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Date: 18 July 2024
Origin: International**Latest date for receipt of comments: 2 October 2024**

Project No. 2024/01964

Responsible committee: PEL/23/1 Circuit breakers and similar equipment for household use

Interested committees:

Title: BS EN IEC 62955 Residual direct current detecting device (RDC-DD) to be used for mode 3 charging of electric vehicles

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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/1356/CD

COMMITTEE DRAFT (CD)

PROJECT NUMBER:

IEC 62955 ED2

DATE OF CIRCULATION:

2024-07-12

CLOSING DATE FOR COMMENTS:

2024-11-01

SUPERSEDES DOCUMENTS:

23E/1355/RR

IEC SC 23E : CIRCUIT-BREAKERS AND SIMILAR EQUIPMENT FOR HOUSEHOLD USE

SECRETARIAT:

Italy

SECRETARY:

Mr Giovanni Cassinelli

OF INTEREST TO THE FOLLOWING COMMITTEES:

TC 69

HORIZONTAL FUNCTION(S):

ASPECTS CONCERNED:

Electromagnetic Compatibility, Safety

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TITLE:

Residual direct current detecting device (RDC-DD) to be used for mode 3 charging of electric vehicles

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

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IEC 62955 has been prepared by subcommittee 23E: Circuit-breakers and similar equipment for household use, of IEC technical committee 23: Electrical accessories. It is an International Standard.

This second edition cancels and replaces the first edition published in 2018. This edition constitutes a technical revision.

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

- Redefinition of classification 4.1.
- Alignment with IEC 61851-1 Ed4 for classification 4.1.1
- Harmonization of EMC requirements with new edition of IEC 61543 and IEC 61851-21-2;
- General improvement of test and requirements.

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

Draft	Report on voting
23E/XX/FDIS	23E/XX/RVD

335
336 Full information on the voting for its approval can be found in the report on voting indicated in
337 the above table.

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

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

343 In this document, the following print types are used:

- 344 – Requirements proper, in roman type;
345 – *Test specifications, in italic type*;
346 – NOTES, in smaller roman type.

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

- 350 • reconfirmed,
351 • withdrawn,
352 • replaced by a revised edition, or
353 • amended.

354

355

INTRODUCTION

According to IEC 60364-7-722, each connecting point is protected by its own RCD of at least type A, having a rated residual operating current not exceeding 30 mA.

Protective measures against DC fault currents need to be taken. The appropriate measures are:

- RCD type B, or
- RCD type A in conjunction with a residual direct current detecting device (RDC-DD) complying with IEC 62955; or
- the use of an RCD type F in conjunction with a residual direct current detecting device (RDC-DD) complying with IEC 62955.

It is the purpose of this document to specify this type of detecting equipment to ensure that the proper functionality of RCDs type A or type F is not impaired by DC residual currents above 6 mA.

RESIDUAL DIRECT CURRENT DETECTING DEVICE (RDC-DD) TO BE USED FOR MODE 3 CHARGING OF ELECTRIC VEHICLES

1 Scope

This International Standard applies to residual direct current detecting devices (RDC-DD) for permanently connected AC electric vehicle charging stations (mode 3 charging of electric vehicles, according to IEC 61851-1 and IEC 60364-7-722). For rated voltages not exceeding 440 V AC with rated frequencies of 50 Hz, 60 Hz or 50/60 Hz and rated currents not exceeding 125 A.

NOTE 1 This document can also be used as guidance for devices for voltages up to and including 690 V AC 50 Hz, 60 Hz or 50/60 Hz, at a rated current not exceeding 250 A.

RDC-DDs are intended to remove of the supply to the EV in cases where a smooth residual direct current equal to or above 6 mA is detected.

NOTE 2 The value of 6 mA for smooth residual direct current was chosen to prevent impairing the correct operation of an upstream type A or type F RCD.

This document covers residual direct current detecting device (RDC-DD) to be used for mode 3 charging of electric vehicles (see classification in 4.1).

This document applies to devices performing simultaneously the functions of detection of the residual direct current, of comparison of the value of this current with the residual operating value, opening of the circuit when the residual direct current is equal to or above 6 mA.

RDC-DDs are intended to be used for single-phase or multi-phase circuits in TN-, TT- and IT-systems.

RDC-DDs are intended to be used in AC circuits only.

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 60060-2:2010, *High-voltage test techniques - Part 2: Measuring systems*

IEC 60068-2-30:2005, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

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

IEC 60228:2004, *Conductors of insulated cables*

IEC 60364 (all parts), *Low-voltage electrical installations*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

- 407 IEC 60664-1:2020, *Insulation coordination for equipment within low-voltage systems – Part 1:*
408 *Principles, requirements and tests*
- 409 IEC 60664-3, *Insulation coordination for equipment within low-voltage systems – Part 3: Use of*
410 *coating, potting or moulding for protection against pollution*
- 411 IEC 60695-2-10, *Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods –Glow-*
412 *wire apparatus and common test procedure*
- 413 IEC 61008-1:202X, *Residual current operated circuit-breakers without integral overcurrent*
414 *protection for household and similar uses (RCCBs) – Part 1: General rules*
- 415 IEC 61008-2-1: 202X, *Residual current operated circuit-breakers without integral overcurrent*
416 *protection for household and similar uses (RCCB's). Part 2-1: RCCBs according to 4.1.1*
- 417 IEC 61008-2-2: 202X, *Residual current operated circuit-breakers without integral overcurrent*
418 *protection for household and similar uses (RCCB's) - Part 2-2: RCCBs according to 4.1.2, 4.1.3,*
419 *4.1.4, 4.1.5 and 4.1.6*
- 420 IEC 61009-1:202X, *Residual current operated circuit-breakers with integral overcurrent*
421 *protection for household and similar uses (RCBOs) – Part 1: General rules*
- 422 IEC 61009-2-1: 202X, *Residual current operated circuit-breakers with integral overcurrent*
423 *protection for household and similar uses (RCBO's) - Part 2-1: RCBOs according to 4.1.1*
- 424 IEC 61009-2-2: 202X, *Residual current operated circuit-breakers with integral overcurrent*
425 *protection for household and similar uses (RCBO's) - Part 2-2: RCBOs according to 4.1.2, 4.1.3,*
426 *4.1.4, 4.1.5 and 4.1.6*
- 427 IEC 61439-1:2020, *Low-voltage switchgear and controlgear assemblies - Part 1: General rules*
- 428 IEC 61439-7:2022, *Low-voltage switchgear and controlgear assemblies - Part 7: Assemblies*
429 *for specific applications such as marinas, camping sites, market squares, electric vehicle*
430 *charging stations*
- 431 IEC 61543:2022, *Residual current-operated protective devices (RCDs) for household and*
432 *similar use – Electromagnetic compatibility*
- 433 IEC 61851-1:2017, *Electric vehicle conductive charging system - Part 1: General requirements*
- 434 IEC 62873-2, *Residual current operated circuit-breakers for household and similar use – Part 2:*
435 *Residual current devices (RCDs) – Vocabulary*
- 436 IEC 62873-3-1, *Residual current operated circuit-breakers for household and similar use –*
437 *Part 3-1: Particular requirements for RCDs with screwless-type terminals for external copper*
438 *conductors*
- 439 IEC 62873-3-2, *Residual current operated circuit-breakers for household and similar use –*
440 *Part 3-2: Particular requirements for RCDs with flat quick-connect terminations*
- 441 IEC 62873-3-3, *Residual current operated circuit-breakers for household and similar use –*
442 *Part 3-3: Specific requirements for RCDs with screw-type terminals for external untreated*
443 *aluminium conductors and with aluminium screw-type terminals for use with copper or with*
444 *aluminium conductors*

445 **3 Terms and definitions**

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

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

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

NOTE Wherever "RCD" is written in IEC 62873-2, it is to be read as "RDC-DD".

3.1 Terms and definitions relating to RDC-DD

3.1.1

RDC-DD

residual direct current detecting device having the functionality of detection and evaluation of DC residual currents and switching of the monitored circuit when a smooth residual direct current is equal to or above 6 mA

3.1.2

RDC-DD-module

module to detect and evaluate residual direct currents and to provide a signal to an electrically coupled switching device to cause switching of the monitored circuit when a smooth residual direct current is equal to or above 6 mA

3.2 Symbols

Rated current	I_n
Residual current	I_{Δ}
Rated DC residual operating current	$I_{\Delta dc}$
Rated DC residual non-operating current	$I_{\Delta ndc}$
Rated voltage	U_n
Rated operational voltage	U_e
Rated insulation voltage	U_i
Rated making and breaking capacity	I_m
Rated conditional short-circuit current	I_{nc}
Rated conditional residual short-circuit current	$I_{\Delta c}$

3.3

Secondary circuit

circuit connected to the secondary winding of the detection transformer

4 Classification

4.1 RDC-DDs are classified according to the type of construction

4.1.1 RDC-DD consisting of an RDC-DD module electrically coupled to a separate switching device (contactor or relay according to IEC 61851-1) and intended to be integrated into the EVSE

NOTE See Figure 1

This classification is an RDC-DDs without terminals for external conductors according to classification 4.4.5.

4.1.2 RDC-DD with integrated AC, pulsating DC and 6 mA DC detection, evaluation and mechanical switching, suitable for isolation, in one device

NOTE See Figure 2

4.2 According to the number of poles

- two-pole RDC-DD;
- three-pole RDC-DD;
- four-pole RDC-DD

4.3 According to the method of connection

- RDC-DDs, the electrical connections of which are not associated with the mechanical mounting;
- RDC-DDs, the electrical connections of which are associated with the mechanical mounting.

NOTE Examples of this type are:

- bolt-on type;
- screw-in type.

Some RDC-DDs can be of bolt-on type on the line side only, the load terminals being usually suitable for wiring connection.

4.4 According to the type of terminals**4.4.1 RDC-DDs with screw-type terminals for external copper conductors;****4.4.2 RDC-DDs with screwless type terminals for external copper conductors;**

NOTE The requirements for RDC-DDs equipped with this type of terminals are given in IEC 62873-3-1.

4.4.3 RDC-DDs with flat quick-connect terminals for external copper conductors;

NOTE The requirements for RDC-DDs equipped with these types of terminals are given in IEC 62873-3-2.

4.4.4 RDC-DDs with screw-type terminals for external aluminium conductors;

NOTE The requirements for RDC-DDs equipped with these types of terminals are given in IEC 62873-3-3.

4.4.5 RDC-DDs without terminals for external conductors.

NOTE For example RDC-DD built into PCBAs in the EV supply equipment.

4.5 According to range of ambient air temperature**4.5.1 Ambient air temperature range $-5\text{ }^{\circ}\text{C}$ up to $40\text{ }^{\circ}\text{C}$** **4.5.2 Ambient air temperature range $-25\text{ }^{\circ}\text{C}$ up to $40\text{ }^{\circ}\text{C}$** **5 Characteristics of RDC-DDs****5.1 Summary of characteristics**

The characteristics of an RDC-DD shall be stated in the following terms:

- rated current I_n (see 5.2.2);
- rated DC residual operating current $I_{\Delta\text{dc}}$ (see 5.2.3);
- rated DC residual non-operating current $I_{\Delta\text{ndc}}$ (see 5.2.4);
- rated operational voltage U_e (see 5.2.1.1);
- rated frequency (see 5.2.5);
- rated making and breaking capacity I_m (see 5.2.6);
- degree of protection (see IEC 60529);
- rated conditional short-circuit current I_{nc} (see 5.4.2);

- rated conditional residual short-circuit current $I_{\Delta c}$ (see 5.4.3);
- rated voltage of the monitored circuit U_{em} (see 5.2.1.4)

5.2 Rated quantities and other characteristics

5.2.1 Rated voltages

5.2.1.1 Rated operational voltage (U_o)

The rated operational voltage of an RDC-DD is the value of voltage, assigned by the manufacturer, to which its performance is referred.

NOTE The same RDC-DD can be assigned to more than one rated voltage.

5.2.1.2 Rated insulation voltage (U_i)

The rated insulation voltage of an RDC-DD is the value of voltage, assigned by the manufacturer, to which dielectric test voltages and creepage distances are referred.

Unless otherwise stated, the rated insulation voltage is the value of the maximum rated voltage of the RDC-DD. In no case shall the maximum rated voltage exceed the rated insulation voltage.

5.2.1.3 Rated impulse withstand voltage (U_{imp})

The rated impulse withstand voltage of an RDC-DD shall be equal to or higher than the standard values of rated impulse withstand voltage given in Table 4.

5.2.1.4 Rated voltage of the monitored circuit (U_{em})

The rated voltage of the monitored circuit of an RDC-DD is the value of voltage, assigned by the manufacturer, to which the insulation performance of the current transformer is referred. Considering the monitored circuit is installed with non-insulated conductor(s) through the current transformer.

5.2.2 Rated current (I_n)

The value of current, assigned to the RDC-DD by the manufacturer, which the RDC-DD can carry in uninterrupted duty.

5.2.3 Rated DC residual operating current ($I_{\Delta dc}$)

The value of residual operating current, at which the RDC-DD shall operate under specified conditions.

5.2.4 Rated DC residual non-operating current ($I_{\Delta ndc}$)

The value of residual non-operating current, at which the RDC-DD does not operate under specified conditions.

5.2.5 Rated frequency

The rated frequency of an RDC-DD is the power frequency for which the RDC-DD is designed and to which the values of the other characteristics correspond.

NOTE The same RDC-DD can be assigned a number of rated frequencies.

5.2.6 Rated making and breaking capacity (I_m)

The RMS value of the AC component of prospective current, assigned by the manufacturer, which an RDC-DD can make, carry and break under specified conditions.

The conditions are those specified in 9.11.2.2.

5.3 Standard and preferred values

5.3.1 Preferred values of rated operational voltage (U_e)

Preferred values of rated voltage are given in Table 1:

Table 1 – Preferred values of rated voltages

RDC-DD	Circuit supplying the RDC-DD	Rated voltage of RDC-DDs for use in 230 V or 230/400 V or 400 V systems V	Rated voltage of RDC-DDs for use in 120/240 V or 240 V systems V
Two-pole	Single phase (phase to neutral or phase to phase or phase to earthed middle conductor)	230	120
	Single phase (phase to phase)	400	240
	Single phase (phase to phase, 3-wire)		120/240
	Three phase (4-wire) (230/400 V-system phase to neutral or 230 V-system phase to phase)	230	
Three-pole (with three current path)	Three phase (3-wire) (400 V or 230/400 V or 240 V-system)	400	240
Four-pole	Three phase (4-wire) (230/400 V-system)	400	

5.3.2 Preferred values of rated current (I_n)

Preferred values of rated current are 16 A – 20 A – 25 A – 32 A – 40 A – 63 A – 80 A – 100 A – 125 A.

5.3.3 Standard value of rated DC residual operating current ($I_{\Delta dc}$)

Standard value of rated residual operating current is 0,006 A DC.

5.3.4 Standard value of DC residual non-operating current ($I_{\Delta ndc}$)

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

5.3.5 Preferred values of rated frequency

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

If another value is used, the rated frequency shall be marked on the device and the tests carried out at this frequency.

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

The minimum value of the rated making and breaking capacity I_m is 10 I_n or 500 A, whichever is the greater.

The associated power factors are specified in Table 16.

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

The minimum value of the rated residual making and breaking capacity $I_{\Delta m}$ is $10 I_n$ or 500 A, whichever is the greater.

The associated power factors are specified in Table 16.

5.3.8 Standard and preferred values of the rated conditional short-circuit current (I_{nc})

5.3.8.1 Standard values up to and including 10 000 A

Up to and including 10 000 A, the values of the rated conditional short-circuit current I_{nc} are standard and are 3 000 A, 4 500 A, 6 000 A and 10 000 A.

The associated power factors are specified in Table 16.

5.3.8.2 Preferred values above 10 000 A

For values above 10 000 A up to and including 25 000 A, the preferred value is 20 000 A.

The associated power factors are specified in Table 16.

Values above 25 000 A are not considered in this document.

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

5.3.9.1 Values up to and including 10 000 A

Up to and including 10 000 A, the values of the rated conditional residual short-circuit current $I_{\Delta c}$ are standard and are 3 000 A, 4 500 A, 6 000 A and 10 000 A.

The associated power factors are specified in Table 16.

5.3.9.2 Values above 10 000 A

For values above 10 000 A up to and including 25 000 A, the preferred value is 20 000 A.

The associated power factors are specified in Table 16.

Values above 25 000 A are not considered in this document.

5.3.10 Limiting values of break time

5.3.10.1 Limiting values of break time at sudden appearance of direct current

Limiting values of break time for residual direct currents are given in Table 2.

Table 2 – Maximum values of break times for residual direct currents

Standard values of break time at a residual direct current equal to s ¹⁾			
6 mA	60 mA	200 mA	1A, 2.5A and 5A
10,0	0,3	0,1	0.1
¹⁾ For the type test the manufacturer of an RDC-DD (4.1.1) shall specify the reference type of contactor(s) or relay(s) to be used			

5.3.10.2 Limiting values of non-operating time at sudden appearance of alternating residual current

Minimum values of delay time for alternating residual currents (RMS values) are given in Table 3.

Table 3 – Minimum values of non-operating time for alternating residual currents

Minimum values of non-operating time (s) in event of alternating residual currents equal to			
up to 30 mA	60 mA	150 mA	5 A
no tripping	0,3	0,08	0,08

5.3.11 Standard value of rated impulse withstand voltage (U_{imp})

Table 4 gives the standard value of rated impulse withstand voltages as a function of the nominal voltage of the installation.

Table 4 – Rated impulse withstand voltage as a function of the nominal voltage of the installation

Rated impulse withstand voltage U_{imp}	Nominal voltage of the installation	
	Three-phase systems	Single-phase system with mid-point earthed
kV	V	V
2,5		120/240 ^a
4	230/400	120/240, 240 ^b
NOTE For test voltages to check the insulation, see Table 13.		
^a For installation practice in Japan.		
^b For installation practice in North American countries.		

5.4 Coordination with short-circuit protective devices (SCPDs)

5.4.1 General

RDC-DDs shall be protected against short-circuits by means of circuit-breakers or fuses complying with their relevant standards according to the installation rules of IEC 60364.

Coordination between RDC-DDs and the SCPD shall be verified under the general conditions of 9.11.2.1, by means of the tests described in 9.11.2.3 which are designed to verify that there is an adequate protection of the RDC-DDs against short-circuit currents up to the conditional short-circuit current I_{nc} and up to the conditional residual short-circuit current $I_{\Delta c}$.

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

The assigned RMS value of prospective current which an RDC-DD, protected by a SCPD can withstand under specified conditions without undergoing alterations impairing its functions.

The conditions are those specified in 9.11.2.3 a).

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

The assigned value of the residual prospective current which an RDC-DD, protected by an SCPD can withstand under specified conditions without undergoing alterations impairing its functions.

The conditions are those specified in 9.11.2.3 c).

6 Marking and other product information

Each RDC-DD shall be marked in a durable manner with all or, for small apparatus, part of the following data:

- a) the manufacturer's name or trademark;
- b) type designation, catalogue number or serial number;
- c) rated voltage(s);
- d) rated frequency; RDC-DDs with more than one rated frequency (e.g. 50/60 Hz) shall be marked accordingly;
- e) rated current;
- f) rated residual DC operating current as $I_{\Delta dc} = 0,006 \text{ A}$ or 6 mA ;
- g) ambient air temperature range -25°C up to 40°C with the marking , if applicable;
- h) rated making and breaking capacity;
- j) the degree of protection (only if different from IP20);
- k) the position of use, if necessary;
- l) rated residual making and breaking capacity, if different from rated making and breaking capacity, if applicable;
- m) operating means of the test device, marked with the letter "T", if applicable;
- n) wiring diagram.

An associated switching device, if any, shall be marked with the data in accordance with the relevant product standard for that device.

The marking shall be on the RDC-DD itself or on a nameplate or nameplates attached to the RDC-DD and shall be located so that it is legible when the RDC-DD is installed.

If a degree of protection higher than IP20 according to IEC 60529 is marked on the device, it shall comply with it, whatever the method of installation. If the higher degree of protection is obtained only by a specific method of installation and/or with the use of specific accessories (e.g. terminal covers, enclosures), this shall be specified in the manufacturer's literature.

If, for small devices, the space available does not allow all the above data to be marked, at least the information in e), f) and m) shall be marked and visible when the device is installed. The information in a), b), c), k), l), and n) may be marked on the side or on the back of the device and be visible only before the device is installed. Alternatively, the information in n) may be inscribed on the inside of any cover which has to be removed in order to connect the supply wires. Any remaining information not marked shall be given in the manufacturer's catalogues.

The manufacturer of the RDC-DD according to classification 4.1.1 shall provide information to the characteristics (e.g. switching time, DC current breaking capacity) of the suitable contactor(s) or relay(s) to fulfil the requirements of the break time given in Table 2.

An information shall be provided to take into account possible additional delays in the connection between the RDC-DD according to classification 4.1.1 and the respective contactor(s) or relay(s).

The manufacturer shall state the Joule integral I^2t and the peak current I_p withstand capabilities for RDC-DD. Where these are not stated, minimum values as given in Table 15 apply.

Where relevant, the manufacturer shall specify one or more suitable SCPDs in his catalogues and in a sheet accompanying each device.

For RDC-DDs operated by means of two push-buttons, the push-button designed for the opening operation only shall be red and/or be marked with the symbol "O".

Red shall not be used for any other push-button of the RDC-DD. If a push-button is used for closing the contact and is evidently identified as such, its depressed position is sufficient to indicate the closed position.

If a single push-button is used for closing and opening the contacts and is identified as such, the button remaining in its depressed position is sufficient to indicate the closed position. On the other hand, if the button does not remain depressed, an additional means indicating the position of the contacts shall be provided.

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

Terminals intended for the protective conductor, if any, shall be indicated by the symbol  (IEC 60417-5019-2006-08).

The marking shall be indelible, easily legible and not be placed on screws, washers or other removable parts.

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

For universal terminals (for rigid-solid, rigid-stranded and flexible conductors):

- no marking.

For non-universal terminals:

- terminals declared for rigid-solid conductors only shall be marked by the letters "s" or "sol";
- terminals declared for rigid (solid and stranded) conductors only shall be marked by the letter "r".

The markings should appear on the RDC-DD or, if the space available is not sufficient, on the smallest package unit or in technical information.

7 Standard conditions for operation in service and for installation

7.1 Standard conditions

RDC-DDs complying with this document shall be capable of operating under the standard conditions shown in Table 5.

712

Table 5 – Standard conditions for operation in service

Influencing quantity	Standard range of application	Reference value	Test tolerances ⁶⁾
Ambient temperature ^{1) 7)}	–5 °C to +40 °C ²⁾ –25 °C to +40 °C	20 °C	±5 °C
Altitude	Not exceeding 2 000 m		
Relative humidity maximum value 40 °C	50 % ³⁾		
External magnetic field	Not exceeding 5 times the earth's magnetic field in any direction	Earth's magnetic field	⁴⁾
Position	As stated by the manufacturer, with a tolerance of 2° in any direction ⁵⁾	As stated by the manufacturer	2° in any direction
Frequency	Reference value ±5 % ⁶⁾	Rated value	±2 %
Sinusoidal wave distortion	Not exceeding 5 %	Zero	5 %
¹⁾ The maximum value of the mean daily temperature is +35 °C. ²⁾ Values outside the range are admissible where more severe climatic conditions prevail, subject to agreement between manufacturer and user. ³⁾ Higher relative humidities are admitted at lower temperature (for example 90 % at 20 °C). ⁴⁾ When an RDC-DD is installed in proximity of a strong magnetic field, supplementary requirements may be necessary. ⁵⁾ The device shall be fixed without causing deformation liable to impair its functions. ⁶⁾ The tolerances given apply unless otherwise specified in the relevant test. ⁷⁾ Extreme limits of –20 °C and +60 °C are admissible during storage and transportation, and should be taken into account in the design of the device.			

713

714 7.2 Conditions for installations

715 RDC-DDs shall be installed in accordance with the manufacturer's instructions.

716 7.3 Pollution degree

717 RDC-DDs complying with this document are intended for environment with pollution degree 2,
718 i.e. normally, only non-conductive pollution occurs; occasionally, however, a temporary
719 conductivity caused by condensation may be expected.

720 8 Requirements for construction and operation

721 8.1 Design requirements

722 8.1.1 General

723 RDC-DD modules shall be electrically coupled to a separate switching device (contactor or
724 relay), in accordance with IEC 61851-1. The RDC-DD module shall be electrically compatible
725 with the separate switching device (i.e. current and voltage).

726 The residual direct current detecting and the residual current release shall be located between
727 the incoming and outgoing connections of the RDC-DD.

728 The DC residual current detection shall be polarity independent and the design of the RDC-DD
729 shall allow connection without any distinction of line and load side.

730 It shall not be possible to alter the operating characteristics of the RDC-DD by means of external
731 interventions.

732 The RDC-DD shall not initiate an intentional current to the PE of the installation to operate the
733 protective device. An intentional short-circuit current shall also not be used to operate the
734 protective device.

735 A standing current flowing under normal conditions on the supply side from the RDC-DD to the
736 protective conductor shall not exceed 1 mA RMS at $1,1 U_e$ with contacts in both open and
737 closed positions. The current of the control pilot communication signal is not considered as part
738 of the standing current.

739 The RDC-DD shall be designed such that in the event that it loses its supply, the contacts of
740 the switching device are opened.

741 For RDC-DD module electrically coupled to a separate switching device (contactor or relay
742 according to IEC 61851-1) in case the connection between the different assembled parts are
743 lost the contacts of the switching device shall open.

744 The RDC-DD shall provide indication or signal in case it has tripped or it has provided a tripping
745 signal or tripping action.

746 *Compliance is checked by inspection and verification at rated voltage, if applicable.*

747 The SCPD with which the RDC-DD is declared to be used in conjunction with shall pass all
748 relevant tests of its own product standard with the RDC-DD connected and in use.

749 **8.1.2 Mechanism**

750 The moving contacts of all poles of multipole RDC-DD shall be mechanically coupled so that all
751 poles, if any, make and break substantially together, whether operated manually or
752 automatically.

753 The neutral pole of four-pole RDC-DDs shall not close after and shall not open before the other
754 poles.

755 Compliance is checked by inspection and by manual tests, using any appropriate means
756 (e.g.: indicator lights, oscilloscope).

757 RDC-DDs with manual operating means shall have a trip-free mechanism.

758 If a mechanical indicator is used to indicate the position of the main contacts, this shall show
759 the colour red for the closed position and the colour green for the open position.

760 NOTE 1 In the USA, the colours red and green are not used for contact position indication.

761 *Compliance is checked by inspection and by the tests of 9.15.*

762 Where an operating means is used to indicate the position of the contacts, the operating means,
763 when released, shall automatically take up the position corresponding to that of the moving
764 contacts; in this case, the operating means shall have two distinct rest positions corresponding
765 to the position of the contacts. But, for automatic opening, a third distinct position of the
766 operating means may be provided, in which case it shall be necessary to reset the RDC-DD
767 manually before reclosing is possible.

768 When an indicator light is used, this shall be lit when the RDC-DD is in a closed position and
769 be of a bright colour.

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

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

773 If the cover is used as a guiding means for push-buttons, it shall not be possible to remove the
774 buttons from the outside of the RDC-DD.

775 Operating means, if any, shall be securely fixed on their shafts and it shall not be possible to
776 remove them without the aid of a tool.

777 Operating means directly fixed to covers, if any, are allowed. If the operating means has an
778 "up-down" movement, when the RDC-DD is mounted as in normal use, the contacts shall be
779 closed by the up movement.

780 NOTE 2 Provisionally, in certain countries top to bottom closing is allowed.

781 *Compliance with the above requirements is checked by inspection, by manual test and, for the*
782 *trip-free mechanism, by the test of 9.15.*

783 **8.1.3 Clearances and creepage distances**

784 **8.1.3.1 General**

785 The minimum required clearances and creepage distances are given in Table 6, which is based
786 on the RDC-DD being designed for operating in an environment with pollution degree 2 and
787 overvoltage category III.

788 NOTE 1 See Annex B.

789 Parts of PCBs connected to the live parts protected against pollution by the use of a type 2
790 protection according to IEC 60664-3 are exempt from this verification.

791 For clearances on printed wiring material, Note c in Table F.2 of IEC 60664-1:2020 applies. For
792 printed wiring material, the values for pollution degree 1 apply except that the value shall not
793 be less than 0,04 mm, as specified in Table F.5 of IEC 60664-1:2020. A protection by means
794 of a solder resist of high quality is the minimum requirement to allow this clearance reduction.

795 The insulating materials are classified into material groups on the basis of their comparative
796 tracking index (CTI) according to IEC 60664-1.

797 NOTE 2 The comparative tracking index (CTI) is declared by the manufacturer on the basis of tests carried out on
798 the insulating material.

799

800 **8.1.3.2 Clearances**

801 *Compliance for item 1 in Table 6 is checked by measurement and by the tests of 9.7.7.3.2. The*
802 *test is carried out with samples not submitted to the humidity treatment described in 9.7.1.*

803 *Compliance for items 2, 3 and 4 in Table 6 is checked by measurement.*

804 The clearances of items 1, 2 and 4 (except accessible surface after installation, see the note
805 below) may be reduced provided that the measured clearances are not shorter than the
806 minimum allowed in IEC 60664-1 for homogenous field conditions. In this case, compliance for
807 item 1 is checked by the test 9.7.7.3.2 and compliance for items 2 and 4 is checked by the test
808 9.7.7.2.

809 NOTE Accessible surface after installation means any surface accessible by the user when the RDC-DD is installed
810 according to the manufacturer's instructions. The test finger can be applied to determine whether a surface is
811 accessible or not.

812 **8.1.3.3 Creepage distances**813 *Compliance for items 1, 2, 3 and 4 in Table 6 is checked by measurement.*814 **8.1.3.4 Solid insulation**815 *Compliance is checked by the tests according to 9.7.2, 9.7.3, 9.7.4, 9.7.5 and 9.7.7 as*
816 *applicable.*

817 NOTE Information on the requirements for design of solid insulation is provided in IEC 60664-1.

818 **Table 6 – Minimum clearances and creepage distances**

	Minimum clearances mm			Minimum creepage distances ^{e, f} mm											
				Group IIIa ^h (175 ≤ CTI < 400) ^d				Group II (400 ≤ CTI < 600) ^d				Group I (600 ≤ CTI) ^d			
	Rated operational voltage V			Working voltage ^e V											
	<i>U_{imp}</i>														
	2,5 kV	4 k V	4 kV												
Description/ Item	120/240 120	120/ 240 230 240 400	230/400 230 400	> 25 ≤ 50 ⁱ	120	250	400	> 25 ≤ 50 ⁱ	120	250	400	> 25 ≤ 50 ⁱ	12 0	250	400
1. Between live parts which are separated when the main contacts are in the open position ^a	1,5	3,0	3,0	1,2	2,0	3,0	4,0	0,9	2,0	3,0	3,0	0,6	1,2	3,0	3,0
2. Between live parts of different polarity ^a	1,5	3,0	3,0	1,2	1,5	3,0	4,0	0,9	1,5	3,0	3,0	0,6	1,5	3,0	3,0
3. Between circuits supplied from different sources, one of which being PELV or SELV ^g	3,0	6,0	8,0		3,0	6,0	8,0		3,0	6,0	8,0		3,0	6,0	8,0

				Rated operational voltage V					
				120 / 240	230 / 400	120 / 240	230 / 400	120 / 240	230 / 400
4. Between live parts and – accessible surfaces of operating means – screws or other means for fixing covers which have to be removed when mounting the RDC-DD – surface on which the RDC-DD is mounted^b – screws or other means for fixing the RDC-DD^b – metal covers or boxes^b – other accessible metal parts^c – metal frames supporting flush-type RDC-DDs	1,5	3,0	3,0	1,5	4,0	1,5	3,0	1,5	3,0

Care should be taken to provide adequate clearances and creepage distances between live parts of different polarity of RDC-DDs. If the clearance and creepage distances requirements are not fulfilled to all the surfaces adjacent to the RDC-DD, appropriate information will be provided for installation purposes.

NOTE 1 The values given for 400 V are also valid for 440 V.

NOTE 2 The parts of the neutral path, if any, are considered to be live parts.

a For auxiliary and control contacts the values are given in the relevant standard.

b The values are doubled if clearances and creepage distances between live parts of the device and the metallic screen or the surface on which the RDC-DD is mounted are not dependent on the design of the RDC-DD only, so that they can be reduced when the RDC-DD is mounted in the most unfavourable condition.

c 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 straight unjointed test finger according to 9.6 (see Figure 3).

d See IEC 60112.

e 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 B.

f Creepage distances cannot be less than the associated clearances.

g To cover all different voltages including ELV in an auxiliary contact.

h For material group IIIb ($100 \text{ V} \leq \text{CTI} < 175 \text{ V}$), the values for material group IIIa multiplied by 1,6 apply.

i For working voltages up to and including 25 V, reference may be made to IEC 60664-1.

819

819 8.1.4 Screws, current-carrying parts and connections

821 8.1.4.1 Connections, whether electrical or mechanical, shall withstand the mechanical stresses occurring in normal use.

823 Screws operated when mounting the RDC-DD during installation shall not be of the thread-cutting type.

Screws (or nuts) that are used for mounting the RDC-DD include screws for fixing covers or cover-plates, but not connecting means for screwed conduits and for fixing the base of an RDC-DD.

Compliance is checked by inspection and by the test of 9.4.

Screwed connections are considered as checked by the tests of 9.8, 9.11, 9.12, 9.13 and 9.20.

8.1.4.2 For screws in engagement with a thread of insulating material and which are operated when mounting the RDC-DD during installation, correct introduction of the screw into the screw hole or nut shall be ensured.

Compliance is checked by inspection and by manual test.

The requirement with regard to correct introduction is met if 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.

8.1.4.3 Electrical connections shall be so designed 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 resilience in the metallic parts to compensate for any possible shrinkage or yielding of the insulating material.

Compliance is checked by inspection.

NOTE The suitability of the material is considered with respect to the stability of the dimensions.

8.1.4.4 Current-carrying parts including parts intended for protective conductors, if any, shall be made of a metal having, under the conditions occurring in the equipment, mechanical strength, electrical conductivity and resistance to corrosion adequate for their intended use.

Examples of suitable materials are given below:

- copper;
- an alloy containing at least 58 % copper for parts worked cold, or at least 50 % copper for other parts;
- other metal or suitably coated metal, no less resistant to corrosion than copper and having mechanical properties no less suitable.

In case of using ferrous alloys or suitably coated ferrous alloys, compliance to resistance to corrosion is checked by a test of resistance to rusting (9.22).

The requirements of this subclause do not apply to contacts, magnetic circuits, heater elements, bimetals, shunts, parts of electronic devices or to screws, nuts, washers, clamping plates, similar parts of terminals and parts of the test circuit.

8.1.5 RDC-DD provided with terminals for external conductors

8.1.5.1 Terminals for external conductors shall be such that the conductors may be connected so as to ensure that the necessary contact pressure is maintained permanently.

Connection arrangements intended for busbar connection are admissible, provided they are not used for the connection of cables.

Such arrangements may be either of the plug-in or of the bolt-on type.

The terminals shall be readily accessible under the intended conditions of use.

Compliance is checked by inspection, by the tests of 9.5 for screw-type terminals, by specific tests for plug-in or bolt-on RDC-DDs included in the document, or by the tests IEC 62873-3-series, as relevant for the type of connection.

8.1.5.2 RDC-DDs shall be provided with:

- either terminals that shall allow the connection of copper conductors having nominal cross sectional areas as shown in Table 7; or

NOTE Examples of possible designs of screw-type terminals are given in Annex F.

- screwless type terminals for copper conductors according to IEC 62873-3-1; or
- flat quick-connect terminals for copper conductors according to IEC 62873-3-2; or
- terminals for untreated aluminium conductors and with aluminium screw-type terminals for use with copper or with aluminium conductors according to IEC 62873-3-3.

Compliance is checked by inspection, by measurement and by fitting, in turn, one conductor of the smallest and one of the largest cross-sectional area as specified.

Table 7 – Connectable cross-sections of copper conductors for screw-type terminals

Rated current ^{a)} A		Range of nominal cross-section to be clamped ^{b)} mm ²	
Greater than	Up to and including	Rigid (solid or stranded ^{c)} conductors	Flexible conductors
–	13	1 to 2,5	1 to 2,5
13	16	1 to 4	1 to 4
16	25	1,5 to 6	1,5 to 6
25	32	2,5 to 10	2,5 to 6
32	50	4 to 16	4 to 10
50	63	10 to 25	10 to 16
NOTE Information on AWG is given in Annex G.			
^{a)} A range of RDC-DDs having the same fundamental design and having the same design and construction of terminals, the terminals are fitted with copper conductors of the smallest cross-section for the minimum rated current and largest cross-section for the maximum rated current, as specified, solid and stranded, as applicable.			
^{b)} It is required that, for current ratings up to and including 50 A, terminals be designed to clamp solid conductors as well as rigid stranded conductors. Nevertheless, it is permitted that terminals for conductors having cross-sections from 1 mm ² up to 6 mm ² be designed to clamp solid conductors only.			
^{c)} Rigid stranded conductors shall be used for conductors having cross-sections from 1,5 mm ² up to 50 mm ² and shall be in compliance with class 2 of IEC 60228, related to stranded conductors for single-core.			

8.1.5.3 The means for clamping the conductors in the terminals shall not serve to fix any other component, although they may hold the terminals in place or prevent them from turning.

Compliance is checked by inspection and by the tests of 9.5.

8.1.5.4 Terminals for rated currents up to and including 32 A shall allow the conductors to be connected without special preparation.

885 *Compliance is checked by inspection.*

886 NOTE The term "special preparation" covers soldering of the conductor wire, the use of cable lugs, the formation
887 of eyelets, etc., but not the reshaping of the conductor before its introduction into the terminal or the twisting of a
888 flexible conductor to consolidate the end.

889 **8.1.5.5** Terminals shall have adequate mechanical strength.

890 Screws and nuts for clamping the conductors shall have a metric ISO thread or a thread
891 comparable in pitch and mechanical strength.

892 *Compliance is checked by inspection and by the tests of 9.4 and 9.5.2.*

893 **8.1.5.6** Terminals shall be so designed that they clamp the conductor without undue damage
894 to the conductor.

895 *Compliance is checked by inspection and by the test of 9.5.3.*

896 **8.1.5.7** Terminals shall be so designed that they clamp the conductor reliably and between
897 metal surfaces.

898 *Compliance is checked by inspection and by the tests of 9.4 and 9.5.2.*

899 **8.1.5.8** Terminals shall be so designed or positioned that neither a rigid solid conductor nor
900 a wire of a stranded conductor can slip out while the clamping screws or nuts are tightened.

901 This requirement does not apply to lug terminals.

902 *Compliance is checked by the test of 9.5.4.*

903 **8.1.5.9** Terminals shall be so fixed or located that, when the clamping screws or nuts are
904 tightened or loosened, their fixings do not work loose.

905 These requirements do not imply that the terminals shall be so designed that their rotation or
906 displacement is prevented, but any movement shall be sufficiently limited so as to prevent non-
907 compliance with the requirements of this document.

908 The use of sealing compound or resin is considered to be sufficient for preventing a terminal
909 from working loose, provided that

- 910 – the sealing compound or resin is not subject to stress during normal use;
- 911 – the effectiveness of the sealing compound or resin is not impaired by temperatures attained
912 by the terminal under the most unfavourable conditions specified in this document.

913 *Compliance is checked by inspection, by measurement and by the test of 9.4.*

914 **8.1.5.10** Clamping screws or nuts of terminals intended for the connection of protective
915 conductors shall be adequately secured against accidental loosening and it shall not be possible
916 to unclamp them without a tool.

917 *Compliance is checked by manual test.*

918 In general, the designs of terminals of which examples are shown in Annex F provide sufficient
919 resilience to comply with this requirement; for other designs, special provisions, such as the
920 use of an adequately resilient part which is not likely to be removed inadvertently, may be
921 necessary.

8.1.5.11 Screws and nuts of terminals intended for the connection of external conductors shall be in engagement with a metal thread and the screws shall not be of the tapping screw type.

8.1.6 Special requirements for RDC-DD according 4.1.1

The RDC-DD according to classification 4.1.1 shall comply to 8.8 of IEC 61851-1 (ED4) and tested in its final configuration inside the EVSE.

8.2 Protection against electric shock

RDC-DDs shall be so designed that, when they are mounted and wired as for normal use, live parts are not accessible.

For RDC-DD according to classification 4.1.1 this clause applies, when mounted in the EVSE.

NOTE The term "normal use" implies that RDC-DDs are installed according to the manufacturer's instructions.

A part is considered to be "accessible" if it can be touched by the standard test finger (see 9.6).

For RDC-DDs, external parts, other than screws or other means for fixing covers and labels, which are accessible when the RDC-DDs are mounted and wired as in normal conditions of use, shall either be of insulating material, or be lined throughout with insulating material, unless the live parts are within an internal enclosure of insulating material.

Linings shall be fixed in such a way that they are not likely to be lost during installation of the RDC-DDs. They shall have adequate thickness and mechanical strength and shall provide adequate protection at places where sharp edges occur.

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

For plug-in RDC-DDs, external parts, other than screws or other means for fixing covers, which are accessible for normal use, shall be made of insulating material.

Metallic operating means shall be insulated from live parts and their conductive parts, which otherwise would be exposed conductive parts, shall be covered by insulating material, with the exception of means for coupling the insulated operating means of several poles.

Metal parts of the mechanism shall not be accessible. In addition, they shall be insulated from accessible metal parts, from metal frames supporting the base of flush-type RDC-DDs, from screws or other means for fixing the base to its support and from metal plates used as support.

It shall be possible to replace plug-in RDC-DDs easily without touching live parts.

Lacquer and enamel are not considered to provide adequate insulation for the purpose of this subclause (8.2).

Compliance is checked by inspection and by the test of 9.6.

8.3 Dielectric properties

RDC-DDs shall have adequate dielectric properties.

Control circuits connected to the main circuit shall not be damaged by high DC voltage owing to insulation measurements that are normally carried out after RDC-DDs are installed.

Compliance is checked by the tests of 9.7.

8.4 Temperature rise

8.4.1 Temperature rise limits

The RDC-DD according to classification 4.1.1 shall comply to 8.4 of IEC 61851-1 (ED4), considering values of this document and it is tested in its final configuration inside the EVSE.

For RDC-DD according to classification 4.1.2, the temperature rises of the parts of the RDC-DD specified in Table 8, measured under the conditions specified in 9.8.2, shall not exceed the limiting values stated in Table 8.

The RDC-DD shall not suffer damage impairing its functions and its safe use.

Table 8 – Temperature-rise values

Parts ^{a, b}	Temperature rise K
RDC-DD according to classification 4.1.1 considered as Built-in components (see table 6 of IEC 61439-1)	60
Terminals for external connections	65
External parts liable to be touched during manual operation of the RDC-DD, including operating means of insulating material and metallic means for coupling insulated operating means of several poles	40
External metallic parts of operating means	25
Other external parts, including the face of the RDC-DD in direct contact with the mounting surface	60
^a No value is specified for the contacts, since the design of most RDC-DDs 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 reliability (see 9.19) 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 RDC-DD shall not be impaired.	

8.4.2 Ambient air temperature

For RDC-DD according to classification 4.1.1 the ambient air temperature shall comply to 8.4 of IEC 61851-1 (ED4).

The temperature-rise limits given in Table 8 are applicable only if the ambient air temperature remains between the limits given in Table 5.

8.5 Operating characteristics

The operating characteristic of RDC-DDs shall comply with the requirements of 9.9.1, 9.9.2 and 9.9.3 as applicable.

8.6 Electrical endurance

RDC-DDs shall be capable of performing an adequate number of electrical operations.

The RDC-DD shall withstand an inrush current representing a typical charger of an electric vehicle.

NOTE The requirement for the inrush current of an electric vehicle is based on ISO 17409.

Compliance is checked by the tests of 9.10.

8.7 Performance at short-circuit currents

RDC-DDs shall be capable of performing a specified number of short-circuit operations during which they shall neither endanger the operator nor initiate a flashover between live conductive parts or between live conductive parts and earth.

Compliance is checked by the tests of 9.11.

8.8 Resistance to mechanical shock and impact

RDC-DDs shall have adequate mechanical behaviour so as to withstand the stresses imposed during installation and use.

Compliance is checked by the test of 9.12.

8.9 Resistance to heat

RDC-DDs shall be sufficiently resistant to heat.

Compliance is checked by the test of 9.13.

8.10 Resistance to abnormal heat and to fire

External parts of RDC-DDs made of insulating material shall not be liable to ignite and to spread fire if current-carrying parts in their vicinity, under fault or overload conditions, attain a high temperature. The resistance to abnormal heat and to fire of the other parts made of insulating material is considered as checked by the other tests of this document.

Compliance is checked by inspection and by the test of 9.14.

8.11 Performance of the test function

An RDC-DD shall be provided with a manual or an automatically initiated test function or both that checks the residual DC sensing and the detection circuit.

Where provided the automatic test function shall be performed at every switch on and at intervals not exceeding at least once a day.

During automatic testing, it is not required to open the contacts.

NOTE 1 The mechanical parts of the mechanism are verified by the endurance tests and the contacts are verified by the short circuit tests. For that reason, these parts are expected to be highly reliable and need not to be included in a periodic test.

In the event of a manual test, the RDC-DD shall trip.

NOTE 2 Additional requirements and testing procedure for testing the performance manually or automatically are under consideration.

In the event that a malfunction is detected during automatic testing, the RDC-DD shall cause disconnection of the supply to the EV.

The protective conductor of the installation shall not become live when the test function is initiated, and it shall not be possible to energize the circuit on the load side when the RDC-DD is in the open position and connected as in normal use.

1020 For verification, the manufacturer shall provide the necessary documentation of the test function
1021 circuit.

1022 *Compliance is checked by tests of 9.16.*

1023 **8.12 Behaviour of RDC-DDs in the case of current surges caused by impulse voltages**

1024 RDC-DDs shall adequately withstand the current surges to earth due to the loading of the
1025 capacitances of the installation and the current surges to earth due to flashover in the
1026 installation.

1027 *Compliance is checked by the tests of 9.18.*

1028 **8.13 Reliability**

1029 RDC-DDs shall operate reliably even after long service, taking into account the ageing of their
1030 components.

1031 *Compliance is checked by the tests of 9.19 and 9.20.*

1032 **8.14 Electromagnetic compatibility (EMC)**

1033 Residual current devices shall comply with relevant EMC requirements.

1034 *Compliance is checked by the tests of 9.21.*

1035 **8.15 Behaviour of the correct operation for three- and four- pole RDC-DD powered on** 1036 **two poles only**

1037 Three- and four-pole RDC-DD shall be able to operate if they are powered on only two poles,
1038 unless the EVSE switches off in case of loss of the supply.

1039 *Compliance is checked by the tests of 9.17.*

1040 **9 Tests**

1041 **9.1 General**

1042 **9.1.1 Type Tests**

1043 The characteristics of RDC-DDs are checked by means of type tests.

1044 For certification purposes, type tests are carried out in test sequences.

1045 NOTE The term "certification" denotes:

- 1046 – either manufacturer's declaration of conformity;
- 1047 – or third-party certification, for example by an independent certification body.

1048 The test sequences and the number of samples to be submitted are stated in Annex A.

1049 Unless otherwise specified, each type test (or sequence of type tests) is made on RDC-DDs in
1050 a clean and new condition, the influencing quantities having their normal reference values (see
1051 Table 5).

9.1.2 Testing procedure for the different type of RDC-DDs

9.1.2.1 RDC-DDs classified according to 4.1.1

RDC-DD according to classification 4.1.1 shall be assembled as declared by the manufacturer into the EVSE. Afterward, the testing procedure given in this standard shall be applied.

In case of RDC-DD intended to be assembled with several switching devices, the testing procedure has to be repeated with each device declared by the manufacturer, unless the switching devices is of the same fundamental design according to A.3.1.

9.1.2.2 RDC-DDs classified according to 4.1.2

RDC-DD according to classification 4.1.2 shall be tested according to Annex I and according to IEC 61008-2-1, IEC 61008-2-2, IEC 61009-2-1 or IEC 61009-2-2, as applicable for type A classification, being supplied at rated voltage, unless otherwise specified in this document.

The testing procedure given in this standard shall be applied together with the additional requirements and tests given in Annex I.

If at the end of the test clause of this standard, the operating characteristics are checked, this verification shall be done additionally at the end of the corresponding clause of the relevant RCD standard.

9.1.3 Routine tests

Routine tests to be carried out by the manufacturer on each device are given in Annex D.

9.2 Test conditions

9.2.1 General test conditions

Where tolerances are not specified, type tests are carried out at values not less severe than those specified in this document. Unless otherwise specified, tests are carried out at the rated frequency $\pm 5\%$; tolerance for voltage and current is $\pm 5\%$.

During the tests, no maintenance or dismantling of the samples is allowed.

9.2.2 RDC-DDs classified according to 4.1.1

The RDC-DD classified according to 4.1.1 is mounted and wired according to manufacturer's instructions into the EVSE, unless otherwise specified in this document.

9.2.3 RDC-DDs classified according to 4.1.2

The RDC-DD classified according to 4.1.2 is mounted individually according to manufacturer's instructions and in free air, at an ambient temperature between 20 °C and 25 °C, unless otherwise specified, and is protected against undue external heating or cooling.

RDC-DDs designed for installation in individual enclosures are tested in the smallest of such enclosures specified by the manufacturer.

NOTE 1 An individual enclosure is an enclosure designed to accept one device only.

Unless otherwise specified, the RDC-DD is wired with the appropriate cable having the cross-section specified in Table 9 and is fixed on a dull black painted plywood board of not less than 20 mm in thickness, the method of fixing being in compliance with the requirements relating to the indications of the manufacturer concerning mounting.

Table 9 – Test copper conductors corresponding to the rated currents

Rated current		6	13	20	25	32	50
I_n	$I_n \leq$	$< I_n \leq$	$< I_n \leq$	$< I_n \leq$	$< I_n \leq$	$< I_n \leq$	$< I_n \leq$
A	6	13	20	25	32	50	63
S mm ²	1	1,5	2,5	4	6	10	16

NOTE 2 For AWG copper conductors, see Annex G.

Where tolerances are not specified, type tests are carried out at values not less severe than those specified in this document. Unless otherwise specified, tests are carried out at the rated frequency $\pm 5\%$; tolerance for voltage and current is $\pm 5\%$.

During the tests, no maintenance or dismantling of the samples is allowed.

For the tests of 9.8, 9.9, 9.10, 9.19.3 and 9.20, the RDC-DD is connected as follows:

- the connections are made by means of single-core, PVC-insulated copper cables;
- the connections are in free air and spaced not less than the distance existing between the terminals;
- the minimum length of each temporary connection from terminal to terminal is:
 - 1 m for cross-sections $\leq 10 \text{ mm}^2$;
 - 2 m for cross-sections $> 10 \text{ mm}^2$.

The tightening torques to be applied to the terminal screws are two-thirds of those specified in Table 10.

For RDC-DDs with dependent manual operation, an operating speed of 0,1 ($1 \pm 25\%$) m/s shall be used during actuation for the tests of 9.10 and 9.11. The speed is measured at the extremity when and where the operating means of the test apparatus touches the actuating means of the RDC-DD under test. For rotary knobs, the angular velocity shall correspond substantially to the above conditions when referring to the speed of the operating means (at its extremities) of the RDC-DD under test.

9.3 Test of indelibility of marking

The test is carried out by rubbing the marking by hand for 15 s with a piece of cotton cloth soaked with water and again for 15 s with a piece of cotton cloth soaked with an aliphatic solvent hexane (with a content of aromatics of maximum 0,1 % volume, a kauributanol value of 29, an initial boiling point approximately 65 °C, a dry point of approximately 69 °C and a specific gravity of 0,68 g/cm³).

Markings made by impressing, moulding, engraving or laser printing are not subjected to this test.

After this test, the marking shall be easily legible. The marking shall also remain easily legible after all the tests of this document.

It shall not be easily possible to remove labels and they shall show no curling.

9.4 Test of reliability of screws, current-carrying parts and connections

Compliance with the requirements of 0 is checked by inspection and, for screws and nuts which are operated when mounting and connecting the RDC-DD, by the following test.

The screws or nuts are tightened and loosened: