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

Interested committees:

Title: Draft BS EN 63464-1 Ed.1.0 BS EN 63464-1 Medical electrical equipment. Particular requirements for the basic safety and essential performance of neutron capture therapy equipment.

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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.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.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	Comment (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/1406/CD

COMMITTEE DRAFT (CD)

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SUPERSEDES DOCUMENTS:

23E/1316/NP, 23E/1324A/RVN

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

SECRETARIAT:

Italy

SECRETARY:

Mr Sergio Bossi

OF INTEREST TO THE FOLLOWING COMMITTEES:

TC 9,TC 64,TC 69,SC 77B,SC 121A,SC 121B,SyC
LVDC

HORIZONTAL FUNCTION(S):

ASPECTS CONCERNED:

Electromagnetic Compatibility,Safety

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TITLE:

<p>Protective devices based on semiconductor technology for household and similar use - Part 1: Semiconductor Residual current operated Circuit-Breakers with integral Overcurrent protection for household and similar uses (SC-RCBOs)

NOTE FROM TC/SC OFFICERS:

Secretary NOTE: This document was developed in IEC TC23 SC23E WG12. Some points are still being under consideration and in preparation by WG12 (e.g. annexes A to J). WG12 worked out this working draft covering the principles and key points for this new SC-RCBO product standard. Requirements and tests are described for key items. Yellow marked text is still under consideration in WG12.

With the decision to publish this document as 1st CD, national committees are invited to review the content and provide feedback, with a focus on the principles and technical content of the draft IEC 63464-1.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

PROTECTIVE DEVICES BASED ON SEMICONDUCTOR TECHNOLOGY FOR HOUSEHOLD AND SIMILAR USE

Part 1: Semiconductor Residual current operated Circuit-Breakers with integral Overcurrent protection for household and similar uses

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

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

529
530 Full information on the voting for its approval can be found in the report on voting indicated in
531 the above table.

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

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

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

- 540 • reconfirmed,
- 541 • withdrawn,
- 542 • replaced by a revised edition, or
- 543 • amended.

544

INTRODUCTION

The introduction is an optional/conditional element of the text.

For rules on the drafting of the introduction, refer to the ISO/IEC Directives, Part 2:2021,
[Clause 13](#).

PROTECTIVE DEVICES BASED ON SEMICONDUCTOR TECHNOLOGY FOR HOUSEHOLD AND SIMILAR USE

Part 1: Semiconductor Residual current operated Circuit-Breakers with integral Overcurrent protection for household and similar uses

1 Scope

This international standard applies to semiconductor residual current operated circuit breakers with integral overcurrent protection (SC-RCBOs) for household and similar uses, for rated voltages not exceeding 440 V AC with rated frequencies of 50 Hz, 60 Hz or 50/60 Hz or 400V DC, rated currents not exceeding 125 A and rated short-circuit capacity not exceeding 25 000 A.

These devices are intended to provide fault protection, the exposed conductive parts of the installation being connected to an appropriate earth electrode, and to protect against overcurrents the wiring installations of buildings and similar applications. In accordance with IEC 60364-4-42, SC-RCBOs with a rated residual operating current not exceeding 300 mA can also be used to provide protection against fire hazards due to a persistent earth fault current.

SC-RCBOs having a rated residual operating current not exceeding 30 mA for AC and not exceeding 80 mA at DC are used to also provide additional protection in the case of failure of the protective provisions against electric shock.

SC-RCBOs are protective devices with semiconductor switching elements and, for isolation function, mechanical switching elements connected in series, performing simultaneously the functions of detection of the residual current, of comparison of the value of this current with the residual operating value and opening of the protected circuit when the residual current exceeds this value. SC-RCBO also perform the function of making, carrying and breaking overcurrent under specified conditions.

The requirements for SC-RCBOs comply with the general safety requirements of IEC 60755 series.

SC-RCBOs are intended to be operated by ordinary or uninstructed persons and designed not to require maintenance.

The requirements of this document apply for standard conditions. Additional requirements can be necessary for SC-RCBOs used in locations having more severe environmental conditions. SC-RCBOs are intended for use in an environment with pollution degree 2 and overvoltage category III.

SC-RCBOs are suitable for isolation.

SC-RCBOs, with the exception of those with an uninterrupted neutral, are suitable for use in IT systems.

SC-RCBOs of the general type are resistant to current surges, including the case where surge voltages (as a result of switching transients or induced by lightning) cause loading currents in the installation without occurrence of flashover.

SC-RCBOs of type S are considered to be sufficiently proofed against unwanted tripping even if the surge voltage causes a flashover and a follow-on current occurs.

This document also applies to SC-RCBO having the possibility of changing specific settings, provided that the means for changing from one setting to another is not accessible in normal service and that the setting cannot be changed by ordinary persons.

This document also applies to SC-RCBOs with one 2-poles, 3-poles or 4-poles input and several 2-poles, 3-poles or 4 poles outputs as defined in Annex K.

This document also applies to SC-RCBO with the ability to be configured (either locally or remotely). This document does not apply to SC-RCBO with an external auxiliary supply.

This document is intended to be used as a stand-alone standard.

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 61009-1:2024

IEC 61000-4-5 Edition 3.1 2017-08 *(Reference to be added to IEC 63464-1 with the test)*

IEC 61000-4-12 Edition 3.0 2017-07 *(Reference to be added to IEC 63464-1 with the test)*

Normative reference to be completed at later stage

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62873-2 and the following apply.

If in the following terms and definition are new descriptions defined compared to IEC 62873-2, the new terms and definitions apply.

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

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

3.1

Semiconductor residual current operated circuit-breaker with integral overcurrent protection

SC-RCBO

residual current operated circuit-breaker designed to perform the functions of protection against overloads and/or short circuits which integrates power semiconductor switching elements and isolation contacts connected in series.

NOTE 1 to entry: The term "solid state" is often used as a synonymous of "semiconductor".

[SOURCE: IEC 62873-2:2016, modified – " which integrates power semiconductor switching elements and isolation contacts connected in series" has been added]

3.1.1**Semiconductor non-hybrid RCBO**

SC-RCBO without additional mechanical switching elements in parallel to the power semiconductor switching elements.

3.1.2**Semiconductor hybrid RCBO**

SC-RCBO with additional mechanical contacts in parallel to the power semiconductor switching elements.

3.2**Isolation contacts**

mechanical contacts ensuring the suitability for isolation of the SC-RCBO and able to make, carry and break the rated current.

[SOURCE: IEC 60947-10, 3.9]

3.3**Open position**

<of a SC-RCBO> position in which the predetermined clearance between open contacts in the main circuit of the SC-RCBO is secured.

[SOURCE: IEC 62873-2:2016 © IEC 2016, 3.3.20, modified – In the definition, "<of a mechanical switching device>" has been replaced by "<of a SC-RCBO>" and "RCD" has been replaced by "SC-RCBO".]

3.4**Standby position**

<of a SC-RCBO> position in which the current of the main circuit is interrupted and limited to the standby current.

NOTE 1 to entry: Standby position is an intentional state of an SC-RCBO waiting for a closing or opening command and not a transitory phase of a switching operation.

NOTE 2 to entry: Isolation is not provided in this position

3.5**Closed position**

<of a SC-RCBO> position in which the predetermined continuity of the main circuit of the SC-RCBO is secured

[SOURCE: IEC 62873-2:2016 © IEC 2016, 3.3.19, modified – In the definition, "<of a mechanical switching device>" has been replaced by "<of a SC-RCBO>" and "RCD" has been replaced by "SC-RCBO".]

3.6**Parallel mechanical contacts**

<of a SC-RCBO> integral mechanical switching elements in parallel to the power semiconductor.

[SOURCE: IEC 60947-10, 3.10]

3.7**Power semiconductor**

semiconductor component used to make, carry and break the current in the main circuit

3.8**Standby current**

<of a SC-RCBO> electric current which flows through each overcurrent protected pole, with SC-RCBO in standby position, under defined testing conditions

[SOURCE: IEC 60947-10, 3.16 modified]

3.9**Main circuit**

<of a SC-RCBO> all the conductive parts or components of the SC-RCBO, included in the circuit which is intended to carry, make, or break the current to the load

[SOURCE: IEC 62873-2:2016 © IEC 2016, 3.3.23, modified by this new definition]

3.10**Maximum admissible short-circuit current rate of rise**

$$\left(\frac{\Delta i}{\Delta t}\right)_{max}$$

maximum admissible rate of rise of the short-circuit current assigned to the SC-RCBO.

3.11**Limitation time**

t_L

interval of time between the onset of the short-circuit current and the time when the let-through current is reached.

[SOURCE: IEC 60947-10]

3.12**Mechanical switching pole**

pole designed to close and open an electric circuit by means of isolation contacts.

NOTE 1 the mechanical switched pole could be a switched neutral pole in AC supply systems or and switched m-pole in DC supply systems.

NOTE 2 Example is given in Figure 23.

3.13**Overcurrent protected pole**

pole provided with an overcurrent release designed to make, carry and break the current in an electric circuit by means of the controlled conductivity of a power semiconductor and in series with isolation contact.

NOTE Example is given in figure Figure 23.

3.14**Remote control**

control of an operation at a point distant from the controlled switching device

NOTE to entry: Remote control covers analogue or digital input, wireless or wired communication in combination with software.

[SOURCE: IEC 60050-441:2000, 441-16-07, modified by adding note]

3.15**Uninterrupted neutral**

current path, not interrupted and not overcurrent protected, intended to be connected to the neutral conductor of the installation in AC supply systems.

715 [SOURCE: IEC 60050-442:1998, 442-01-51]

716 NOTE Example is given in Figure 23.

717 **3.16**

718 **Uninterrupted M**

719 current path, not interrupted and not overcurrent protected, intended to be connected to the
720 midpoint conductor of the installation in DC supply systems.

721 [SOURCE: IEC 60050-442:1998, 442-01-51] modified

722 NOTE Example is given in Figure 23.

723 **3.17**

724 **Current setting (of an over-current release)**

725 value of the operating current for which the release is adjusted and in accordance with which
726 its operating conditions are defined

727 [SOURCE: 441-16-46]

728 **3.18**

729 **Instantaneous tripping current setting**

730 Setting of the instantaneous tripping current for which the release is adjusted and in accordance
731 with which its operating conditions are defined

732 **3.19**

733 **Residual operating current setting**

734 Setting of the Residual operating current for which the release is adjusted and in accordance
735 with which its operating conditions are defined

736 **3.20**

737 **Residual non-operating current setting**

738 Setting of the Residual non-operating current for which the release is adjusted and in
739 accordance with which its operating conditions are defined

740 **3.21**

741 **Short circuit operation setting**

742 Setting of the final position due to short circuit (L to L/N only)

743 **3.22**

744 **Overload operation setting**

745 Setting of the final position due to overload (L to L/N only)

746 **3.23**

747 **Maximum switchable inductance**

748 $L_{\max}$

749 <of a SC-RCBO> maximum value of the circuit inductance for which the device is capable of
750 breaking the prescribed current at a stated DC voltage under prescribed conditions of use and
751 behaviour

752 **3.24**

753 **Maximum switching voltage**

754 U_{sw}

755 <of a SC-RCBO> maximum peak value of a transient overvoltage due to a switching operation
756 of the circuit breaker, measured across each protected pole

3.25**Individual pole rated operational voltage** U_{e1}

<of a SC-RCBO> voltage rating of each individual protected pole of a SC-RCBO for DC supply system

3.26**Let-through current**

maximum instantaneous value of current attained during the breaking operation of a switching device or a fuse

NOTE This concept is of particular importance when the switching device or the fuse operates in such a manner that the prospective peak current of the circuit is not reached.

[SOURCE: 441-17-12]

4 Classification**4.1 According to the use of parallel mechanical contacts**

4.1.1 Semiconductor non-hybrid RCBOs, see 3.1.1

4.1.2 Semiconductor hybrid RCBOs, see 3.1.2

4.2 According to the supply system

4.2.1 SC-RCBO for AC supply system

4.2.2 SC-RCBO for DC supply system

4.3 According to the existence of a standby position

4.3.1 SC-RCBO without standby position

4.3.2 SC-RCBO with standby position for functional switching

4.3.3 SC-RCBO with standby position as reaction to overcurrent (short circuit / overload L to L/N only for AC or L+/L- to M or L+ to L- for DC)

NOTE This classification needs to be considered together with classification 4.15.2 e) and f).

NOTE several classifications can apply

4.4 According to the supply conditions

NOTE 1 Assuming the initial position is closed position since the device can only operate when in closed position.

NOTE 2 By "change state", changing between closed position, standby position and open position is meant.

4.4.1 SC-RCBO operating correctly on the occurrence of residual current or overcurrent within the voltage range of 1,1 U_e and zero volt

The SC-RCBO operates with any number of supply conductors connected.

The SC-RCBO does not change state in the event of loss of supply.

4.4.2 SC-RCBO operating correctly on the occurrence of residual current or overcurrent within the voltage range 1,1 U_e and U_x and going in the open position in the event of loss of supply

The SC-RCBO goes into the open position (with or without delay) in the event of loss of supply and remains in open position after restoration of the supply voltage.

- 795 **4.4.3 SC-RCBO operating correctly on the occurrence of residual current or**
 796 **overcurrent within the voltage range 1,1 U_e and U_x and going in the standby**
 797 **position in the event of loss of supply**
- 798 **4.4.3.1 The SC-RCBO goes into the standby position (with or without delay) in the**
 799 **event of loss of supply and remains in standby position after restoration of**
 800 **the supply voltage.**
- 801 **4.4.3.2 The SC-RCBO goes into the standby position (with or without delay) in the**
 802 **event of loss of supply and returns to closed position after restoration of the**
 803 **supply voltage.**
- 804 **4.5 According to the possibility of adjusting the residual operating current**
- 805 **4.5.1 SC-RCBO with a single value of rated residual operating current**
- 806 **4.5.2 SC-RCBO with multiple settings of residual operating current by fixed steps**
- 807 **4.6 According to their operation in response to the type of residual current**
- 808 **4.6.1 Classifications for AC supply systems**
- 809 **4.6.1.1 SC-RCBO of type AC**
- 810 **4.6.1.2 SC-RCBO of type A**
- 811 **4.6.1.3 SC-RCBO of type F**
- 812 **4.6.1.4 SC-RCBO of type B**
- 813 **4.6.2 Classification for DC supply systems**
- 814 **4.6.2.1 SC-RCBO of type DC for smooth direct current**
- 815 **4.6.2.2 SC-RCBO of type DC+ for smooth and non-smooth direct current**
- 816 Type DC+ also covers type DC.
- 817 **4.7 According to time-delay (in the presence of a residual current)**
- 818 **4.7.1 SC-RCBO without time-delay: type for general use**
- 819 **4.7.2 SC-RCBO with time-delay: type S for selectivity**
- 820 **4.8 According to the protection against external influences**
- 821 **4.8.1 Enclosed-type SC-RCBO (not requiring an appropriate enclosure)**
- 822 **4.8.2 Unenclosed-type SC-RCBO (for use with an appropriate enclosure)**
- 823 **4.9 According to the type of terminals**
- 824 **4.9.1 SC-RCBO with screw-type terminals for copper conductors**
- 825 **4.9.2 SC-RCBO with screwless-type terminals for copper conductors**
- 826 NOTE Related terminal requirements for SC-RCBOs equipped with these types of terminals are given in
 827 IEC 62873-3-1.
- 828 **4.9.3 SC-RCBO with flat quick-connect terminals for copper conductors**
- 829 NOTE Related terminal requirements for SC-RCBOs equipped with these types of terminals are given in
 830 IEC 62873-3-2.

4.9.4 SC-RCBO with screw-type terminals for aluminium conductors

NOTE Related terminal requirements for SC-RCBOs equipped with this type of terminal are given in IEC 62873-3-3.

4.10 According to the number of poles and current paths**4.10.1 According to the number of poles and current paths for AC supply systems**

4.10.1.1 Single-pole SC-RCBO with one overcurrent protected pole and uninterrupted neutral (two current paths)

4.10.1.2 Two-pole SC-RCBO with one overcurrent protected pole

4.10.1.3 Two-pole SC-RCBO with two overcurrent protected poles

4.10.1.4 Three-pole SC-RCBO with three overcurrent protected poles

4.10.1.5 Three-pole SC-RCBO with three overcurrent protected poles and uninterrupted neutral (four current paths)

4.10.1.6 Four-pole SC-RCBO with three overcurrent protected poles

4.10.1.7 Four-pole SC-RCBO with four overcurrent protected poles

NOTE Examples of SC-RCBOs according to this classification are given in Figure 24.

4.10.2 According to the number of poles and current paths for DC supply systems

4.10.2.1 Single pole SC-RCBO with one overcurrent protected pole and uninterrupted M (two current paths)

4.10.2.2 Two pole SC-RCBO with one overcurrent protected pole and one mechanical switching pole

4.10.2.3 Two pole SC-RCBO with two overcurrent protected poles (M/L+, L-/L+, M/L-)

4.10.2.4 Two pole SC-RCBO with two overcurrent protected poles and uninterrupted M (three current paths)

4.10.2.5 Three pole SC-RCBO with two overcurrent protected poles and one mechanical switching pole

4.10.2.6 Three pole SC-RCBO with three overcurrent protected poles

NOTE Examples of SC-RCBOs according to this classification are given in Figure 25

4.11 According to the instantaneous tripping current**4.11.1 B-type**

NOTE This classification applies to SC-RCBOs with integral overcurrent protection based on IEC 60898-1 for AC and IEC 60898-3 for DC

4.11.2 C-type

NOTE This classification applies to SC-RCBOs with integral overcurrent protection based on IEC 60898-1 for AC and IEC 60898-3 for DC

4.11.3 D-type

NOTE This classification applies to SC-RCBOs with integral overcurrent protection based on IEC 60898-1 for AC

4.11.4 TB-Type**4.11.5 TC-Type****4.11.6 TD-Type****4.12 According to the direction of current flow and overcurrent protection in DC supply systems (applicable for 4.2.2)****4.12.1 SC-RCBO with overcurrent protection in both directions of the current****4.12.2 SC-RCBO with overcurrent protection only in one direction of the current, and preventing current flow in the opposite direction****4.12.3 SC-RCBO with overcurrent protection only in one direction of the current, and not preventing current flow in the opposite direction**

NOTE This classification is under consideration.

NOTE Examples are given in Figure 27.

4.13 According to polarity of the SC-RCBO**4.13.1 Polarized SC-RCBO (+/-/M for DC; L/N for AC)****4.13.2 Non-polarised SC-RCBO**

NOTE Example is given in Figure 26 for SC-RCBOs in AC supply systems and Figure 27 for SC-RCBOs in DC supply systems.

4.14 According to the supply side of the device**4.14.1 SC-RCBO to be supplied on one specific side (one side supplied SC-RCBO)**

SC-RCBO intended to be supplied from one defined set of connection terminals only.

4.14.2 SC-RCBO to be supplied on any side (any side supplied SC-RCBO)

SC-RCBO intended to be supplied from any set of connection terminals.

NOTE Example is given in Figure 26 for SC-RCBOs in AC supply systems and Figure 27 for SC-RCBOs in DC supply systems.

4.15 According to possibility of changing settings**4.15.1 Without the possibility of changing settings****4.15.2 With the possibility of changing settings**

The following settings can be changed:

- a) Current setting (of an over-current release)
- b) Instantaneous tripping current setting
- c) Residual operating current setting
- d) Residual non-operating current setting
- e) Short circuit operation setting (L to L/N)
- f) Overload operation setting (L to L/N)
- g) Remote functional switching
- h) Time delay

- 903 **4.16 According to the single pole voltage rating U_{e1} for DC applications**
- 904 **4.16.1 SC-RCBOs with each protected pole rated at $U_{e1} = U_e$**
- 905 **4.16.2 SC-RCBOs with each protected pole rated at $U_{e1} < U_e$**
- 906 **4.17 According to the withstanding of surge current to earth caused by impulse**
907 **voltages**
- 908 **4.17.1 6 kV, 3 kA prospective current**
- 909 **4.17.2 4 kV, 2 kA prospective current**
- 910 This classification is intended to be installed with an SPD declared by the manufacturer
- 911 **4.18 According to the method of controlling the operation**
- 912 **4.18.1 With remote control of the operation**
- 913 **4.18.2 Without remote control of the operation**
- 914 **4.19 Software update (version of firmware)**
- 915 Under consideration
- 916 **4.20 Software upgrade (e.g., additional functionality)**
- 917 Under consideration
- 918

5 Characteristics of SC-RCBOs

5.1 Summary of characteristics

The characteristics of an SC-RCBO shall be stated in the following terms:

- rated voltages (see 5.2.1);
- rated current I_n (see 5.2.2);
- rated frequency (see 5.2.3);
- short circuit characteristics (see 5.2.4);
- rated residual operating current $I_{\Delta n}$ (see 5.2.5);
- rated residual non-operating current $I_{\Delta no}$ (see 5.2.6);
- rated residual making and breaking capacity $I_{\Delta m}$ (see 5.2.7);
- time-delay, if applicable (see 5.2.10);
- operating characteristics in the case of residual currents with DC components (see 5.2.8);
- degree of protection (see IEC 60529);
- ranges of overcurrent instantaneous tripping (see 5.3.12)
- maximum admissible short-circuit current rate of rise (see 5.2.4.2)
- minimum operating voltage U_x (see 5.2.11);

5.2 Rated quantities and other characteristics

5.2.1 Rated voltages

5.2.1.1 Rated operational voltage (U_e)

The rated AC or DC operational voltage of an SC-RCBO is the value of voltage, assigned by the manufacturer, to which its performance is referred.

NOTE The same SC-RCBO can be assigned a number of rated operational voltages and associated performance characteristics.

5.2.1.2 Individual pole rated operational voltage (U_{e1})

The individual pole rated operational voltage of a DC SC-RCBO, is the value of voltage, assigned by the manufacturer, to which its performance is referred.

5.2.1.3 Rated insulation voltage (U_i)

Unless otherwise stated, the rated insulation voltage is assumed to be equal to the highest rated operational voltage assigned to the SC-RCBO.

Where the rated insulation voltage assigned by the manufacturer exceeds the highest rated operational voltage of the SC-RCBO, the dielectric test voltages and creepage distances shall be chosen for that rated insulation voltage in accordance with IEC 60664-1.

5.2.1.4 Rated impulse withstand voltage (U_{imp})

The rated impulse withstand voltage of an SC-RCBO shall comply with the values given in 5.3.7

5.2.2 Rated current (I_n)

The current assigned by the manufacturer which the SC-RCBO can carry in uninterrupted duty, at a specified reference ambient air temperature.

The reference calibration temperature is 30 °C. If a different reference calibration temperature for the SC-RCBO is used, the effect on the overload protection of cables shall be taken into account, since this is also based on an ambient air temperature of 30 °C, according to installation rules (see Clause 523 of IEC 60364-5-52:2009).

5.2.3 Rated frequency

The rated frequency of an SC-RCBO according to 4.2.1 is the power frequency for which the SC-RCBO is designed and to which the values of the other characteristics correspond.

NOTE A number of rated frequencies can be assigned to the same SC-RCBO.

5.2.4 Short-circuit characteristics

5.2.4.1 Rated short-circuit capacity (I_{cn})

The rated short-circuit capacity of an SC-RCBO is the value of the ultimate short-circuit breaking capacity assigned to that SC-RCBO by the manufacturer for the rated operational voltage, under specified conditions.

NOTE A SC-RCBO having a given rated short-circuit capacity (I_{cn}) has a corresponding service short-circuit capacity (I_{cs}) (see Table 39).

For AC, a rated short-circuit breaking capacity requires that the SC-RCBO shall be able to break any value of short-circuit current up to and including the value corresponding to the rated capacity at a power-frequency recovery voltage corresponding to the prescribed test voltage values and at any power factor not less than those required in clause 9.11.5.

For DC, the SC-RCBO shall be able to break any current upon the following conditions:

- the rate of rise of the current not exceeding the maximum admissible short-circuit current rate of rise (see 5.2.4.2) declared in the product documentation,
- the circuit inductance not exceeding the maximum switchable inductance L_{max} (see 3.23) declared in the product documentation.

The minimum L_{max} value is 160 µH.

5.2.4.2 Maximum admissible short-circuit current rate of rise

$$\left(\frac{\Delta i}{\Delta t}\right)_{max}$$

Maximum admissible rate of rise of the short-circuit current (see 3.10) assigned to that SC-RCBO by the manufacturer, under the conditions specified in 9.24. It is expressed in A/µs.

5.2.5 Rated residual operating current ($I_{\Delta n}$)

The value of residual operating current, assigned by the manufacturer, at which the SC-RCBO shall operate under specified conditions.

For an SC-RCBO having multiple settings of residual operating current, the highest setting is used to designate it.

5.2.6 Rated residual non-operating current ($I_{\Delta no}$)

The value of residual non-operating current at which the SC-RCBO does not operate under specified conditions. The standard value of residual non-operating current is defined in 5.3.5.

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

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

5.2.8 Operating characteristics in response to the type of residual current for SC-RCBOs for AC supply systems according to classification 4.2.1**5.2.8.1 SC-RCBO type AC**

An SC-RCBO for which tripping is ensured for residual sinusoidal alternating currents, whether suddenly applied or slowly rising.

5.2.8.2 SC-RCBO type A

An SC-RCBO for which tripping is ensured:

- as for type AC;
- for residual pulsating direct currents; and
- for residual pulsating direct currents superimposed on a smooth direct current of 0,006 A with or without phase-angle control, independent of polarity, whether suddenly applied or slowly rising.

5.2.8.3 SC-RCBO type F

A SC-RCBO for which tripping is ensured:

- as for Type A;
- for composite residual currents which may result from circuits supplied between phase and neutral or phase and earthed mid point conductor; and
- for residual pulsating direct currents superimposed on smooth direct current of 0,01 A.

The above specified residual currents may be suddenly applied or slowly rising.

NOTE Operation in case of alternating current superimposed with smooth DC residual current is assumed to be covered by the test of pulsating DC superimposed with smooth DC residual current.

5.2.8.4 SC-RCBO type B

A SC-RCBO for which tripping is ensured as for Type F and in addition:

- for residual sinusoidal alternating currents up to 1 000 Hz;
- for residual alternating currents superimposed on a smooth direct current of 0,4 times the rated residual current ($I_{\Delta n}$) or 10 mA, whichever is the highest value;
- for residual pulsating direct currents superimposed on a smooth direct current of 0,4 times the rated residual current ($I_{\Delta n}$) or 10 mA, whichever is the highest value;
- for residual direct currents which may result from rectifying circuits, i.e.
 - two-pulse bridge connection line to line for two-, three- and four-pole devices;
 - three-pulse star connection or six-pulse bridge connection for three- and four-pole devices;
- for residual smooth direct currents.

The above specified residual currents may be suddenly applied or slowly increased independent of polarity.

5.2.9 Operating characteristics in response to the type of residual current for SC-RCBOs for DC supply systems according to classification 4.2.2

5.2.9.1 SC-RCBO of type DC for smooth direct current

A SC-RCBO for which tripping is ensured for residual smooth direct currents, whether suddenly applied or slowly rising.

5.2.9.2 SC-RCBO of type DC+ for smooth and non-smooth direct current

A SC-RCBO for which tripping is ensured for residual smooth direct currents and residual non smooth direct currents, whether suddenly applied or slowly rising.

NOTE Type DC+ is under consideration

5.2.10 SC-RCBO type S

A time-delay SC-RCBO which complies with the relevant part of Table 1 or Table 2, if applicable

Table 1 – Standard limit values of break time and non-actuating time for alternating residual currents (RMS values) for type AC and A

			Standard limit values of break time and non-actuating time(s) for type AC and A in the event of alternating residual currents (RMS values)						
Type	I_n A	$I_{\Delta n}$ A	$I_{\Delta n}$	$2 I_{\Delta n}$	$5 I_{\Delta n}$	$5 I_{\Delta n}$ or 0,25 A ^a	5 A to 200 A ^b	500 A or $I_{\Delta t}$ ^c	
General	any	≤ 0,03	0,3	0,15		0,04	0,04	0,04	Maximum break times
		> 0,03	0,3	0,15	0,04		0,04	0,04	
S	≥ 25	> 0,03	0,5	0,2	0,15		0,15	0,15	Minimum non- actuating times
		> 0,03	0,13	0,06	0,05		0,04	0,04	

^a Value for this test to be decided by the manufacturer.

^b The tests are only carried out during the verification of the correct operation according to 9.9.1.2.4. For SC-RCBOs, values exceeding the lower limit of the overcurrent instantaneous tripping range are not tested.

^c For SC-RCBOs, the test is carried out with a current $I_{\Delta t}$ equal to the lower limit of the overcurrent instantaneous tripping range according to type B, C, D or T, as applicable. For the tests of 9.9.1.2.5 and 9.9.1.2.6 2), the current $I_{\Delta t}$ is established so that the vector sum $I_{\Delta t} + I_n$ is equal to the lower limit of the overcurrent instantaneous tripping range, according to type B, C, D or T, as applicable.

Table 2 – Standard maximum values of break time for half-wave residual currents (RMS values) for type A

			Standard maximum values of break time for type A in the event of half-wave pulsating residual currents (RMS values) equal to							
Type	I_n A	$I_{\Delta n}$ A	$1,4 I_{\Delta n}$	$2 I_{\Delta n}$	$2,8 I_{\Delta n}$	$4 I_{\Delta n}$	$7 I_{\Delta n}$	0,35 A	0,5 A	350 A ^a
General	Any	$< 0,03$		0,3		0,15			0,04	0,04
		0,03	0,3		0,15			0,04		0,04
		$> 0,03$	0,3		0,15		0,04			0,04
S	≥ 25	$> 0,03$	0,5		0,2		0,15			0,15
^a For SC-RCBOs, this value shall be limited to the lower limit of the overcurrent instantaneous tripping ranges according to type B, C, D or T, as applicable.										

Table 3 – Type B RCDs – Standard values of break time and non-actuating time for residual direct currents which result from rectifying circuits and for residual smooth direct current

Type	I_n A	$I_{\Delta n}$ A	Standard values of break time and non-actuating time at a residual operating 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, 100 A, 200 A a	
General	Any value	Any value	0,3	0,15	0,04	0,04	Maximum break times
S	≥ 25	$> 0,030$	0,5	0,2	0,15	0,15	Maximum break times
			0,13	0,06	0,05	0,04	Minimum non-actuating times
For Type B SC-RCBOs any value exceeding the lower limit of the overcurrent instantaneous tripping range are not tested.							
a The tests are only made during the verification of the correct operation as mentioned in 9.9.1.5.3 b) according to Figure 6a, and 9.9.1.5.4 b) according to Figure 6b.							

Table 4 – Standard limit values of break time and non-actuating time for direct residual current for type DC (DC supply system)

Type	I_n A	$I_{\Delta n}$ A	Standard limit values of break time and non-actuating time (s) for type DC in event of direct residual currents equal to					
			$I_{\Delta n}$	2 $I_{\Delta n}$	3 $I_{\Delta n}$	0,5 A ^c	1A, 2A, 5A, 10A, 20A, 50A, 100A	
General	Any value	Any value	0,3 ^a	0,15 ^a	0,04 ^a	0,04	0,4 ^b	Maximum break times
S	≥ 25	> 0,08	0,5 ^a	0,2 ^a	0,15 ^a	-	0,4 ^b	Maximum break times
			0,13	0,06	0,05	-	0,4	Minimum non-actuating times
NOTE The maximum break time of this table is for $U_0 \leq 230$ V. In case of fault protection and higher voltages use the maximum disconnection times according to IEC 60364-4-41 Table 41.1								
^a For residual currents of 1 A and above, the maximum break time shall not exceed 0,4 s.								
^b The overall disconnection time shall not exceed 0,4 s.								
^c This value only applies to DC-SC-RCBOs with rated residual currents equal or less than 0,08 A.								

5.2.11 Minimum operating voltage (U_x)

The minimum operating voltage, where applicable, as declared by the manufacturer for SC-RCBOs.

5.3 Standard and preferred values

5.3.1 Standard and preferred values of rated operational voltage (U_e)

Standard values of rated operational voltage for AC are indicated in Table 5 and preferred values of rated operational voltage for DC are indicated in Table 6.

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Table 5 – Standard values of rated operational voltage (U_e) for AC

SC-RCBO	Circuit supplying the SC-RCBO	Rated operational voltage of SC-RCBOs for use in systems 230 V or 230/400 V or 400 V V	Rated operational voltage of SC-RCBOs for use in systems 120/240 V or 240 V V
Single-pole (with two current paths)	Single-phase (phase to earthed middle conductor or phase to neutral)	230	120
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, three-wire)		120/240
	Three-phase 230/400 V-system phase to neutral (4-wires) or 230 V-system phase to phase (3-wires)	230	
Three-pole (with three or four current paths)	Three-phase (three-wire or four-wire) (400 V or 230/400 V or 240 V system)	400	240
Four-pole	Three-phase (four-wire) (230/400 V system)	400	
NOTE 1 The value of 230/400 V is the result of the evolution of 220/380 V and 240/415 V systems which has been completed in Europe and many other countries. However, 220/380 V and 240/415 V systems still exist. NOTE 2 Wherever in this document there is a reference to 230 V or 400 V, they can be read as 220 V or 240 V, 380 V or 415 V, respectively. NOTE 3 Wherever in this document there is a reference to 120 V or 120/240 V or 240 V, they can be read as 100 V or 100/200 V or 200 V, respectively. NOTE 4 Wherever in this document there is a reference to 240 V three phases, it can be read as 100 V or 120/208 V. NOTE 5 In Japan, phase to neutral conductor and phase to earthed conductor (grounded conductor) is thought of differently because a single-phase two-wire system supplied from two-wire system source does not have a neutral point.			

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Secretary NOTE: Following item is still under consideration in WG12

Table 6 including table notes and related figures need to be updated according to WG2 decision in WG2 Nov. 2025 meeting (Sydney)

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Table 6 – Preferred values of rated operational voltage (U_e) for DC

SC-RCCB	Supply system	DC voltage	
		Rated operational voltage	Examples of DC supply systems
Single-pole with two-current path	2 wires (L+ or L- to M)	200 V	Figure x a)

Two poles	2 wires or 3 wires (L+ to L-)	200 V 400 V	Figure x b) Figure x c)
Two-pole with three-current path	3 wires (L+ to L-)	400 V	Figure x d)
Three-pole	3 wires (L+ to L-)	400 V	Figure x e)
NOTE The two-wire arrangement refers to Figure 6 of IEC 60364-1:2005, the three-wire arrangement refers to Figure 7 of IEC 60364-1:2005.			

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1067 For DC-SC-RCBO, one of the following options shall apply:

1068 Each protected pole is rated for the full voltage U_e ($U_{e1} = U_e$);

1069 NOTE 1 These SC-RCBOs are intended for applications where in case of a fault the full voltage U_e can appear
1070 across a single protected pole.

1071 NOTE 2 Only SC-RCBOs with $U_{e1} = U_e$ are intended for unearthed or impedance earthed systems (IT) without first
1072 earth-fault protection.

1073 Each protected pole is equally rated at U_{e1} , where $U_e > U_{e1} \geq U_e / 2$.

1074 NOTE 3 These SC-RCBOs are intended for applications where in case of a fault just half of the voltage U_e can
1075 appear across a single protected pole.

1076 5.3.2 Preferred values of rated current (I_n)

1077 Preferred values of rated current are:

1078 6 A – 8 A – 10 A – 13 A – 16 A – 20 A – 25 A – 32 A – 40 A – 50 A – 63 A – 80 A – 100 A –
1079 125 A.

1080 5.3.3 Standard values of rated residual operating current ($I_{\Delta n}$) for SC-RCBOs for AC 1081 supply systems according to classification 4.2.1

1082 Standard values of rated residual operating current are:

1083 0,006 A – 0,01 A – 0,03 A – 0,1 A – 0,3 A – 0,5 A.

1084 NOTE In Korea and Japan, 0,015 A, 0,2 A and 1 A are also considered as standard values.

1085 5.3.4 Standard values of rated residual operating current ($I_{\Delta n}$) for SC-RCBOs for DC 1086 supply systems according to classification 4.2.2

1087 Standard values of rated residual operating current are:

1088 0,02 A – 0,08 A – 0,3 A – 0,6 A – 1 A.

1089 5.3.5 Standard minimum value of residual non-operating current ($I_{\Delta no}$)

1090 For devices without residual operating current setting, the standard minimum value of residual
1091 non-operating current is $0,5 I_{\Delta n}$.

For devices with residual operating current setting, the standard minimum value of residual non-operating current is 0,5 times the residual operating current setting.

NOTE For residual pulsating direct currents, residual non-operating currents depend on the phase angle (see Table 7).

Table 7 – Tripping current limits

Phase angle	Tripping current		
	Lower limit	Upper limit	
		$I_{\Delta n} < 30 \text{ mA}$	$I_{\Delta n} \geq 30 \text{ mA}$
0°	$0,35 I_{\Delta n}$	$2 I_{\Delta n}$	$1,4 I_{\Delta n}$
90°	$0,25 I_{\Delta n}$	$2 I_{\Delta n}$	$1,4 I_{\Delta n}$
135°	$0,11 I_{\Delta n}$	$2 I_{\Delta n}$	$1,4 I_{\Delta n}$

5.3.6 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 shall be carried out at that frequency.

5.3.7 Standard values of rated impulse withstand voltage (U_{imp})

Table 8 and Table 11 give the standard values of rated impulse withstand voltages as a function of the nominal voltage of the installation.

Table 8 – Rated impulse withstand voltage as a function of the nominal voltage of the installation

Rated impulse withstand voltage U_{imp} kV	Nominal voltage of the installation	
	Three-phase systems	Single-phase system with mid-point earthed
	V	V
2,5 ^a		120/240 ^b
4 ^a	230/400	120/240, 240 ^c
NOTE 1 For test voltages to check the insulation, see Table 9.		
NOTE 2 For test voltages to check the isolation distance across open contacts, see Table 10.		
^a The values 3 kV and 5 kV respectively are used for verifying the isolating distances across open contacts at the altitude of 2 000 m (see Table 20 and Table 10).		
^b For installation practice in Japan.		
^c For installation practice in North American countries.		

1108 **Table 9 – Test voltage for verification of rated impulse withstand voltage**

Rated impulse withstand voltage U_{imp} kV	Test voltages at corresponding altitude $U_{1,2/50}$ peak kV				
	Sea level	200 m	500 m	1 000 m	2 000 m
2,5	2,9	2,8	2,8	2,7	2,5
4	4,9	4,8	4,7	4,4	4,0

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1110 **Table 10 – Test voltage for verifying the suitability for isolation,**
1111 **referred to the rated impulse withstand voltage of the SC-RCBO and the altitude where**
1112 **the test is carried out**

Nominal voltage of the installation V	Test voltages at corresponding altitude $U_{1,2/50}$ peak kV				
	Sea level	200 m	500 m	1 000 m	2 000 m
Single-phase system with mid-point earthed 120/240 ^a	3,5	3,5	3,4	3,2	3,0
Single-phase system 120/240 240 ^b	6,2	6,0	5,8	5,6	5,0
Three-phase systems 230/400	6,2	6,0	5,8	5,6	5,0
^a For installation practice in Japan.					
^b For installation practice in North American countries.					

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1114 **Table 11 – Rated impulse withstand DC voltage as a function of the nominal voltage of**
1115 **the installation**

Rated impulse withstand voltage U_{imp} kV	Nominal voltage of the installation	
	Three wires supply systems V	Two wires supply systems with mid-point earthed V
2,5 ^a		100/200
4 ^a	200/400	100/200, 200
NOTE 1 For test voltages to check the insulation, see Table 9		
NOTE 2 For test voltages to check the isolation distance across open contacts, see Table 10		
^a The values 3 kV and 5 kV respectively are used for verifying the isolating distances across open contacts at the altitude of 2 000 m (see Table 20 and Table 10).		

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1117 **5.3.8 Standard limit values of break time and non-actuating time for SC-RCBO of type** 1118 **AC and A**

1119 **5.3.8.1 Standard limit values of break time and non-actuating time for alternating** 1120 **residual currents (RMS values) of type AC and A**

1121 Standard limit values are indicated in Table 1.

5.3.8.2 Standard maximum values of break time for half-wave residual currents (RMS values) of type A

Standard limit values are indicated in Table 2.

5.3.8.3 Standard values of break time and non-actuating time for residual direct currents which result from rectifying circuits and for residual smooth direct current of type B

Standard limit values are indicated in

Table 3.

5.3.8.4 Values of tripping current according to frequencies which differ from the rated frequency 50/60 Hz of type B

Standard limit values are indicated in Table 12

Table 12 – Type B RCDs – Residual non-operating and operating current according to frequencies which differ from the rated frequency 50/60 Hz

Frequency Hz	Residual non-operating current $I_{\Delta n}$	Residual operating current $I_{\Delta n}$
150	0,5 $I_{\Delta n}$	2,4 $I_{\Delta n}^a$
400	0,5 $I_{\Delta n}$	6 $I_{\Delta n}^a$
1 000	$I_{\Delta n}$	14 $I_{\Delta n}^{a b}$
NOTE 1 The definitions of “residual non-operating current and of “operating currents” are those of IEC 62873-2. NOTE 2 The waveform for the given frequencies is sinusoidal. NOTE 3 The maximum permissible earthing impedance at a frequency f_x depends on the upper limit of the operating currents of the RCD at that frequency. NOTE 4 The relationship between the frequency of the acceptable touch voltages and the dissipated power in the human body are under consideration. Until final values are fixed the maximum allowed touch voltage of 50 V for 50/60 Hz is recommended. ^a The values correspond to the threshold of ventricular fibrillation according to IEC/TS 60479-1 in combination with the frequency factor for ventricular fibrillation according to IEC/TS 60479-2. ^b IEC 60479 series gives no factors for frequencies above 1 kHz.		

5.3.9 Standard limit values of break time and non-actuating time for DC SC-RCBOs of type DC and DC+ (DC system)

5.3.9.1 Standard limit values of break time and non-actuating time for direct residual currents of type DC

Standard limit values are indicated in Table 4.

5.3.9.2 Standard limit values of break time and non-actuating time for direct residual currents of type DC+

Under study.

5.3.10 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.

5.3.11 Values of rated short-circuit capacity

Standard values of rated short-circuit capacities up to and including 10 000 A are given in Table 13.

Table 13 – Standard values of rated short circuit capacity

1 500 A
3 000 A
4 500 A
6 000 A
10 000 A

For values above 10 000 A up to and including 25 000 A, preferred values are 15 000 A and 20 000 A.

5.3.12 Standard ranges of overcurrent instantaneous tripping

Standard ranges of overcurrent instantaneous tripping are given in Table 14 and Table 15.

Table 14 – Ranges of overcurrent instantaneous tripping for type B, C, D and TB, TC, TD (for AC supply systems)

Type	Range
B and TB	Above $3 I_n$ up to and including $5 I_n$
C and TC	Above $5 I_n$ up to and including $10 I_n$
D and TD	Above $10 I_n$ up to and including $20 I_n^a$
^a For special cases values up to $50 I_n$ is also used.	

Table 15 – Ranges of overcurrent instantaneous tripping for type B, C and TB, TC (for DC supply systems)

Type	Range
B and TB	Above $4 I_n$ up to and including $7 I_n$
C and TC	Above $7 I_n$ up to and including $15 I_n$

5.3.13 Individual pole inductance

The individual pole inductance corresponds to the greatest value of the pole inductances of the SC-RCBO in normal operation.

The tolerance for the measurement of the individual pole inductance value L_{CB} shall be:

- +/- 50 % for an inductance value less equal 1 μ H,

- 1168 – +/- 20 % for an inductance value larger than 1 μH , but less than or equal to 10 μH , and
- 1169 – +/- 10 % for larger values.

1170 The individual pole inductance shall be measured with a RLC-meter without load and with a
1171 frequency equal to 1 kHz.

1172 **6 Product information**

1173 Information according to Table 16, shall be provided in a durable manner for each SC-RCBO.

1174 The suitability for isolation, which is provided by all SC-RCBOs of this document, may be
1175 indicated by the symbol  (IEC 60417-6169-1:2012-08) on the device. When affixed, this
1176 marking may be included in a wiring diagram, where it may be combined with symbols of other
1177 functions.

1178 When the symbol is used on its own (i.e. not in a wiring diagram), combination with symbols
1179 of other functions is not allowed.

1180 If a degree of protection higher than IP20 according to IEC 60529 is declared, then the
1181 device shall comply with it, whichever the method of installation. If the higher degree
1182 of protection is obtained only by a specific method of installation or with the use of
1183 specific accessories (e.g. terminal covers, enclosures, etc.), this shall be specified in product
1184 information.

1185 For SC-RCBOs other than those operated by means of push-button, the open position shall be
1186 indicated by the symbol "O" and the closed position by the symbol "I" (a short straight
1187 line).

1188 The product information shall inform the user about the existence and the means for indication
1189 of standby position, if applicable.

1190 For SC-RCBOs with a standby position according to 4.3.2 and 4.3.3, the means for indication
1191 of the standby position shall be indicated with the letters "STBY". The standby position
1192 indication shall preferably be yellow but shall not be green or red. This indication shall be visible
1193 when the SC-RCBO is installed and normally powered.

1194 For devices according to 4.3.2 and 4.3.3 the product information shall contain the information:
1195 "For maintenance of the electrical installation the SC-RCBO shall be switched in the open
1196 position. Standby position does not provide isolation."

1197 Additional national symbols can be required for this indication. These indications shall
1198 be readily visible when the SC-RCBO is installed.

1199 For SC-RCBOs operated by means of two push-buttons, the push-button designed for the
1200 opening operation only shall be red and/or be marked with the symbol "O".

1201 Red shall not be used for any other push-button of the SC-RCBO.

1202 If a push-button is used for closing the contacts and is evidently identified as such, its
1203 depressed position is sufficient to indicate the closed position.

1204 If a single push-button is used for closing and opening the contacts and is identified as
1205 such, the button remaining in its depressed position is sufficient to indicate the closed
1206 position. On the other hand, if the button does not remain depressed, an additional means
1207 indicating the position of the contacts shall be provided.

1208 Product information visible on the product shall be indelible, easily legible without power supply
 1209 and not be placed on screws, washers or other removable parts.

1210 The list of adjustable settings and consequences shall be provided by the product information.

1211 *Compliance is checked by inspection and by the test of 9.3.*

1212 **Table 16 – Product information**

	Marking or information item	Position of the marking or information		
		Visible on product when installed	On the product	In the product information
A	Manufacturer's name or trademark		X	
B	Type designation, catalogue number or serial number		X	
C	Rated operational voltage(s) followed by "AC" or "DC" or both		X	
D ^a	Rated current	X		
E	Rated frequency according to the preferred values of 5.3.6 Rated frequency different from the preferred values of 5.3.6		X	X
F	Rated residual operating current	X		
G	Settings of residual operating current for SC-RCBOs with multiple residual operating currents	X		
H	Rated short-circuit capacity (in amperes) for AC SC-RCBO or rate of raise (in amperes per μ s) for DC SC-RCBO and optionally for AC SC-RCBO		X	
I	Reference calibration temperature, if different from 30 °C			X
J ^b	Rated residual making and breaking capacity		X	
K	Degree of protection (only if different from IP 20)			X
L	Position of use, if necessary		X	
M	Letter symbol  (S in a square) for type S devices	X		
N	Marking according to classification of 4.4			X
O	Operating means of the test device, by the letter T	X		
P	Wiring diagram unless the connection is evident		X	
Q ^{c, d}	Operating characteristic for AC SC-RCBO in presence of residual currents with DC components	X		
R	Classification according to 4.17 and information about required SPD for SC-RCBOs according to classification 4.17.2			X
S	Reference to the product standard (IEC 63434-1)		X	
T	For type D and TD SC-RCBOs: the maximum instantaneous tripping current, if higher than 20 I_n (see Table 14)		X	
U	If it is necessary to distinguish between the supply and the load terminals according to classification 4.14, they shall be clearly marked (e.g. by the words "line" and "load" placed near the corresponding terminals or by arrows indicating the direction of power flow)		X	
V	List of adjustable settings and consequences			X
W	Individual pole inductance			X
X	Individual pole rated operational voltage if not equal to U_e (e.g. $U_{e1} = 200$ V)		X	

- ^a For SC-RCBOs: rated current without symbol "A", preceded by the symbol of overcurrent instantaneous tripping (B, C, D or TB, TC, TD),
for example B 16
- ^b To be marked if different from the rated short circuit capacity
- ^c One of the following markings apply:
- SC-RCBOs of type AC with the symbol (IEC 60417-6148:2012-01) 
 - SC-RCBOs of type A with the symbol (IEC 60417-6149:2012-01) 
 - SC-RCBOs of type F with the symbol (IEC 60417-6149:2012-01 + 6160:2012-04) 
- Alternatively, the following symbol may be used (IEC 60417-6399:2017) 
- SC-RCBO's of type B with the symbol (IEC 60417-6149:2012-01 + 6160:2012-04 + 6297:2014-11) 
- Alternatively, the following symbol may be used (IEC 60417-6398:2017) 
- Marking for DC is under consideration
- ^d It is not necessary for the symbol for Type AC to be visible after installation, but it shall be marked on the product

7 Standard conditions for operation in service and for installation

7.1 Standard conditions

SC-RCBOs shall be capable of operating under the standard conditions shown in Table 17.

Table 17 – Values of influencing quantities

Influencing quantity	Conditions of use	Reference values for tests	Test tolerances ^e
Ambient air temperature ^a	–5 °C to +40 °C	See 9.2	±5 °C
Altitude	Not exceeding 2 000 m		
Relative humidity maximum value at 40 °C	50 % ^b		
External magnetic field	Not exceeding 5 times the earth's magnetic field in any direction	Earth's magnetic field	^c
Position	As stated by the manufacturer with a tolerance of 5° in any direction ^d	As stated by the manufacturer	2° in any direction
Frequency if applicable	Reference value ±5 %	Rated value	±5 %
Sinusoidal wave distortion if applicable	Not exceeding 5 %	Zero	5 %

DC supply voltage	see 9.2 (where the ripple is defined)	Rated value	
^a The maximum value of the mean daily temperature is +35 °C. ^b Higher relative humidities are admitted at lower temperatures (for example 90 % at 20 °C). ^c When an SC-RCBO is installed in proximity to strong magnetic field, supplementary requirements may be necessary. ^d The device shall be fixed in such a way that it does not cause deformation liable to impair its functions. ^e The tolerances given apply unless otherwise specified in the relevant test.			

1217

1218 7.2 Conditions of installation

1219 SC-RCBOs shall be installed in accordance with the manufacturer's instructions.

1220

1221 7.3 Pollution degree

1222 SC-RCBOs are intended for an environment with pollution degree 2, i.e. normally, only non-
 1223 conductive pollution occurs. However, occasionally, a temporary conductivity caused by
 1224 condensation may be expected.

1225 8 Requirements for construction and operation

1226 8.1 Mechanical design

1227 8.1.1 General

1228 SC-RCBOs shall be designed and constructed so that, in normal use, their use is safe and
 1229 without danger to the user or to the environment.

1230 The residual current detection and the residual current release shall be located between the
 1231 incoming and outgoing terminals of the SC-RCBO.

1232 It shall not be possible to disable or inhibit the RCD and overcurrent protection function by any
 1233 means.

1234 SC-RCBOs with continuously adjustable settings, such as by the use of a potentiometer are not
 1235 allowed.

1236 Provisions for remote tripping of the SC-RCBO, if any, shall:

- 1237 – not cause any current to the PE;
- 1238 – not cause any fault voltage when actuated, and
- 1239 – not impair the isolation function of the SC-RCBO.

1240 SC-RCBOs shall not be operated by introduction of an external connection for the purpose of
 1241 intentionally creating a residual current to trip the SC-RCBO.

1242 NOTE This does not preclude the use of a test instrument.

1243 SC-RCBO shall be designed for rail mounting.

8.1.2 Changing the settings of SC-RCBO

It shall not be possible to alter settings of the SC-RCBO by means of external interventions other than those specifically intended for changing the settings, as defined in 8.1.3.

Changing settings shall not be possible without the use of a tool or dedicated software. This is, to ensure that no unintended change of setting is possible.

NOTE examples of a tool are:

- hardware tool e.g. screwdriver,
- wireless or wired communication in combination with software

Changing settings of the SC-RCBO shall requires physical access to the SC-RCBO.

The intention of changing settings via remote access (wireless or wired communication in combination with software) has to be confirmed locally at the device. Additionally, the provided software for changing settings shall have a password protection for the change of settings.

In any case the rated value shall not be exceeded by the setting values.

The setting shall be visible on a display or visible/readable using software.

NOTE Examples of marking/indicating the present device settings are by:

- mechanical, electrical indicator
- an LCD display on the device,
- the use of an indelible marking on the device in combination with a software platform

8.1.3 List of adjustable settings

The following settings can be adjustable within the limits specified in Table 18:

Table 18 – List of adjustable settings

Setting	Limits
a) Current setting (of an over-current release)	The value of the current setting shall never be greater than the rated current
b) Instantaneous tripping current setting	B-type, C-type, D-type, TB-type, TC-type, TD-Type The setting for the instantaneous tripping current setting must never be greater than the rated instantaneous tripping current
c) Residual operating current setting	The value of the setting shall be in accordance with clause 5.3.3 for AC SC-RCBO and 5.3.4 for DC SC-RCBO The residual operating current setting shall not exceed the rated residual operating current.
d) Residual non-operating current setting	0,5 times the residual operating current setting, or higher
e) Short circuit operation setting (L to L/N) ¹⁾	By default open position Adjustable to standby position
f) Overload operation setting (L to L/N) ²⁾	By default open position Adjustable to standby position
g) Functional switching via remote control Remote functional switching	Enable or disable
h) Time delay	General type or type S Type S is only possible with residual operating current setting above 30mA for AC and 80mA for DC
¹⁾ Short circuit is considered by 9.9.3.3 Test of instantaneous tripping and 9.11 Short-circuit tests	
²⁾ Overload is considered by 9.9.3.2 Test of time-(over)current characteristic	

1265

1266 8.1.4 Requirements to reaction in case of overcurrent and residual current

1267 SC-RCBO by default shall always go into open position as reaction to overcurrent (overload
1268 and/or short circuit) and residual current.

1269 Depending on the classification 4.3.3 SC-RCBO with standby position as reaction to overcurrent
1270 (short circuit / overload L to L/N only for AC or L+/L- to M or L+ to L- for DC) and classification
1271 4.15 According to possibility of changing settings it is possible to change from the default
1272 configuration (open position) to Standby state as reaction to overcurrent (overload and short
1273 circuit) between line and line or line and neutral.

1274 For a fault of negligible impedance between the line conductor and a protective conductor
1275 ("Overcurrent to ground L to PE(N)") and for residual current fault, the device shall always trip
1276 going into open position. This configuration cannot be changed.

1277 8.1.5 Requirements for changing the operating mode between ON, Standby and OFF 1278 position

1279 It shall not be possible to close the isolation contacts remotely without external accessories.

1280 It shall be possible to open and close isolation contacts locally.

1281 **Table 19 – Changing the operating mode between ON, Standby and OFF position**

Initial position	Allowed action – locally at the SC-RCBO	allowed action – remote ²⁾	End position
Open	Initiate closed position ¹⁾	Not allowed	Closed
	Initiate Standby position ¹⁾		Standby
Standby	Initiate open position	Initiate open position	Open
	Initiate closed position	Initiate closed position	Closed
Closed	Initiate open position	Initiate open position	Open
	Initiate Standby position	Initiate Standby position	Standby
1) if not locked in the open position			
2) remote means via analogue or digital input, wireless or wired communication in combination with software			

1282

1283 8.1.6 Mechanism

1284 All isolation contacts of all poles of multipole SC-RCBOs shall be mechanically coupled so that
1285 all poles, except the neutral or midpoint, if any, close and open substantially together, whether
1286 operated manually or automatically.

1287 All power semiconductors of all overcurrent protected poles of multipole SC-RCBOs shall be
1288 controlled so that all power semiconductors, except the neutral or midpoint, if any, make and
1289 break within 0,1 s whether operated manually or automatically.

1290 For four-pole SC-RCBOs for AC supply, the neutral pole shall not close after and shall not open
1291 before the other poles.

1292 For three-pole SC-RCBOs for DC supply, the mid-point M-pole shall not close after and shall
1293 not open before the other poles.

1294 *Compliance is checked by inspection and by manual tests, using any appropriate means*
1295 *(example: indicator lights, oscilloscope, etc.).*

1296 If a pole having an appropriate short-circuit making and breaking capacity is used as a neutral
1297 pole or as a mid-point M pole, and if the SC-RCBO has an independent manual operation, then
1298 all poles, including the neutral pole or M pole, may operate substantially together.

1299 SC-RCBOs shall have a trip-free mechanism.

1300 After tripping to OPEN position due to residual current or overcurrent (short circuit or overload)
1301 or after tripping to standby position due to overcurrent (short circuit or overload), the SC-RCBO
1302 shall not restore power without a deliberate human action under the conditions of Table 19.

1303 It shall be possible to switch the SC-RCBO on and off by hand.

1304 SC-RCBOs shall be so constructed that the isolation contacts can come to rest only in the
1305 closed position or in the open position, even when the operating means is released in an
1306 intermediate position.

1307 SC-RCBOs shall provide in the open position an isolation distance in accordance with the
1308 requirements necessary to satisfy the isolating function (see 8.3).

1309 Indication of the position of the isolation contacts shall be provided by one or both of the
1310 following means:

- 1311 – the position of the actuator (this being preferred); or
- 1312 – a separate mechanical indicator.

1313 If a separate mechanical indicator is used to indicate the position of the isolation contacts, this
1314 shall show the colour red for the closed position and the colour green for the open position.

1315 NOTE In the US, the colours red and green are not used for contact position indication.

1316 The means of indication of the isolation contact position shall be reliable.

1317 SC-RCBOs shall be designed so that the actuator, front plate or cover can only be correctly
1318 fitted in a manner which ensures correct indication of the contact position.

1319 It shall be possible to lock the SC-RCBOs in the open position, and it shall not be possible to
1320 close the SC-RCBO when the open position is locked. The locking means may be integral to
1321 the SC-RCBO or provided as a separate external accessory.

1322 Locking of the operating means in the closed position is permitted, provided the trip free function
1323 is ensured.

1324 *Compliance is checked by inspection*

1325 Where the operating means is used to indicate the position of the isolation contacts, the
1326 operating means, when released, shall automatically take up the position corresponding to that
1327 of the isolation contacts; in this case, the operating means shall have two distinct rest positions
1328 corresponding to the position of the contacts but, for automatic opening, a third distinct position
1329 of the operating means may be provided, in which case it shall be necessary to reset the SC-
1330 RCBO manually before reclosing is possible.

1331 When an indicator light is used, this shall be lit when the SC-RCBO is in the closed position
 1332 and be of bright colour. The indicator light shall not be the only means to indicate the closed
 1333 position.

1334 The action of the mechanism shall not be influenced by the position of enclosures or covers
 1335 and shall be independent of any removable part.

1336 A cover sealed in position by the manufacturer is considered to be a non-removable part.

1337 If the cover is used as a guiding means for push-buttons, it shall not be possible to remove the
 1338 buttons from the outside of the SC-RCBO.

1339 Operating means shall be securely fixed on their shafts and it shall not be possible to remove
 1340 them without the aid of a tool.

1341 Operating means directly fixed to covers are allowed. If the operating means has an "up-down"
 1342 movement, when the SC-RCBO is mounted as in normal use, the contacts shall be closed by
 1343 the up movement.

1344 *Compliance is checked by inspection, by manual test and, for the trip-free mechanism, by the*
 1345 *tests of 9.9.3.3, 9.11 and 9.15.*

1346 **8.1.7 Clearances, creepage distances and solid insulation**

1347 **8.1.7.1 General**

1348 The minimum required clearances and creepage distances are given in Table 20 which is based
 1349 on the SC-RCBO being designed for operating in an environment with pollution degree 2.

1350 **Table 20 – 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 kV	4 kV												
Description/ Item	120/ 240AC 120AC	120/ 240AC 240AC	230/ 400AC 230AC 400AC	> 25 ≤ 50 ⁱ	120	250	400	> 25 ≤ 50 ⁱ	120	250	400	> 25 ≤ 50 ⁱ	120	250	400
			200/ 400DC 200 DC 400 DC												
1. Between live parts which are separated when the isolation contacts are in the open position ^{a, j}	2,0	4,0	4,0	1,2	2,0	4,0	4,0	0,9	2,0	4,0	4,0	0,6	2,0	4,0	4,0

2. Between live parts of different polarity ^{a, k}	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 AC		230 / 400 AC		120 / 240 AC		230/400AC		120 / 240AC		230 / 400AC	
						200/400 DC				200/400 DC				200/400DC	
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 SC-RCBO – surface on which the SC-RCBO is mounted ^b – screws or other means for fixing the SC-RCBO ^b – metal covers or boxes ^b – other accessible metal parts ^c – metal frames supporting flush-type SC-RCBOs	1,5	3,0	3,0	1,5		4,0		1,5		3,0		1,5		3,0	

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

2) The parts of the neutral or mid-point 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 shall be doubled if clearances and creepage distances between live parts of the device and the metallic screen or the surface on which the SC-RCBO is mounted are not dependent on the design of the SC-RCBO only.

^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 (test probe 11 of IEC 61032).

^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 taken 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 (see IEC 60364-4-41:2005, 414) in an auxiliary contact.

^h For material group IIIb ($100 \leq CTI < 175$) 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.

^j The clearance and creepage distances between the metal parts within the arc chamber may be less than 1 mm, provided that the sum of distances is greater than that specified in item 1 of this Table 20.

^k In general this also applies to clearances and creepage distances between live parts and any surfaces adjacent to the circuit-breaker when installed. If any surfaces adjacent to the circuit-breaker do not meet the clearance and creepage distance requirements, appropriate information shall be provided for installation. In this case at least half the required distances shall be provided.

1352 Parts of PCBs connected to the live parts protected against pollution by the use of type 2
1353 protection according to IEC 60664-3 are exempt from this verification.

1354 The insulating materials are classified into material groups based on their comparative tracking
1355 index (CTI) according to IEC 60664-1.

1356 NOTE 1 The comparative tracking index (CTI) is declared by the manufacturer based on tests carried out on the
1357 insulating material.

1358 NOTE 2 Information on the requirements for design of solid insulation is provided in IEC 60664-1.

1359 For clearances on printed wiring material, footnote c in Table F.2 of IEC 60664-1:2020 applies:
1360 "For printed wiring material, the values for pollution degree 1 apply except that the value shall
1361 not be less than 0,04 mm, as specified in Table F.5 of IEC 60664-1:2020. A protection by means
1362 of a solder resist of high quality is the minimum requirement to allow this clearance reduction".

1363 All measurements required in this Subclause 8.1.7 are carried out in test **sequence A** on one
1364 sample. Tests according to 9.7 are carried out in test **sequence B** on three samples

1365 **8.1.7.2 Clearance**

1366 *Compliance for item 1 in Table 20 is checked by measurement and by the tests of 9.7.7.3. The*
1367 *test is carried out with samples not submitted to the humidity treatment described in 9.7.1.*

1368 *Compliance for items 2 and 4 in Table 20 is checked by measurement and, if the clearances*
1369 *are reduced, by the tests of 9.7.7.2.*

1370 The clearances of items 2 and 4 in Table 20 (except for accessible surface after installation,
1371 see below) may be reduced provided that the measured clearances are not shorter than the
1372 minimum allowed in IEC 60664-1 for homogenous field conditions. In this case, compliance for
1373 items 2 and 4 is always checked by the test of 9.7.7.2.

1374 Accessible surface after installation means any surface accessible by the user when the SC-
1375 RCBO is installed according to the manufacturer's instructions. The test finger can be applied
1376 to determine whether a surface is accessible or not.

1377 *Compliance for item 3 in Table 20 is checked by measurement.*

1378 **8.1.7.3 Creepage distances**

1379 *Compliance for items 1, 2, 3 and 4 in Table 20 is checked by measurement.*

1380 **8.1.7.4 Solid insulation**

1381 *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*
1382 *applicable.*

1383 **8.1.7.5 Additional requirements for control circuits connected to the main circuit**

1384 *Compliance is checked by the test of 9.7.6.*

1385 **8.1.8 Screws, current-carrying parts and connections**

1386 **8.1.8.1 Connections**

1387 Connections, whether electrical or mechanical, shall withstand the stresses occurring in normal
1388 use.

1389 Screws (or nuts) which are operated when mounting the SC-RCBO include screws for fixing
 1390 covers or cover-plates, but not connecting means for screwed conduits and for fixing the base
 1391 of an SC-RCBO.

1392 NOTE Screwed connections are also considered to be checked by the tests of 9.8, 9.11, 9.12, 9.13 and 9.20.

1393 *Compliance is checked by inspection, by manual test and by the test of 9.4.*

1394 **8.1.8.2 Screws in engagement with a thread of insulating material**

1395 For screws in engagement with a thread of insulating material and which are operated when
 1396 mounting the SC-RCBO during installation, correct introduction of the screw into the screw hole
 1397 or nut shall be ensured.

1398 *Compliance is checked by inspection and by manual test.*

1399 The requirement with regard to correct introduction is met if introduction of the screw in a
 1400 slanting manner is prevented, for example by guiding the screw by the part to be fixed, by a
 1401 recess in the thread or by the use of a screw with the leading thread removed.

1402 **8.1.8.3 Electrical connections**

1403 Electrical connections shall be so designed that contact pressure is not transmitted through
 1404 insulating material other than ceramic, pure mica or other material with characteristics no less
 1405 suitable, unless there is sufficient resilience in the metallic parts to compensate for any possible
 1406 shrinkage or yielding of the insulating material.

1407 *Compliance is checked by inspection.*

1408 NOTE The suitability of the material is considered in respect of the stability of the dimensions.

1409 **8.1.8.4 Current-carrying parts**

1410 Current-carrying parts and parts intended for protective conductors, if any, shall be made of a
 1411 metal having, under the conditions occurring in the equipment, mechanical strength, electrical
 1412 conductivity and resistance to corrosion adequate for their intended use.

1413 Examples of suitable materials are given below:

- 1414 – copper;
- 1415 – an alloy containing at least 58 % copper for parts worked cold, or at least 50 % copper for
 1416 other parts;
- 1417 – other metal or suitably coated metal, no less resistant to corrosion than copper and having
 1418 mechanical properties no less suitable.

1419 If using ferrous alloys or suitably coated ferrous alloys, compliance to resistance to corrosion
 1420 is checked by a test of resistance to rusting according to 9.22.

1421 The requirements of this Subclause 8.1.8.4 do not apply to contacts, magnetic circuits, heater
 1422 elements, bimetals, shunts, electronic components, printed circuit boards, nor to screws, nuts,
 1423 washers, clamping plates, similar parts of terminals and parts of the test circuit.

1424 **8.1.9 Terminals for external conductors**

1425 **8.1.9.1**

1426 Terminals for external conductors shall be such that the conductors may be connected so as to
 1427 ensure that the necessary contact pressure is maintained permanently.

1428 Connection arrangements intended for busbar connection are admissible, provided they are not
1429 used for the connection of cables.

1430 The terminals shall be readily accessible under the intended conditions of use.

1431 *Compliance is checked by inspection, by the tests of 9.5 for screw-type terminals, or by the*
1432 *tests of IEC 62873-3-1, IEC 62873-3-2, and IEC 62873-3-3, as relevant for the type of*
1433 *connection.*

1434 8.1.9.2

1435 SC-RCBOs shall be provided with one of the following:

1436 – terminals which shall allow the connection of copper conductors having nominal cross-
1437 sectional areas as shown in Table 21; or

1438 NOTE Examples of possible designs of screw-type terminals are given in Annex H.

1439 – screwless type terminals for copper conductors according to IEC 62873-3-1; or

1440 – flat quick-connect terminals for copper conductors according to IEC 62873-3-2; or

1441 – terminals for untreated aluminium conductors and with aluminium screw-type terminals for
1442 use with copper or with aluminium conductors according to IEC 62873-3-3.

1443 *Compliance for terminals according to the first indent is checked by inspection, by measurement*
1444 *and by fitting in turn one conductor of the smallest and one of the largest cross-section as*
1445 *specified in Table 21.*

1446 **Table 21 – Connectable cross-sections of copper conductors for screw-type terminals**

Rated current ^a		Range of nominal cross-section to be clamped ^b			
A		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	80	10	to 25	10	to 16
80	100	16	to 35	16	to 25
100	125	25	to 50	25	to 35

^a A range of SC-RCBOs 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 mm² up to 6 mm² be designed to clamp solid conductors only.

^c Rigid stranded conductors shall be used for conductors having cross-sections from 1,5 mm² up to 50 mm² and shall be in compliance with Class 2 of IEC 60228, related to stranded conductors for single-core.

1447

1448 8.1.9.3

1449 The means for clamping the conductors in the terminals shall not serve to fix any other
1450 component, although they may hold the terminals in place or prevent them from turning.

1451 *Compliance is checked by inspection.*

1452 **8.1.9.4**

1453 Terminals for rated currents up to and including 32 A shall allow the conductors to be connected
1454 without special preparation.

1455 *Compliance is checked by inspection.*

1456 NOTE The term "special preparation" covers soldering of wire of the conductor, use of cable lugs, formation of
1457 eyelets, etc., but not the reshaping of the conductor before its introduction into the terminal or the twisting of a flexible
1458 conductor to consolidate the end.

1459 **8.1.9.5**

1460 Terminals shall have adequate mechanical strength for the intended use.

1461 Screws and nuts for clamping the conductors shall have a metric ISO thread or a thread
1462 comparable in pitch and mechanical strength.

1463 *Compliance is checked by inspection and by the tests of 9.4 and 9.5.*

1464 **8.1.9.6**

1465 Terminals shall be so designed that they clamp the conductor without undue damage to the
1466 conductor.

1467 *Compliance is checked by inspection and by the test of 9.5.4.*

1468 **8.1.9.7**

1469 Terminals shall be so designed that they clamp the conductor reliably and between metal
1470 surfaces.

1471 *Compliance is checked by inspection and by the tests of 9.4 and 9.5.4.*

1472 **8.1.9.8**

1473 Terminals shall be so designed or positioned that neither a rigid solid conductor nor a wire of a
1474 stranded conductor can slip out while the clamping screws or nuts are tightened.

1475 This requirement does not apply to lug terminals.

1476 *Compliance is checked by the test of 9.5.4.*

1477 **8.1.9.9**

1478 Terminals shall be so fixed or located that, when the clamping screws or nuts are tightened or
1479 loosened, their fixings do not work loose.

1480 These requirements do not imply that the terminals shall be so designed that their rotation or
1481 displacement is prevented, but any movement shall be sufficiently limited so as to prevent
1482 non-compliance with the requirements of this document.

1483 The use of sealing compound or resin is considered to be sufficient for preventing a terminal
1484 from working loose, provided that

- 1485 • the sealing compound or resin is not subject to stress during normal use;