current (I_n)

The preferred values of the rated current are indicated in Table 1.

Table 1 – Preferred values of rated current and corresponding preferred values of rated voltages

Type	Rated voltage V	Rated current A
Three-phase systems	480 ^a	6, 8, 10, 13, 15, 16, 20, 24, 30, 32
	400	6, 8, 10, 13, 15, 16, 20, 25, 32
	240	15, 20, 30
Single- and two-phase systems	230	6, 8, 10, 13, 15, 16, 20, 25, 30, 32
	120	6, 8, 10, 12, 15, 16, 20, 30, 32.
^a Only for mid-point or star-point earthed systems with voltage to earth 240 V or 277 V, as applicable.		

If the IC-CPD supports simplified control pilot circuit the rated current shall be 10 A or higher.

The rated current shall not be higher than 32A.

5.3.3 Standard values of rated residual operating current ($I_{\Delta n}$)

Standard values of rated residual operating current are:

$$0,006 \text{ A} - 0,01 \text{ A} - 0,015 \text{ A} - 0,02 \text{ A} - 0,03 \text{ A}.$$

5.3.4 Standard value of rated residual non-operating current ($I_{\Delta no}$)

The standard value of alternating residual non-operating current is $0,5 I_{\Delta n}$.

If for IC-CPD according to 4.4.2 the protective conductor is passed with more turns than the live conductors through the current transformer on a $I_{\Delta n} = 30 \text{ mA}$ device this value may be reduced to $0,25 I_{\Delta n}$.

5.3.5 Standard minimum value of the non-operating overcurrent through the IC-CPD

The standard minimum value of the non-operating overcurrent through the IC-CPD is $4 I_n$.

5.3.6 Preferred values of rated frequency

Preferred values of rated frequency are 50 Hz, 60 Hz or 50/60 Hz.

5.3.7 Minimum value of the rated making and breaking capacity (I_m)

The minimum value of the rated making and breaking capacity I_m is 100 A.

5.3.8 Minimum value of the rated residual making and breaking capacity ($I_{\Delta m}$)

The minimum value of the rated residual making and breaking capacity is 100 A.

5.3.9 Standard value of the rated conditional short-circuit current (I_{nc})

The standard value of the rated conditional short-circuit current is 1 500 A.

5.3.10 Standard value of the rated conditional residual short-circuit current ($I_{\Delta c}$)

The standard value of the rated conditional residual short-circuit current is 1 500 A.

5.3.11 Limit values of break time

The limit values of break time are given in Table 2 for a.c. residual currents, in Table 3 for smooth d.c. residual currents and in Table 4 for residual pulsating direct currents which may result from rectifying circuits supplied from two or three phases.

Table 2 – Limit values of break time for a.c. residual currents at rated frequency

Limit values of break time at a residual current (I_{Δ}) equal to			
s			
$I_{\Delta n}$	$2 I_{\Delta n}$	$5 I_{\Delta n}$	5 A, 10 A, 20 A, 50 A, 100 A ^a
0,3	0,15	0,04	0,04

The maximum value of the test current should not exceed I_m .

NOTE For operation with residual currents having a d.c. component, see 9.7.3.

^a The tests at 5 A, 10 A, 20 A, 50 A and 100 A are only made during the verification of the correct operation as mentioned in 9.7.2.5.

Table 3 – Limit values of break time for smooth d.c. residual currents

Limit values of break time at a d.c residual current equal to		
s		
6 mA	60 mA	300 mA
10,0	0,3	0,04

Table 4 – Limit values of break time for residual pulsating direct currents which may result from rectifying circuits supplied from two or three phases

Limit values of break time at a residual pulsating direct current (I_{Δ}) equal to			
s			
$2 I_{\Delta n}$	$4 I_{\Delta n}$	$10 I_{\Delta n}$	5 A, 10 A, 20 A, 50 A
0,3	0,15	0,04	0,04

6 Marking and other product information

6.1 Data to be marked on the IC-CPD

The IC-CPD shall be marked in a durable manner with the following data:

- a) the manufacturer's or distributor's name or trademark;
- b) type designation, catalogue number or serial number;
- c) rated voltage;
- d) rated frequency, if the IC-CPD is designed for frequencies other than 50 Hz and 60 Hz (see 5.3.6);
- e) rated current;
- f) rated residual operating current;
- g) degree of protection. The IP degree is applicable only to the function box and marking g) shall be on the function box;
- h) the marking with the name of the product: IC-CPD;
- j) IC-CPD shall be marked with the symbol , indicating the lowest ambient temperature, -25°C or lower, within the symbol. If a lower value than -25°C is declared by the manufacturer, the declared value shall be a multiple of 5°C ; the symbol shall indicate this value;
- k) for IC-CPD according to 4.5.2, a statement that the IC-CPD may not operate if used on IT or other unearthed systems such as an isolated winding generator or isolating transformer.

Marking with the following symbol:  IEC 60417-6293 (2015-05);

A statement is not needed for an IC-CPD according to 4.5.2 with a function to deactivate the verification check of the availability of the upstream protective conductor.

NOTE 1 This information can be on a durable label attached to the cord.

- l) value of the residual non-operating current $I_{\Delta no}$, if different from $0,5 I_{\Delta n}$;
- m) indication according to the design of the protective conductor path as follows:

– classified according to 4.4.2 with marking  IEC 60417-6289 (2015-03)

– classified according to 4.4.3 with marking:  IEC 60417-6290 (2015-03)

The symbol may be integrated in a wiring diagram;

- n) additional information about technical data at higher altitudes, if applicable;
- o) the maximum charging current of the IC-CPD, if lower than the rated current;

For the marking of rated current and rated voltage marking, numbers alone may be used. These figures shall be placed on one line, separated or not by an oblique line, or the number

1217 for rated current shall be placed above the number for rated voltage, separated by a
1218 horizontal line.

1219 The marking for the nature of supply shall be placed next to the marking for rated current and
1220 rated voltage.

1221 Examples of marking for current, voltage and nature of supply:

1222 16 A 230 V~, or $\frac{16}{230}$ ~, or 16 A 230 V a.c., or 16/230 a.c., etc.

1223 When symbols are used, they shall be as follows:

1224 – amperes A

1225 – volts V

1226 – alternating current ~ IEC 60417-5032 (2002-10)

1227 – neutral N

1228 – protective earth; protective ground  IEC 60417-5019 (2006-08)

1229 For details of the symbols for a.c. and protective conductor, see IEC 60417.

1230 The markings a), b), c), d), e), f), h), j), k), l), m) and o) shall be on the enclosure of the
1231 function box itself or on a nameplate or nameplates attached to the IC-CPD and shall be
1232 located so that they are visible and legible when the IC-CPD is assembled as for normal use.

1233 Information k) shall also be given in the instruction sheet.

1234 NOTE 2 This information can be given within the car manual.

1235 Information n) shall be given in the instruction sheet.

1236 For IC-CPD without the integrated function to trip at maximum 6 mA smooth d.c. residual
1237 currents, in addition to information p) on the product, detailed information shall be given in the
1238 instruction sheet, including the information, that this IC-CPD shall not be used for vehicles
1239 which may cause smooth d.c. residual currents under first fault conditions.

1240 This requirement including p) is limited to the transition period (see Foreword) and is not
1241 applicable afterwards.

1242 Operating and indication means shall be marked in accordance with the operating instruction.

1243 Terminals exclusively intended for the connection of the neutral circuit shall be indicated by
1244 the letter "N".

1245 For non-rewirable IC-CPD, the indication of "N" is not necessary.

1246 If it is necessary to distinguish between the supply and the load terminals, they shall be
1247 clearly marked (e.g. by "line" and "load" placed near the corresponding terminals or by arrows
1248 indicating the direction of power flow).

1249 Terminals intended for the protective conductor shall be indicated by the symbol for protective
1250 earth; protective ground  IEC 60417-5019 (2006-08).

1251 In addition, screwless terminals of devices according to 4.3.3 shall be marked with an
1252 appropriate marking indicating the length of insulation to be removed before the insertion of
1253 the conductor into the screwless terminal.

1254 Marking shall be indelible, legible and shall not be placed on screws, washers or other
1255 removable parts.

1256 *Compliance is checked by inspection and by the test of 9.3.*

1257 **6.2 Information to be provided to the end-user**

1258 The information to be provided to the end-user is:

- 1259 a) information for the user about the automatic process of verification for the self test;
- 1260 b) information that the device shall not be used if it fails to operate correctly in accordance
1261 with the instructions and to seek advice from the manufacturer, responsible vendor or an
1262 electrician;
- 1263 c) information warning against storage or use beyond the service conditions given in Table 5
1264 and against misuse such as dropping, immersion, etc.;
- 1265 d) information instructing the user that the IC-CPD shall be plugged in without the use of an
1266 adaptor except if the adaptor is part of the IC-CPD and meets the requirements of a
1267 pluggable IC-CPD.;
- 1268 e) information instructing the user that the IC-CPD shall be plugged in directly into the fixed
1269 socket-outlet without the use of an extension cord;
- 1270 f) information about the detected failures and the related indications given by the product in
1271 this case;
- 1272 g) information that the components of a pluggable IC-CPD shall not be connected or
1273 disconnected while the IC-CPD is in use (infrastructure plug connected in a socket-outlet
1274 or the vehicle connector is engaged in a vehicle inlet);
- 1275 h) a list of instructions about how to connect the IC-CPD to the socket-outlet and to the car,
1276 and how to store it properly. This includes the information to the user that it is
1277 recommended for the electrical installation intended for EV charging to be checked by an
1278 electrical installer;
- 1279 i) information about which components of a pluggable IC-CPD are allowed to be used in
1280 combination.

1281 *Compliance is checked by inspection.*

1282 **7 Standard conditions for operation in service and for installation**

1283 **7.1 Standard conditions**

1284 IC-CPDs complying with this standard shall be capable of operating under the standard
1285 conditions shown in Table 5.

1286

1287

Table 5 – Standard conditions for operation in service

Influencing quantity	Standard range of application	Reference value	Test tolerances ^e
Ambient temperature ^{a, f, h}	–25 °C to +45 °C ^b	23 °C	±5 °C
Altitude	Up to 2 000 m ^g		
Relative humidity (maximum value at 40 °C)	75 % ^c		
External magnetic field	Not exceeding five times the earth's magnetic field in any direction	Earth's magnetic field	^d
Frequency	Reference value ±5 %	Rated value	±2 %
Sinusoidal wave distortion	Not exceeding 5 %	Zero	5 %
^a The maximum value of the mean daily temperature is +35 °C. ^b Values outside this range are admissible where more severe climatic conditions prevail, subject to agreement between manufacturer and user. The declared values shall be a multiple of 5 °C. ^c Higher relative humidities are admitted at lower temperature (for example 90 % at 20 °C). ^d IC-CPDs should not be used in the proximity of a strong magnetic field. In this case, supplementary requirements may be necessary. ^e The tolerances given apply unless otherwise specified in the relevant test. ^f Extreme limits of -40 °C and 85 °C, for IC-CPDs are admissible during storage and transportation. ^g For higher altitudes it is necessary to take into account the reduction of the dielectric strength and the cooling effect of the air. Therefore the increased clearances and creepage distances according to Table 7 shall be considered and the manufacturer shall provide additional information about technical data for use at higher altitudes. ^h If the IC-CPD is equipped with a plug according to a standard with a lower standard maximum temperature or a higher standard minimum value then this temperature is applicable for the whole IC-CPD. For plugs according to IEC 60884-1 the maximum temperature is 35 °C, the minimum temperature is -5 °C and for plugs according to IEC 60309-1 the upper temperature is 40 °C the minimum temperature is -25 °C unless higher performances are stated by the manufacturer.			

1288

1289 7.2 Conditions for installations

1290 IC-CPDs shall be used in accordance with their instructions.

1291 8 Requirements for construction and operation

1292 8.1 Mechanical design

1293 IC-CPDs shall be so designed and constructed that in normal use their performance is reliable
 1294 and the risk of danger to the user or surroundings, even in the case of miswiring conditions as
 1295 defined in this standard, is minimised.

1296 For devices according to 4.3.2 (non re-wirable) and 4.3.4, it shall be verified that it is not
 1297 possible to change wiring of the device without leaving permanent and visible damage.

1298 For devices according to 4.3.3 (wired by the manufacturer), it shall be verified that the user
 1299 cannot re-wire the device without leaving permanent and visible damage.

1300 Pluggable IC-CPDs according to 4.3.4 shall be provided with a retaining means which holds
 1301 accessories in position when properly engaged and prevents their unintentional withdrawal.

1302 Pluggable IC-CPDs according to 4.3.4 shall not be operational without engaged retaining
 1303 means.

- 1304 The IC-CPD shall not be functional until all mandatory functions are properly connected.
- 1305 The IC-CPD, without considering plugs and vehicle connector, shall have a minimum degree
1306 of protection of IPXXD according to IEC 60529 after assembly as for normal use.
- 1307 Components of pluggable IC-CPDs according to 4.3.4 shall have a minimum degree of
1308 protection of IPXXB according to IEC 60529 before being connected to each other.
- 1309 A maximum length of cord of 1,7 m is allowed between the plug and the function box.
- 1310 If the function box(es) is (are) located at more than 0,3 m of the plug it/they shall have drive-
1311 over capability as defined in 9.34.
- 1312 If a pluggable electrical connection of a pluggable IC-CPD according to 4.3.4 is located at
1313 more than 0,3 m of the plug, it shall have drive-over capability in a mated position as defined
1314 in 9.34.
- 1315 For IC-CPDs the protective conductor shall be coloured green and yellow.
- 1316 There shall be no provision to alter the residual operating characteristics of IC-CPDs.
- 1317 The plugs of the IC-CPDs shall be mechanically and electrically compatible with the socket
1318 outlet system in which they are intended to be used, and the requirements of the national
1319 standard shall be used. If no national requirements exist, the requirements of IEC 60884-1
1320 shall apply for plugs for household and similar use and the IEC 60309 series shall apply for
1321 industrial plugs.
- 1322 Live pins of plugs shall be of solid metal construction or a folded-over metal blade
1323 construction, if plugs are pin type.
- 1324 For specific applications and areas, non interchangeable industrial plugs may be used in
1325 conjunction with the IEC 60309 series.
- 1326 Where reference is made to vehicle connectors the IEC 62196 series applies.
- 1327 *Compliance is checked by inspection and by the tests of the relevant clauses.*
- 1328 **8.2 Pluggable electrical connections of pluggable IC-CPDs according to 4.3.4**
- 1329 **8.2.1 General**
- 1330 Connections of an IC-CPD shall be designed in a way that only accessories fulfilling the
1331 requirements of 8.2 can be connected. Components of a pluggable IC-CPD shall not be
1332 intermateable in any other way than declared by the manufacturer. Notably, pluggable
1333 connections at the function box shall not comply with standard products, for example
1334 IEC 62196 (all parts) or IEC 60309 (all parts).
- 1335 If components of an IC-CPD with different rated currents are intermateable, an automatic
1336 means which the end-user cannot influence shall be provided to limit the maximum current
1337 given by the control pilot signal of the IC-CPD to the lowest rated current of any of the
1338 components.
- 1339 The manufacturer shall specify the minimum level of engagement of each contact of the
1340 electrical connection from which it can be used at nominal current.

1341 The connection shall meet the requirements in Clause 22 of IEC 60309-1:1999,
1342 IEC 60309-1:1999/AMD1:2005 and IEC 60309-1:1999/AMD2:2012 at the minimum level of
1343 engagement of each contact specified by the manufacturer for its use at nominal current.

1344 Vehicle connectors and the connection to their cables shall be non-rewirable or rewirable by
1345 the manufacturer. They shall not be pluggable.

1346 For pluggable electrical connections which are intended to be plugged or unplugged by the
1347 user or others the fitting, replacement or exchange of components of the IC-CPD assembly
1348 shall be in accordance with the tests in IEC 60309-1.

1349 – Only accessories classified according to 6.1.3 of IEC 60309-1:1999 as accessories with
1350 earthing contact shall be used.

1351 – Only accessories classified according to 6.1.4 of IEC 60309-1:1999 as non-rewirable plugs
1352 and connectors shall be used.

1353 – Only socket-outlets and connectors classified according to 6.1.8 of IEC 60309-1:1999 and
1354 IEC 60309-1:1999/AMD2:2012 as accessories providing for a minimum of IPXXB shall be
1355 used.

1356 – The retaining means may be rendered ineffective before the test, if agreed upon by the
1357 manufacturer.

1358 *Compliance is checked by inspection and by the tests of the relevant clauses.*

1359 **8.2.2 Degree of protection of pluggable electrical connection against solid foreign**
1360 **objects and water for pluggable IC-CPD**

1361 All accessories shall provide for IP55 in the mated position.

1362 All accessories shall provide for IP24 in the unmated position. IP24 may be obtained by the
1363 combination of the accessory and a lid or cap.

1364 **8.2.3 Breaking capacity of pluggable electrical connection for pluggable IC-CPD**

1365 The breaking capacity shall be tested according to Clause 20 of IEC 60309-1:1999 and
1366 IEC 60309-1:1999/AMD2:2012 by using a current of 2 A or a current specified by the
1367 manufacturer, whichever is lower.

1368 The on-load tests shall be conducted according to Clause 21 of IEC 60309-1:1999,
1369 IEC 60309-1:1999/AMD1:2005 and IEC 60309-1:1999/AMD2:2012 by using a current of 2 A or
1370 a current specified by the manufacturer, whichever is lower.

1371 The number of off-load tests according to Clause 21 of IEC 60309-1:1999, IEC 60309-
1372 1:1999/AMD1:2005 and IEC 60309-1:1999/AMD2:2012 shall be determined by the rated
1373 current and the corresponding number of cycles given in Table 7 of IEC 60309-1:1999 and
1374 IEC 60309-1:1999/AMD2:2012.

1375 If it is not intended to limit the load, the maximum breaking capacity shall be provided. In that
1376 case 8.2.4 does not apply.

1377 **8.2.4 Additional requirements**

1378 Additional requirements as follows:

1379 a) For pluggable electrical connections located between the contacts of the plug and the
1380 contact mechanism controlled by the pilot function of the IC-CPD a means shall be
1381 provided for

1382 – limiting the load on each contact not properly engaged with its counterpart to 2 A or its
1383 maximum breaking capacity, whichever is lower;

- limiting the load on each contact when being plugged to 2 A or its maximum breaking capacity, whichever is lower, before the contact is not yet engaged at least to the minimum level specified by the manufacturer for its use at nominal current;
- limiting the load on each contact when being unplugged to 2 A or its maximum breaking capacity, whichever is lower, before the contact is no longer engaged at least to the minimum level specified by the manufacturer for its use at nominal current.

Compliance is checked by inspection.

- b) For pluggable electrical connections located between the contact mechanism controlled by the pilot function of the IC-CPD and the contacts of the vehicle connector a means shall be provided for

- limiting the voltage on each contact of an accessory not sufficiently engaged with its counterpart to provide for IPXXD to 30 V a.c. or 60 V d.c;
- limiting the load on each contact not properly engaged with its counterpart to 2 A or its maximum breaking capacity, whichever is lower;
- limiting the load on each contact when being plugged to 2 A or its maximum breaking capacity, whichever is lower, before the contact is not yet engaged at least to the minimum level specified by the manufacturer for its use at nominal current;
- limiting the load on each contact when being unplugged to 2 A or its maximum breaking capacity, whichever is lower, before the contact is no longer engaged at least to the minimum level specified by the manufacturer for its use at nominal current.

Compliance is checked by inspection.

8.3 Construction

8.3.1 General

It shall not be possible to disassemble an IC-CPD classified according to 4.3.2.

If the IC-CPD is provided with a suspension means the relevant tests as given in IEC 60884-1:2002, IEC 60884-1:2002/AMD1:2006 and IEC 60884-1:2002/AMD2:2013, 24.1, 24.11, 24.12 and 24.13 shall be made.

Parts of the assembly classified according to 4.3.3 shall be securely assembled and it shall not be possible to disassemble them without the aid of a tool.

Except for the pluggable connections of IC-CPDs classified according to 4.3.4, it shall not be possible to disassemble the IC-CPD without the aid of a special purpose tool.

The control pilot function controller shall not be able to close the switching device in case of

- single fault inside the control pilot function controller, or
- single fault of the control circuit of the switching device, or
- after residual current fault without a reset of the IC-CPD

Under single fault conditions of the control pilot function (PWM), no critical overload situation shall appear.

Compliance is checked by fault analysis provided by the manufacturer (e.g. FMEA).

The IC-CPD may be equipped with a control device that detects the temperatures in the plug and/or in the device and limits the charging current when the temperature exceeds the limited values. If equipped with a control device, the manufacturer shall declare the functionality and shall provide respective charging curves.

Compliance is checked by the tests of Clause 9.

1427 Plugs of IC-CPD shall be non rewirable.

1428 *Compliance is checked by inspection.*

1429 **8.3.2 Terminations of IC-CPDs**

1430 Terminations of IC-CPDs shall be so located or protected that they cannot create a dangerous
1431 situation.

1432 *Compliance is checked by the test of 9.4.*

1433 **8.3.3 Enclosure of IC-CPDs according to 4.3.3**

1434 The enclosure of IC-CPDs according to 4.3.3 shall completely enclose the terminals and the
1435 ends of flexible cables and cords.

1436 The construction shall be such that the conductors can be properly connected and such that,
1437 when the accessory is wired and assembled as for normal use, there is no risk that

- 1438 – the conductors are pressed against each other,
- 1439 – a core, the conductor of which is connected to a live terminal, comes into contact with
1440 accessible metal parts,
- 1441 – a core, the conductor of which is connected to the earthing terminal, comes into contact
1442 with live parts.

1443 *Compliance is checked by inspection and by manual test.*

1444 **8.3.4 Terminal screws or nuts of IC-CPDs according to 4.3.3**

1445 The IC-CPD shall be so designed that terminal screws or nuts cannot become loose and fall
1446 out of position in such a way that they establish an electrical connection between live parts
1447 and the earthing terminal or metal parts connected to the earthing terminal.

1448 *Compliance is checked by inspection and by manual test.*

1449 **8.3.5 Strain on the conductors of IC-CPDs according to 4.3.3**

1450 IC-CPDs according to 4.3.3 shall be designed with ample space for slack of the earthing
1451 conductor in such a way that, if the strain relief should fail, the connection of the earthing
1452 conductor is subjected to strain after the connections of the current-carrying conductors and
1453 such that, in case of excessive stresses, the earthing conductor will break after the current-
1454 carrying conductors.

1455 *Compliance is checked by the test of 9.22.*

1456 **8.3.6 Additional requirements for IC-CPDs according to 4.3.3**

1457 For IC-CPDs according to 4.3.3 the following additional requirements apply:

- 1458 – it shall be clear how the relief from strain and the prevention of twisting is intended to be
1459 effected;
- 1460 – the cord anchorage, or at least part of it, shall be integral with or permanently fixed to one
1461 of the component parts;
- 1462 – makeshift methods, such as tying the cable or cord in a knot or tying the ends with string,
1463 shall not be used;

- 1464 – cord anchorages shall be suitable for the different types of flexible cable or cord which
1465 may be connected, and their effectiveness shall not depend upon the assembly of the
1466 parts of the body;
- 1467 – cord anchorages shall be of insulating material or be provided with an insulating lining
1468 fixed to the metal parts,
- 1469 – metal parts of the cord anchorage, if any, including clamping screws, shall be insulated
1470 from the earthing circuit.

1471 *Compliance is checked by inspecting the construction and documents provided by the*
1472 *manufacturer.*

1473 **8.3.7 Insulating parts which keep the live parts in position**

1474 They shall be reliably fixed.

1475 *Compliance is checked by inspection and by manual test.*

1476 **8.3.8 Screws for IC-CPD according to 4.3.3**

1477 The use of tight-fitting washers of cardboard or the like is deemed to be an adequate method
1478 for securing screws which are to be captive.

1479 *Compliance is checked by inspection.*

1480 **8.3.9 Means for suspension from a wall or other mounting surfaces**

1481 An IC-CPD with means for suspension shall fulfil the requirements for protection against
1482 electric shock according to 8.5 in the mounted and in the unmounted position.

1483 *Compliance is checked by inspection.*

1484 **8.3.10 Plug as an integral part of plug-in equipment**

1485 If a plug is an integral part of plug-in equipment, the plug-in equipment shall not cause
1486 overheating of the pins.

1487 *Compliance is checked by the tests of 9.6.*

1488 The IC-CPD shall not impose undue strain on fixed socket-outlets.

1489 *For an IC-CPD with a plug for household and similar use compliance is checked by the test of*
1490 *9.23.*

1491 **8.3.11 Flexible cables and cords and their connection**

1492 **8.3.11.1 Cord anchorage**

1493 Any part of IC-CPD according to 4.3.3 and 4.3.4, if relevant, shall be provided with a cord
1494 anchorage such that the conductors are relieved from strain, including twisting, when they are
1495 connected to the terminals or terminations, and their covering is protected from abrasion.

1496 The sheath, if any, of the cord shall be clamped within the cord anchorage.

1497 *Compliance is checked by inspection and by the test of 9.24.*

8.3.11.2 Minimum cross section

IC-CPDs shall be provided with a flexible copper cable complying with IEC 60227 or IEC 60245.

The minimum cross-sectional areas of the load conductors and the protective earth conductor are given in Table 6 in relation to the current limit given by the control pilot signal.

Table 6 – Minimum cross-sectional area of flexible cable or cord

Current limit given by control pilot signal	Minimum cross-section mm ²	AWG 1Ø
≤ 13 A	1,5	16
13 A < I ≤ 15 A	2,5	14
15 A < I ≤ 20 A	2,5	14
20 A < I ≤ 30 A	6	10
30 A < I ≤ 32 A	6	10

The control pilot wire shall have a minimum cross-section of 0,5 mm²/AWG20.

Compliance is checked by inspection, by measurement and by checking that the flexible cables or cords are in accordance with the IEC 60227 series or the IEC 60245 series, as applicable.

8.3.11.3 Bending

Parts of IC-CPDs shall be so designed that the flexible cable or cord is protected against excessive bending where it enters the accessory.

Guards provided for this purpose shall be of insulating material and shall be fixed in a reliable manner.

NOTE Helical metal springs, whether bare or covered with insulating material are not suitable to be used as cord guards.

Compliance is checked by inspection and by the test of 9.25.

8.4 Electrical performance

8.4.1 Protective conductor path

The switched contact within the protective conductor path, if any, shall provide adequate contact pressure and shall not deteriorate in normal use.

The protective conductor may pass through the sensing toroid as long as the unit complies with the appropriate operating test.

It shall be verified by inspection that the protective conductor path does not have any semiconductor device connected in series.

Compliance is checked by the temperature rise test of 9.6.2, the residual short-circuit test of 9.9.2.3 and the conditional short-circuit test of 9.9.2.4c).

8.4.2 Contact mechanism

Each line conductor and the neutral conductor, if any, of the IC-CPD shall be provided with switching contacts. For IC-CPDs according to 4.4.2 the protective conductor shall be provided with a switching contact. The line contacts and the neutral contact, if any, shall be mechanically or electrically coupled such that they make and break substantially together.

The protective conductor contact, if any, may be mechanically or electrically coupled to the line and neutral contacts.

The switching contact of the protective conductor path, if any, shall close before and open after the switching contacts of the live conductors or close and open substantially together with the live conductors.

It may be possible to switch off the IC-CPD when energized as in normal use. A test device may be used for that purpose.

The IC-CPD shall have means for manual reset after a residual current operation. This may be done by a dedicated means or by disconnecting from the socket-outlet.

A test device may be provided.

An automatic verification shall ensure detection of unintended closed contacts.

The IC-CPD shall have an indicator showing the state of the contacts and give a clear indication or response in case of unintentionally closed contacts.

The action of the mechanism shall not be influenced by the position of enclosures or covers and shall be independent of any removable part.

A cover sealed in position by the manufacturer is considered to be a non-removable part.

Compliance with the above requirements is checked by inspection and by the relevant tests of 9.7.

8.4.3 Clearances and creepage distances (see Annex C)

Clearances and creepage distances shall not be less than the values shown in Table 7, when the IC-CPD is mounted as in normal use. The values in Table 7 are based on the IC-CPD being designed for operating in an environment with pollution degree 2 and overvoltage category II.

NOTE If higher altitudes, pollution degrees or overvoltage category are considered, the appropriate clearances and creepage distances are defined in IEC 60664-1.

Compliance for item 1 in Table 7 is checked by measurement or by the test of 9.5.5.3.1 and 9.5.5.3.2. The test is carried out with samples not submitted to the humidity treatment described in 9.5.1.

The clearances of items 2 and 4 may be reduced provided that the measured clearances are not shorter than the minimum allowed in IEC 60664-1 for homogenous field conditions. In this case, after the humidity treatment described in 9.5.1, compliance for items 2 and 4 and the arrangements of 9.5.2, items b), c), d) and e) is checked in the following order:

- tests according to 9.5.2,
- test according to 9.5.5.2, applied with the test voltages given in Table 10 and with the test arrangements of 9.5.2 items b), c), d), e).

- 1567 If the measurement does not show any reduced clearance, test 9.5.5.2 is not applied.
- 1568 Double insulation or reinforced insulation shall be provided upstream of the interrupting
1569 contacts of the IC-CPD between hazardous-live parts and
- 1570 – accessible surfaces of operating means,
 - 1571 – screws or other means for fixing covers which may be removed when connecting the
1572 connector,
 - 1573 – accessible metal parts.
- 1574 *Compliance is checked by the test of 9.5.5.2. The test voltage shall be multiplied by 1,6.*
- 1575 All measurements required in 8.4.3 shall be carried out in Test sequence A on one sample
1576 and the tests 9.5.5.2 shall be carried out before 9.5.1 on three samples of Test sequence B.
- 1577 The insulating materials are classified into material groups on the basis of their comparative
1578 tracking index (CTI) according to 4.8.1 of IEC 60664-1:2007.
- 1579 For domestic plugs and when a national standard exists the relevant national standard
1580 applies. If no relevant national standard is available IEC 60884-1 applies.
- 1581 For industrial plugs, the IEC 60309 series applies.
- 1582 For vehicle connectors IEC 62196-1 or IEC 62196-2 applies.
- 1583 The verification of clearances and creepage distances on printed circuit boards is made by
1584 the tests of 9.27.
- 1585

1586

Table 7 – Minimum clearances and creepage distances (rated voltage 230 V, 230/400 V)

	Minimum clearances ^g mm				Minimum creepage distances ^c mm											
					Group IIIa ^d (175 V ≤ CTI < 400 V) ^b				Group II (400 V ≤ CTI < 600 V) ^b				Group I (600 V ≤ CTI) ^b			
	Rated voltage V ^e				Working voltage V											
	U _{im} p 1,5 kV	U _{imp} 2,5 kV														
Item/Description	120	250	230/ 400	48 0	120	250	400	48 0	120	250	400	480	120	250	400	480
1. between live parts which are separated when the main contacts are in the open position ^a	0,5	1,5			1,5	2,5	4,0	5	1,0 5	1,8	2,8	3,6	0,75	1,5	2,0	2,5
2. between live parts of different polarity	0,5	1,5			1,5	2,5	4,0	5	1,0 5	1,8	2,8	3,6	0,75	1,5	2,0	2,5
3. void																
					Rated voltage V											
					120	250	230/ 400	48 0	120	250	230/ 400	480	120	250	230/ 400	480
4. downstream interrupting contacts of the IC-CPD between live parts and - accessible surfaces of operating means - screws or other means for fixing covers which may be removed when connecting the connector - accessible metal parts ^f - PE	0,5	1,5			1,5	2,5	4	5	1,0 5	1,8	2,8	3,6	0,75	1,5	2,0	2,5
5. upstream interrupting contacts of the IC-CPD between live parts and - accessible surfaces of operating means	1,5	3			2,5	5	8	10	2,1	3,6	5,6	7,2	1,5	3	4	5

	Minimum clearances ^g mm		Minimum creepage distances ^c mm											
			Group IIIa ^d (175 V ≤ CTI < 400 V) ^b				Group II (400 V ≤ CTI < 600 V) ^b				Group I (600 V ≤ CTI) ^b			
	Rated voltage V ^e		Working voltage V											
	U_{imp} 1,5 kV	U_{imp} 2,5 kV												
- screws or other means for fixing covers which may be removed when connecting the connector - accessible metal parts ^f														
NOTE 1 The parts of the neutral path, if any, are considered to be live parts.														
NOTE 2 Clearances and creepage distances of the secondary circuit and between the primary windings of the IC-CPD transformer are not considered.														
^a For auxiliary and control contacts the values are given in the relevant standard.														
^b See IEC 60112.														
^c Interpolation is allowed in determining creepage distances corresponding to voltage values intermediate to those listed as working voltage. When interpolating, linear interpolation shall be used and values shall be rounded to the same number of digits as the values picked up from the tables. For determination of creepage distances, see Annex C.														
^d For material group IIIb (100 V ≤ CTI < 175 V) the values for material group IIIa multiplied by 1,6 apply.														
^e The rated voltage is the maximum operational voltage to earth.														
^f Including a metal foil in contact with the surfaces of insulating material which are accessible after installation for normal use. The foil is pushed into corners, grooves, etc., by means of a test wire according to 9.4 (see Figure 9).														
^g For altitudes of 3 000 m the values shall be multiplied by 1,14, for 4 000 m they shall be multiplied by 1,29.														

1587

1588 **8.5 Protection against electric shock**1589 **8.5.1 General**

1590 IC-CPDs shall be so designed that, when they are used according to the manufacturers'
 1591 instructions, live parts are not accessible.

1592 External parts, other than screws or other means for fixing covers and labels, which are
 1593 accessible when the IC-CPD is used under normal conditions, shall either be of insulating
 1594 material, or be lined throughout with insulating material, unless the live parts are within an
 1595 internal enclosure of insulating material.

1596 Such lining shall be fixed so that it is not likely to be lost. It shall have adequate thickness and
 1597 mechanical strength and shall provide adequate protection even at places where sharp edges
 1598 occur.

1599 Inlet openings for cables shall either be of insulating material or be provided with bushing or
 1600 similar devices of insulating material. Such devices shall be reliably fixed and shall have
 1601 adequate mechanical strength.

1602 Accessible parts of operating means shall be made of insulating material.

1603 Metal parts of the mechanism shall not be accessible. In addition, they shall be insulated from
1604 all accessible metal parts, including metal frames, plates, screws or other means used as
1605 supporting or fixing means.

1606 Lacquer and enamel are not considered to provide adequate insulation for the purpose of
1607 8.5.1.

1608 *Compliance is checked by inspection and by the tests of 9.4.*

1609 **8.5.2 Requirements relating to plugs, whether incorporated or not in integral items**

1610 For plugs for household and similar use, this is covered by the requirements of national
1611 standards. In the absence of national standards IEC 60884-1 applies.

1612 For industrial plugs the IEC 60309 series applies.

1613 **8.5.3 Degree of protection of the function box**

1614 The degree of protection of the parts of the function box after assembly as for normal use
1615 shall not be less than IP55. This also means that all connections between the function box
1616 and other components of a pluggable IC-CPD are mated.

1617 This requirement does not apply to the plug inserted in a standard socket outlet.

1618 The relevant tests of IEC 60529 apply.

1619 The test conditions for the function box regarding the first and second IP number according to
1620 IEC 60529 apply as follows:

- 1621 – the samples shall be tested in different positions chosen at random, if applicable;
- 1622 – the samples are not connected to supply voltage;
- 1623 – the dust test is performed in an enclosure of category 2.

1624 In addition to the IP requirement the function box for IC-CPD according to 4.6.1, 4.6.2 and
1625 4.6.3 shall be submitted to the test procedure according to 14.2.7 of IEC 60529:1989 with the
1626 upper part of the function box placed 5 cm under water.

1627 After the test under the conditions of tests specified in 9.7.2.4, the IC-CPD shall trip with a
1628 test current of $1,25 I_{\Delta n}$ and shall not trip with a current of $I_{\Delta n0}$. One test only is made on one
1629 pole taken at random, without measurement of break-time.

1630 **8.5.4 Requirements relating to vehicle connectors**

1631 For vehicle connectors the IEC 62196 series applies.

1632 **8.6 Dielectric properties**

1633 IC-CPDs shall have adequate dielectric properties.

1634 *Compliance is checked by the tests of 9.5.*

1635 **8.7 Temperature rise**

1636 The temperature-rises of the parts of an IC-CPD specified in Table 8, measured under the
1637 conditions specified in 9.6, shall not exceed the limiting values stated in this table.

1638 The IC-CPD shall not suffer damage impairing its functions and its safe use.

1639 **Table 8 – Temperature-rise values**

Parts a, b, c	Temperature rise ^d K
Contacts or terminals for external connections	50
Parts likely to be touched made of metallic non-metallic	30 50
a No value is specified for the contacts, since the design of most IC-CPDs is such that a direct measurement of the temperature of those parts cannot be made without the risk of causing alterations or displacement of parts likely to affect the reproducibility of the tests. The test of 9.17.2 is considered to be sufficient for checking indirectly the behaviour of the contacts with respect to undue temperature rises in service. b No value is specified for parts other than those listed, but no damage shall be caused to adjacent parts of insulating materials, and the operation of the IC-CPD shall not be impaired. c For plugs, connectors and cables the relevant values of the individual product standards apply. d Values derived from touch times of 4 s, taken from IEC Guide 117.	

1640

1641 **8.8 Operating characteristics**

1642 **8.8.1 General**

1643 IC-CPDs shall present adequate operating characteristics.

1644 *Compliance is checked by the tests of 9.7.*

1645 **8.8.2 Safe connection operating characteristics**

1646 It shall be verified that the protective conductor, on the load side, is connected to the vehicle.

1647 *Compliance with this requirement is checked by the test of 9.7.8.*

1648 The IC-CPD shall comply with the additional requirements of 5.1 for supply failures defined in
1649 3.3.1.5, and hazardous live protective conductor conditions defined in 3.3.3.16 (see 8.22).
1650 The hazardous live protective conductor conditions only apply to IC-CPD classified according
1651 to 4.4.2.

1652 **8.8.3 Operating characteristics with a.c. residual currents and residual currents** 1653 **having a d.c. component**

1654 The break times for the IC-CPD shall be according to Table 2 in presence of a.c. residual
1655 currents at rated frequency and residual currents having a d.c. component.

1656 The correct operation in case of residual pulsating direct currents superimposed by smooth
1657 direct currents, shall also be verified.

1658 The IC-CPD shall also detect and break composite residual currents.

1659 *Compliance is checked by the tests of 9.7.2, 9.7.3 and 9.7.5.*