

Electrical accessories— Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCB's)—

Part 1: General rules

The European Standard EN 61008-1:1994 with the incorporation of amendments A2:1995, A11:1995, A12:1998, A13:1998, A14:1998 and A17:2000 has the status of a British Standard

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Cooperating organizations

The European Committee for Electrotechnical Standardization (CENELEC), under whose supervision this European Standard was prepared, comprises the national committees of the following countries:

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Contents

	Page
Cooperating organizations	Inside front cover
National foreword	ii
Foreword	2
Text of EN 61008-1	3
National annex NA (informative) Committees responsible	103

National foreword

This British Standard has been prepared by Technical Committee PEL/23. It is the English language version of EN 61008-1 *Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCB's) — Part 1: General rules*, including amendments A2:1995, A11:1995, A12:1998, A13:1998, A14:1998 and A17:2000, published by the European Committee for Electrotechnical Standardization (CENELEC), and incorporates the corrigenda dated September 1994, December 1997 and April 1998. It was derived by CENELEC from IEC 61008-1:1990, including amendment 1:1992 and amendment 2:1995, published by the International Electrotechnical Commission (IEC).

The CENELEC common modifications have been implemented at the appropriate places in the text and are indicated on original pages by a sideline in the margin. The attention of users of this standard is drawn to the dates of withdrawal in the forewords of the amendments to EN 61008-1.

This British Standard is one of a series in which the other publications, which together supersede BS 4293:1983, are as follows:

BS EN 61008-2-1:1995, *Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCB's) — Part 2-1: Applicability of the general rules to RCCB's functionally independent of line voltage*.

BS IEC 1008-2-2:1990, *Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCB's) — Part 2-2: Applicability of the general rules to RCCB's functionally dependent on line voltage*.

Cross-references

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 103 and a back cover.

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English version

Electrical accessories — Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCB's) Part 1: General rules

(includes amendments A11:1995, A2:1995, A12:1998, A13:1998, A14:1998 and A17:2000)
(IEC 61008-1:1990 + A1:1992 + A2:1995, modified)

Petit appareillage électrique Interrupteurs automatiques à courant différentiel résiduel pour usages domestiques et analogues sans dispositif de protection contre les surintensités incorporé (ID)
Partie 1: Règles générales
(inclut les amendements A11:1995, A2:1995, A12:1998, A13:1998, A14:1998 et A17:2000)
(CEI 61008-1:1990 + A1:1992 + A2:1995, modifiée)

Elektrisches Installationsmaterial Fehlerstrom-/Differenzstrom-Schutzschalter ohne eingebauten Überstromschutz für Hausinstallationen und für ähnliche Anwendungen
Teil 1: Allgemeine Anforderungen
(enthält Änderungen A11:1995, A2:1995, A12:1998, A13:1998, A14:1998 und A17:2000)
(IEC 61008-1:1990 + A1:1992 + A2:1995, modifiziert)

This European Standard was approved by CENELEC on 1994-03-08, amendment A11 was approved by CENELEC on 1995-07-04, amendment A2 was approved by CENELEC on 1995-09-20, amendment A12 on 1997-10-01, amendment A13 on 1998-04-01, amendment A14 on 1997-03-11 and A17:2000 on 2000-02-13. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

The text of the international standard IEC 1008-1:1990 and its amendment 1:1992 together with common modifications prepared by Technical Committee CENELEC TC 23E, Circuit-breakers and similar equipment for household and similar uses, was submitted to the Unique Acceptance Procedure (UAP) for acceptance as a European Standard.

As the original document did not obtain a sufficient number of positive votes, a revised draft was prepared and submitted to a second vote. The new draft was approved by CENELEC as EN 61008-1 on 1994-03-08.

The following dates were fixed:

- latest date of publication of an identical national standard (dop) 1996-07-01
- latest date of withdrawal of conflicting national standards (dow) 2000-07-01

Conformity of products with the requirements of this standard ensures conformity with the essential requirements of Directive 73/23/EEC (Low voltage Directive) and its amendment 93/68/EEC.

Annexes designated “normative” are part of the body of the standard. Annexes designated “informative” are given for information only. In this standard, Annex A, Annex B, Annex C, Annex D, Annex ZA and Annex ZB are normative and Annex IA, Annex IB, Annex IC and Annex ZC are informative.

Annex ZA (normative references), Annex ZB (special national conditions) and Annex ZC (A-deviations) have been added by CENELEC.

Subclauses, figures and tables added by CENELEC are numbered starting with Z1, Z2 ...

Foreword to amendment A11

This amendment was prepared by the Technical Committee CENELEC TC 23E, Circuit breakers and similar devices for household and similar applications.

Its aim is to add a type of RCCB able to operate at temperatures down to -25°C with unified requirements acceptable by all members of CENELEC.

The text of the draft was submitted to the formal vote and was approved by CENELEC as amendment A11 to EN 61008-1:1994 on 1995-07-04.

The following dates were fixed:

- latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1996-07-01
- latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 2000-07-01

Foreword to amendment A2

The text of document 23E/210/DIS, future amendment 2 to IEC 1008-1:1990, prepared by SC 23E, Circuit-breakers and similar equipment for household use, of IEC TC 23, Electrical accessories, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A2 to EN 61008-1:1990 on 1995-09-20.

The following dates were fixed:

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- latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 2000-07-01

Foreword to amendment A12

This amendment was prepared by the Technical Committee CENELEC TC 23E, Circuit breakers and similar devices for household and similar applications.

The text of the draft was submitted to the formal vote and was approved by CENELEC as amendment A12 to EN 61008-1:1994 on 1997-10-01.

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- latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1998-07-01
- latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 2001-01-01

Foreword to amendment A13

This amendment was prepared by the Technical Committee CENELEC TC 23E, Circuit breakers and similar devices for household and similar applications.

The text of the draft was submitted to the Unique Acceptance Procedure and was approved by CENELEC as amendment A13 to EN 61008-1:1994 on 1998-04-01.

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Foreword to amendment A14

The texts of document 23E/245/FDIS, intended to be published in a new (second) edition of IEC 61008-1, and document 23E/251/FDIS, future amendment to that new edition, both prepared by SC 23E, Circuit breakers and similar equipment for household use, of IEC TC 23, Electrical accessories, were submitted to the IEC-CENELEC parallel vote and were approved by CENELEC as amendment A14 to EN 61008-1:1994 on 1997-03-11.

The following dates were fixed:

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- latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 2001-01-01

Foreword to amendment A17

At the request of the Swedish electrotechnical committee, a draft for an amendment to EN 61008-1:1994 was submitted to the CENELEC members for acceptance in December 1999.

The text of the draft was accepted by CENELEC as amendment A17 to EN 61008-1:1994 on 2000-02-13.

The following dates were fixed:

- latest date by which the existence of the amendment has to be announced at national level (doa) 2000-05-13
- latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2000-08-13

Contents

	Page	Page
Foreword	2	Figure 4a
Introduction	7	Figure 4b — Test circuit for the verification of the correct operation of RCCB's, in the case of residual pulsating direct currents
1 Scope	7	64
2 Normative references	7	Figure 4c — Test circuit for the verification of the correct operation of RCCB's, in the case of superimposed residual smooth direct currents
3 Definitions	8	65
4 Classification	15	Figure 6 — Test circuit for the verification of the rated making and breaking capacity and of the co-ordination with a SCPD of a two-pole RCCB, in case of a single-phase circuit (9.11)
5 Characteristics of RCCB's	16	67
6 Marking and other product information	20	Figure Z1 — Test circuit for the verification of the rated making and breaking capacity and of the co-ordination with a SCPD of a three-pole RCCB on three-phase circuit (9.11)
7 Standard conditions for operation in service and for installation	25	68
8 Requirements for construction and operation	25	Figure Z2 — Test circuit for the verification of the rated making and breaking capacity and of the co-ordination with a SCPD of a three-pole RCCB on three-phase circuit (9.11)
9 Tests	33	69
Annex A (normative) Test sequence and number of samples to be submitted for certification purposes	83	Figure 10 — Test apparatus for the verification of the minimum I^2t and I_p values to be withstood by the RCCB [9.11.2.1 a)]
Annex B (normative) Determination of clearances and creepage distances	87	70
Annex C (normative) Arrangement for the detection of the emission of ionized gases during short-circuit tests	89	Figure 11 — Mechanical shock test apparatus (9.12.1)
Annex D (normative) Routine tests	91	71
Annex E (normative) List of tests, additional test sequences and numbers of samples for verification of compliance of RCCBs with the requirements of electromagnetic compatibility (EMC)	92	Figure 12 — Mechanical impact test apparatus (9.12.2.1)
Annex IA (informative) Methods of determination of short-circuit power-factor	93	72
Annex IB (informative) Glossary of symbols	94	Figure 13 — Striking element for pendulum impact test apparatus (9.12.2.1)
Annex IC (informative) Examples of terminal designs	94	73
Annex ID (informative) <i>deleted</i>		Figure 14 — Mounting support for sample for mechanical impact test (9.12.2.1)
Annex IE (informative) Follow-up testing program for RCCBs	98	73
Annex ZA (normative) Other international publications quoted in this standard with the references of the relevant European publications	101	Figure 15 — Example of mounting an unenclosed RCCB for mechanical impact test (9.12.2.1)
Annex ZB (normative) Special national conditions	102	74
Annex ZC (informative) A-deviations	102	Figure 16 — Example of mounting of panel mounting type RCCB for the mechanical impact test (9.12.2.1)
Figure 1 — Thread-forming tapping screw (3.6.10)	61	75
Figure 2 — Thread-cutting tapping screw (3.6.11)	61	Figure 17 — Application of force for mechanical test of rail mounted RCCB (9.12.2.2)
Figure 3 — Standard test finger (9.6)	62	76
		Figure 18 — Ball-pressure test apparatus (9.13.2)
		76
		Figure 19 — Test circuit for the verification of the limiting value of overcurrent in case of single-phase load through a three-pole or four-pole RCCB (9.18.2)
		77

	Page		Page
Figure 19a — Current ring wave 0.5 μ s/100 kHz		Table 12 — Test voltage of auxiliary circuits	39
Figure 19b — Test circuit for the ring wave test at RCCBs	78	Table 13 — Tests to be made to verify the behaviour of RCCB's under short-circuit conditions	43
Figure 20 — Stabilizing period for reliability test (9.22.1.3)	78	Table 14 — Silver wire diameter as a function of rated current and short-circuit currents	44
Figure 21 — Reliability test cycle (9.22.1.3)	79	Table 15 — Minimum values of I^2t and I_p	45
Figure 22 — Example for test circuit for verification of ageing (9.23)	80	Table 16 — Power factors for short-circuit tests	46
Figure 23 — Surge current impulse 8/20 μ s	81	Table 17 — Tripping current ranges for type A RCCB's	57
Figure 24 — Test circuit for the surge current test at RCCBs	82	Table A.1	84
Figure Z3 — Test cycle for low temperature test (9.24)	82	Table A.2	85
Figure B.1 to Figure B.10 — Illustrations of the application of creepage distances	83	Table A.3	86
Figure C.1 — Test arrangement	88	Table E.1	92
Figure C.2 — Grid	90	Table E.2	93
Figure C.3 — Grid circuit	90	Table IE.1 — Test sequences during follow-up inspections	98
Figure IC.1 — Examples of pillar terminals	91	Table IE.2 — Number of samples to be tested	100
Figure IC.2 — Examples of screw terminals and stud terminals	95		
Figure IC.3 — Examples of saddle terminals	96		
Figure IC.4 — Examples of lug terminals	97		
Table Z1 — Survey of the type of RCCB's according to their method of operation	97		
Table 1 — Standard values of break time and non-actuating time	15		
Table 2 — Standard conditions for operation in service	19		
Table 3 — Clearances and creepage distances	25		
Table 4 — Connectable cross-sections of copper conductors for screw-type terminals	27		
Table 5 — Temperature-rise values	29		
Table 6 — Requirements for RCCB's functionally dependent on line voltage	31		
Table 7 — List of type tests	32		
Table 8 — Test copper conductors corresponding to the rated currents	34		
Table 9 — Screw thread diameters and applied torques	34		
Table 10 — Pulling forces	35		
Table 11 — Conductor dimensions	36		

Introduction

This part includes definitions, requirements and tests, covering all types of RCCB's. For the applicability to a specific type this part shall apply in conjunction with the relevant part, as follows:

- Part 2-1: *Applicability of the general rules to RCCB's functionally independent of line voltage*;
- Part 2-2: *Applicability of the general rules to RCCB's functionally dependent on line voltage*.

1 Scope

This International Standard applies to residual current operated circuit-breakers functionally independent of, or functionally dependent on, line voltage, for household and similar uses, not incorporating overcurrent protection (hereafter referred to as RCCB's), for rated voltages not exceeding 440 V a.c. and rated currents not exceeding 125 A for fixed installation, intended principally for protection against shock-hazard.

These devices are intended to protect persons against indirect contact, the exposed conductive parts of the installation being connected to an appropriate earth electrode. They may be used to provide protection against fire hazards due to a persistent earth fault current, without the operation of the overcurrent protective device.

RCCB's having a rated residual operating current not exceeding 30 mA are also used as a means for additional protection in case of failure of the protective means against electric shock.

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

NOTE 1 The requirements for RCCB's are in line with the general requirements of IEC 755. RCCB's are essentially intended to be operated by uninstructed persons and designed not to require maintenance. They may be submitted for certification purposes.

NOTE 2 Installation and application rules of RCCB's are given in IEC 364.

NOTE 3 RCCB's within the scope of the present standard are considered as suitable for isolation (see 8.1.3, 9.7.2, 9.7.3, 9.11.2.1).

Special precautions (e.g. lightning arresters) may be necessary when excessive overvoltages are likely to occur on the supply side (for example in the case of supply through overhead lines) (see IEC 364-4-443).

RCCBs of the general type are resistant to unwanted tripping 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.

RCCBs of the S type are considered to be sufficient proof against unwanted tripping even if the surge voltage causes a flashover and a follow-on current occurs.

NOTE 4 Surge arresters installed downstream of the general type of RCCBs and connected in common mode may cause unwanted tripping.

NOTE 5 For RCCB's having a degree of protection higher than IP20 special constructions may be required.

Particular requirements are necessary for

- Residual current operated circuit-breakers with integral overcurrent protection (see IEC 1009);
- RCCB's integrated in one unit with a socket-outlet or designed exclusively for being associated locally with a socket-outlet in the same mounting box.

NOTE 6 For the time being, for RCCB's integrated in one unit with a socket-outlet or designed exclusively for being associated locally with a socket-outlet in the same mounting box the requirements of this standard in conjunction with those of IEC 884-1 may be used as far as applicable.

The requirements of this standard apply for normal environmental conditions (see 7.1). Additional requirements may be necessary for RCCB's used in locations having severe environmental conditions.

RCCB's including batteries are not covered by this standard.

2 Normative references

NOTE Normative references to international publications are listed in Annex ZA (normative).

3 Definitions

For the purpose of this standard, the following definitions apply.

Where the terms “voltage” or “current” are used, they imply r.m.s. values, unless otherwise specified.

NOTE For glossary of symbols see Annex IB.

3.1 Definitions relating to currents flowing from live parts to earth

3.1.1

earth fault current

current flowing to earth due to an insulation fault

3.1.2

earth leakage current

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

3.1.3

pulsating direct current

current of pulsating wave form (IEV 101-04-34) which assumes, in each period of the rated power frequency, the value 0 or a value not exceeding 0,006 A d.c. during one single interval of time, expressed in angular measure, of at least 150°

3.1.4

current delay angle α

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

3.2 Definitions relating to the energization of a residual current circuit-breaker

3.2.1

energizing quantity

an electrical excitation quantity which alone, or in combination with other such quantities, shall be applied to a RCCB to enable it to accomplish its function under specified conditions

3.2.2

energizing input-quantity

energizing quantity by which the RCCB is activated when it is applied under specified conditions

These conditions may involve, for example, the energizing of certain auxiliary elements.

3.2.3

residual current (I_{Δ})

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

3.2.4

residual operating current

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

3.2.5

residual non-operating current

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

3.3 Definitions relating to the operation and to the functions of residual current circuit-breakers

3.3.1

residual current operated circuit-breaker

a mechanical switching device designed to make, carry and break currents under normal service conditions and to cause the opening of the contacts when the residual current attains a given value under specified conditions

3.3.2**residual current operated circuit-breaker without integral over-current protection (RCCB)**

a residual current operated circuit-breaker not designed to perform the functions of protection against overloads and/or short-circuits

3.3.3**residual current operated circuit-breaker with integral overcurrent protection (RCBO)**

a residual current operated circuit-breaker designed to perform the functions of protection against overloads and/or short-circuits

3.3.4**RCCB's functionally independent of line voltage**

RCCB's for which the functions of detection, evaluation and interruption do not depend on the line voltage

NOTE These devices are defined in 2.3.2 of IEC 755 as residual current devices without auxiliary source.

3.3.5**RCCB's functionally dependent on line voltage**

RCCB's for which the functions of detection, evaluation or interruption depend on the line voltage

NOTE 1 This definition covers partially the definition of residual current devices with auxiliary source of 2.3.3 of IEC 755.

NOTE 2 It is understood that the line voltage is applied to the RCCB, for detection, evaluation or interruption.

3.3.6**switching device**

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

3.3.7**mechanical switching device**

a switching device designed to close and to open one or more electric circuits by means of separable contacts

3.3.8**trip-free RCCB**

a RCCB the moving contacts of which return to and remain in the open position when the automatic opening operation is initiated after the initiation of the closing operation, even if the closing command is maintained

NOTE To ensure proper breaking of the current which may have been established, it may be necessary that the contacts momentarily reach the closed position.

3.3.9**break time of a RCCB**

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

3.3.10**limiting non-actuating time**

maximum delay during which a value of residual current higher than the residual non-operating current can be applied to the RCCB without causing it to operate

3.3.11**time-delay RCCB**

RCCB specially designed to attain a predetermined value of limiting non-actuating time, corresponding to a given value of residual current

3.3.12**closed position**

the position in which the predetermined continuity of the main circuit of the RCCB is secured

3.3.13**open position**

the position in which the predetermined clearance between open contacts in the main circuit of the RCCB is secured

3.3.14

pole

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

3.3.15

switched neutral pole

a pole only intended to switch the neutral and not intended to have a short-circuit capacity

3.3.16

main circuit (of a RCCB)

all the conductive parts of a RCCB included in the poles (see 4.3)

3.3.17

control circuit (of a RCCB)

a circuit (other than a path of the main circuit) intended for the closing operation or the opening operation, or both, of the RCCB

NOTE The circuits intended for the test device are included in this definition.

3.3.18

auxiliary circuit (of a RCCB)

all the conductive parts of a RCCB intended to be included in a circuit other than the main circuit and the control circuit of the RCCB

3.3.19

RCCB Type AC

RCCB for which tripping is ensured for residual sinusoidal alternating currents, whether suddenly applied or slowly rising

3.3.20

RCCB Type A

RCCB for which tripping is ensured for residual sinusoidal alternating currents and residual pulsating direct currents, whether suddenly applied or slowly rising

3.3.21

test device

device incorporated in the RCCB simulating the residual current conditions for the operation of the RCCB under specified conditions

3.4 Definitions relating to values and ranges of energizing quantities

3.4.1 rated value

a quantity value assigned by the manufacturer for a specific operating condition of a RCCB

3.4.2 Non-operating overcurrents in the main circuit

The definitions of limiting values of non-operating overcurrents are given in 3.4.2.1 and 3.4.2.2.

NOTE In the case of overcurrent in the main circuit, in the absence of residual current, operation of the detecting device may occur as a consequence of asymmetry existing in the detecting device itself.

3.4.2.1

limiting value of overcurrent in case of a load through a RCCB with two current paths

maximum value of overcurrent of a load which, in the absence of any fault to frame or to earth, and in the absence of an earth leakage current, can flow through a RCCB with two current paths without causing it to operate

3.4.2.2**limiting value of overcurrent in case of a single phase load through a three-pole or four-pole RCCB**

maximum value of a single phase overcurrent which, in the absence of any fault to frame or to earth, and in the absence of an earth leakage current, can flow through three-pole or four-pole RCCB without causing it to operate

3.4.3**residual short-circuit withstand current**

maximum value of the residual current for which the operation of the RCCB is ensured under specified conditions and above which the device may undergo irreversible alterations

3.4.4**prospective current**

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

NOTE The prospective current may be qualified in the same manner as an actual current, for example: prospective breaking current, prospective peak current, prospective residual current, etc.

3.4.5**making capacity**

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

3.4.6**breaking capacity**

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

3.4.7**residual making and breaking capacity**

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

3.4.8**conditional short-circuit current**

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

3.4.9**conditional residual short-circuit current**

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

3.4.10 Limiting values (U_x and U_y) of the line voltage for RCCB's functionally dependent on line voltage**3.4.10.1**

U_x

minimum value of the line voltage at which a RCCB functionally dependent on line voltage still operates under specified conditions in case of decreasing line voltage (see 9.17.1)

3.4.10.2

U_y

minimum value of the line voltage below which a RCCB functionally dependent on line voltage opens automatically in the absence of any residual current (see 9.17.2)

3.4.11

I^2t (Joule integral)

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

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

3.4.12 recovery voltage

the voltage which appears across the terminals of a pole of a RCCB after the breaking of the current

NOTE 1 This voltage may be considered as comprising two successive intervals of time, one during which a transient voltage exists, followed by a second one during which power-frequency voltage alone exists.

NOTE 2 This definition refers to a single-pole device. For a multipole device the recovery voltage is the voltage across the supply terminals of the device.

3.4.12.1

transient recovery voltage

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

NOTE The transient voltage may be oscillatory or non-oscillatory or a combination of these depending on the characteristics of the circuit and of the RCCB. It includes the voltage shift of the neutral of a polyphase circuit.

3.4.12.2

power-frequency recovery voltage

the recovery voltage after the transient voltage phenomena have subsided

3.5 Definitions relating to values and ranges of influencing quantities

3.5.1

influencing quantity

any quantity likely to modify the specified operation of a RCCB

3.5.2

reference value of an influencing quantity

the value of an influencing quantity to which the manufacturer's stated characteristics are referred

3.5.3

reference conditions of influencing quantities

collectively, the reference values of all influencing quantities

3.5.4

range of an influencing quantity

the range of values of an influencing quantity which permits the RCCB to operate under specified conditions, the other influencing quantities having their reference values

3.5.5

extreme range of an influencing quantity

the range of values of an influencing quantity within which the RCCB suffers only spontaneously reversible changes, although not necessarily complying with all the requirements of this standard

3.5.6

ambient air temperature

the temperature, determined under prescribed conditions, of the air surrounding the RCCB (for an enclosed RCCB it is the air outside the enclosure)

3.6 Definitions relating to terminals

NOTE These definitions may be modified when the work of Sub-Committee 23F on terminals is completed.

3.6.1

terminal

a terminal is a conductive part of a device, provided for reusable electrical connection to external circuits

3.6.2**screw-type terminal**

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

3.6.3**pillar terminal**

a screw-type terminal in which the conductor is inserted into a hole or cavity, where it is clamped under the shank of the screw(s).

The clamping pressure may be applied directly by the shank of the screw or through an intermediate clamping element to which pressure is applied by the shank of the screw.

NOTE Examples of pillar terminals are shown in Figure IC.1 of Annex IC.

3.6.4**screw terminal**

a screw-type terminal in which the conductor is clamped under the head of the screw.

The clamping pressure may be applied directly by the head of the screw or through an intermediate part, such as a washer, a clamping plate or an anti-spread device.

NOTE Examples of screw terminals are shown in Figure IC.2 of Annex IC.

3.6.5**stud terminal**

a screw-type terminal in which the conductor is clamped under a nut

The clamping pressure may be applied directly by a suitably shaped nut or through an intermediate part, such as a washer, a clamping plate or an anti-spread device.

NOTE Examples of stud terminals are shown in Figure IC.2 of Annex IC.

3.6.6**saddle terminal**

a screw-type terminal in which the conductor is clamped under a saddle by means of two or more screws or nuts

NOTE Examples of saddle terminals are shown in Figure IC.3 of Annex IC.

3.6.7**lug terminal**

a screw terminal or a stud terminal, designed for clamping a cable lug or a bar by means of a screw or nut

NOTE Examples of lug terminals are shown in Figure IC.4 of Annex IC.

3.6.8**screwless terminal**

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

3.6.9**tapping screw**

a screw manufactured from a material having high resistance to deformation, when applied by rotary insertion to a hole in a material having less resistance to deformation than the screw.

The screw is made with a tapered thread, the taper being applied to the core diameter of the thread at the end section of the screw. The thread produced by application of the screw is formed securely only after sufficient revolutions have been made to exceed the number of threads on the tapered section.

3.6.10

thread forming tapping screw

a tapping screw having an uninterrupted thread; it is not a function of this thread to remove material from the hole

NOTE An example of a thread forming tapping screw is shown in Figure 1.

3.6.11

thread cutting tapping screw

a tapping screw having an interrupted thread; it is a function of this thread to remove material from the hole

NOTE An example of a thread cutting tapping screw is shown in Figure 2.

3.7 Conditions of operation

3.7.1

operation

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

NOTE If distinction is necessary, an operation in the electrical sense (e.g. make or break) is referred to as a switching operation and an operation in the mechanical sense (e.g. close or open) is referred to as a mechanical operation.

3.7.2

closing operation

an operation by which the RCCB is brought from the open position to the closed position

3.7.3

opening operation

an operation by which the RCCB is brought from the closed position to the open position

3.7.4

operating cycle

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

3.7.5

sequence of operation

a succession of specified operations with specified time intervals

3.7.6

clearance (see Annex B)

the shortest distance in air between two conductive parts

NOTE For the purpose of determining a clearance to accessible parts, the accessible surface of insulating enclosure shall be considered conductive as if it was covered by a metal foil wherever it can be touched by hand or by the standard test finger according to Figure 3.

3.7.7

creepage distance (see Annex B)

the shortest distance along the surface of an insulating material between two conductive parts

NOTE For the purpose of determining a creepage distance to accessible parts, the accessible surface of insulating enclosure shall be considered conductive as if it was covered by a metal foil wherever it can be touched by a hand or a standard test finger according to Figure 3.

3.8 Test

3.8.1

type test

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

3.8.2

routine tests

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

4 Classification

RCCB's are classified:

4.1 According to the method of operation

The selection of the various types is made according to of HD 384 and nonconflicting national wiring rules. Table Z1 lists the types of RCCB's according to the various applications but does not exclude the use of RCCB's of any classification for protection over and above that required by the relevant wiring rules.

4.1.1 RCCB functionally independent of line voltage (see 3.3.4)

4.1.2 RCCB functionally dependent on line voltage (see 3.3.5)

4.1.2.1 Opening automatically in case of failure of the line voltage, without or with delay (see 8.12):

a) Deleted.

b) Not reclosing automatically when the line voltage is restored.

NOTE RCCB's of type 4.1.2.1b) shall comply with the relevant requirements of 8.12.

4.1.2.2 Not opening automatically in case of failure of the line voltage:

a) Able to trip in case of a hazardous situation (e.g. due to an earth fault) arising on failure of the line voltage (additional requirements are under consideration);

b) Not able to trip in case of a hazardous situation (e.g. due to an earth fault) arising on failure of line voltage.

NOTE The selection of the RCCB's of b) is subject to the condition of 532.2.2.2 of IEC 364-5-53.

Table Z1 — Survey of the types of RCCB's according to their method of operation

Classification	4.1.1	4.1.2.2a)	4.1.2.1b)	4.1.2.2b)
Marking of use	Without	E1	E2	E3
Protection	Indirect contact and additional ^a	Indirect contact and additional ^a	Additional ^a	Additional ^{ab}
Service continuity ^c	Yes	Yes	No	Yes
^a Additional protection, provided only by RCCB's with $I_{\Delta n} \leq 0,03$ A.				
^b Only devices integrated in one unit with a socket-outlet or designed exclusively for being associated locally with socket-outlet in the same mounting box.				
^c This information is given for guidance only.				

4.2 According to the type of installation

Deleted.

4.3 According to the number of poles and current paths

- two-pole RCCB;
- three-pole RCCB;
- four-pole RCCB.

4.4 According to the possibility of adjusting the residual operating current

Deleted.

4.5 According to resistance to unwanted tripping due to voltage surges

- RCCBs with normal resistance to unwanted tripping (general type as in Table 1);
- RCCBs with increased resistance to unwanted tripping (S type as in Table 1).

4.6 According to behaviour in presence of d.c. components

- RCCB's of type AC;
- RCCB's of type A.

4.7 According to time-delay (in presence of a residual current)

- RCCB without time-delay: type for general use;
- RCCB with time-delay: type S for selectivity.

4.8 According to the protection against external influences

- enclosed-type RCCB (not requiring an appropriate enclosure);
- unenclosed-type RCCB (for use with an appropriate enclosure).

4.9 According to the method of mounting

- surface-type RCCB;
- flush-type RCCB;
- panel board type RCCB, also referred to as distribution board type.

NOTE These types may be intended to be mounted on rails.

4.10 According to the method of connection

- RCCB's the connections of which are not associated with the mechanical mounting;
- RCCB's the connections of which are associated with the mechanical mounting, for example:
 - plug-in type;
 - bolt-on type.

NOTE Some RCCB's may be of the plug-in type or bolt-on type on the line side only, the load terminals being usually suitable for wiring connection.

4.11 According to the range of ambient temperature

- RCCB's for use at ambient air temperatures between -5°C and $+40^{\circ}\text{C}$;
- RCCB's for use at ambient air temperatures between -25°C and $+40^{\circ}\text{C}$.

5 Characteristics of RCCB's**5.1 Summary of characteristics**

The characteristics of a RCCB shall be stated in the following terms:

- number of poles and current paths (see 4.3);
 - rated current I_n (see 5.2.2);
 - rated residual operating current $I_{\Delta n}$ (see 5.2.3);
 - rated residual non-operating current (see 5.2.4);
 - rated voltage U_n (see 5.2.1);
 - rated frequency (see 5.2.5);
 - rated making and breaking capacity I_m (see 5.2.6);
 - rated residual making and breaking capacity $I_{\Delta m}$ (see 5.2.7);
 - time-delay, if applicable, (see 5.2.8);
 - operating characteristics in case of residual currents with d.c. components (see 5.2.9);
 - insulation coordination including clearances and creepage distances (see 5.2.10);
 - degree of protection (see IEC 529);
 - rated conditional short-circuit current I_{nc} (see 5.4.2);
 - rated conditional residual short-circuit current $I_{\Delta c}$ (see 5.4.3).
- ranges of ambient air temperature (see 5.3.13).

For RCCB's functionally dependent on line voltage

- behaviour of the RCCB in case of failure of line voltage (see 4.1.2).

5.2 Rated quantities and other characteristics

5.2.1 Rated voltage

5.2.1.1 Rated operational voltage (U_e)

The rated operational voltage (hereafter referred to as “rated voltage”) of a RCCB is the value of voltage, assigned by the manufacturer, to which its performance is referred.

NOTE The same RCCB may be assigned a number of rated voltages.

5.2.1.2 Rated insulation voltage (U_i)

The rated insulation voltage of a RCCB 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 RCCB. In no case shall the maximum rated voltage exceed the rated insulation voltage.

5.2.2 Rated current (I_n)

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

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

The value of residual operating current (see 3.2.4), assigned to the RCCB by the manufacturer, at which the RCCB shall operate under specified conditions.

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

The value of residual non-operating current (3.2.5), assigned to the RCCB by the manufacturer, at which the RCCB does not operate under specified conditions.

5.2.5 Rated frequency

The rated frequency of a RCCB is the power frequency for which the RCCB is designed and to which the values of the other characteristics correspond.

NOTE The same RCCB may be assigned a number of rated frequencies.

5.2.6 Rated making and breaking capacity (I_m)

The r.m.s. value of the a.c. component of prospective current (see 3.4.4), assigned by the manufacturer, which a RCCB can make, carry and break under specified conditions.

The conditions are those specified in 9.11.2.2.

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

The r.m.s. value of the a.c. component of residual prospective current (3.2.3 and 3.4.4), assigned by the manufacturer, which a RCCB can make, carry and break under specified conditions.

The conditions are those specified in 9.11.2.3.

5.2.8 RCCB type S

A time-delay RCCB (see 3.3.11) which complies with the relevant part of Table 1.

5.2.9 Operating characteristics in case of residual currents with d.c. components

5.2.9.1 RCCB type AC

A RCCB for which tripping is ensured for residual sinusoidal alternating currents, whether suddenly applied or slowly rising.

5.2.9.2 RCCB type A

A RCCB for which tripping is ensured for residual sinusoidal alternating currents and residual pulsating direct currents, whether suddenly applied or slowly rising.

5.2.10 Insulation coordination including clearances and creepage distances

Under consideration.

NOTE For the time being clearances and creepage distances are given in 8.1.3.

5.3 Standard and preferred values

5.3.1 Preferred values of rated voltage (U_n)

Preferred values of rated voltage are as follows:

RCCB	Circuit supplying the RCCB	Rated voltage
Two pole with two current paths	single phase, phase to neutral, phase to phase	230 V
	single phase, phase to phase	400 V
Three pole with three current paths	three-phase three-wire	400 V
Four pole	three-phase four-wire	400 V

NOTE 1 In IEC 38 the voltage values of 230 V and 400 V have been standardized. These values should progressively replace the values of 220 V and 240 V, and of 380 V and 415 V, respectively.

NOTE 2 Wherever in this standard there is a reference to 230 V and 400 V, they may be read as 220 V or 240 V, and 380 V or 415 V, respectively.

5.3.2 Preferred values of rated current (I_n)

Preferred values of rated current are

10 – 13 – 16 – 20 – 25 – 32 – 40 – 63 – 80 – 100 – 125 A.

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

Standard values of rated residual operating current are

0,01 – 0,03 – 0,1 – 0,3 – 0,5 A.

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

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

NOTE For residual pulsating direct currents residual non-operating currents depend on the current delay angle α (see 3.1.4).

5.3.5 Standard minimum value of non-operating overcurrent in case of a multiphase balanced load through a multipole RCCB (see 3.4.2.1)

The standard minimum value of the non-operating current in case of a multiphase balanced load through a multipole RCCB is $6 I_n$.

5.3.6 Standard minimum value of the non-operating overcurrent in case of a single-phase load through a three-pole or four-pole RCCB (see 3.4.2.2)

The standard minimum value of the non-operating overcurrent in case of a single-phase load through a three-pole or four-pole RCCB is $6 I_n$.

5.3.7 Preferred values of rated frequency

The preferred value of rated frequency is 50 Hz,

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

5.3.8 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.

5.3.9 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.

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

5.3.10.1 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 – 4 500 – 6 000 – 10 000 A.

The associated power factors are specified in Table 16.

5.3.10.2 Values above 10 000 A

For values above 10 000 A up to and including 25 000 A a 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 standard.

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

5.3.11.1 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 – 4 500 – 6 000 – 10 000 A.

The values of 500 A, 1 000 A and 1 500 A are also standard for RCCB's incorporated in or intended for association with socket-outlets.

The associated power factors are specified in Table 16.

5.3.11.2 Values above 10 000 A

For values above 10 000 A up to and including 25 000 A a 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 standard.

5.3.12 Standard values of break time and non-actuating time

The standard values of break time (see 3.3.9) and non-actuating time (see 3.3.10) for type AC RCCB's are given in Table 1.

Table 1 — Standard values of break time and non-actuating time

Type	I_n	$I_{\Delta n}$	Standard values of break time(s) and non-actuating time(s) at a residual current (I_{Δ}) equal to:				
	A	A	$I_{\Delta n}$	2 $I_{\Delta n}$	5 $I_{\Delta n}$	500 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
NOTE For RCCB's of the general type integrated in one unit with a socket-outlet or designed exclusively for being associated locally with a socket-outlet in the same mounting box and for RCCB's with $I_{\Delta n} \leq 0,030$ A, 0,25 A may be used as an alternative to 5 $I_{\Delta n}$.							
^a The verifications of break times at this value are only made at the conditions specified in 9.9.2.3 .							

For type A RCCB's the maximum break times stated in Table 1 shall also be valid, the current values (i.e. $I_{\Delta n}$, $2 I_{\Delta n}$, $5 I_{\Delta n}$, 0,25 A and 500 A), however, being increased, for the test of 9.21.1, by the factor 1,4 for RCCB's with $I_{\Delta n} > 0,01$ A and by the factor 2 for RCCB's with $I_{\Delta n} \leq 0,01$ A.

5.3.13 Standard ranges of ambient air temperature

The standard ranges of ambient air temperature are:

- -5°C to $+40^{\circ}\text{C}$;
- -25°C to $+40^{\circ}\text{C}$.

5.4 Coordination with short-circuit protective devices (SCPD's)

5.4.1 General

RCCB's 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 364.

Coordination between RCCB's and the SCPD shall be verified under the general conditions of 9.11.2.1, by means of the tests described in 9.11.2.4 which are designed to verify that there is an adequate protection of the RCCB's against short-circuit currents up to the conditional short-circuit current I_{nc} and up to the conditional residual short-circuit current $I_{\Delta c}$.

NOTE The manufacturer of the RCCB may give references of suitable SCPD's in his catalogues.

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

The r.m.s. value of prospective current, assigned by the manufacturer, which a RCCB, protected by a SCPD, can withstand under specified conditions without undergoing alterations impairing its functions.

The conditions are those specified in 9.11.2.4a).

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

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

The conditions are those specified in 9.11.2.4c).

6 Marking and other product information

6.1 Standard marking

Each RCCB 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) with the symbol $\sim$;
- d) rated frequency, if the RCCB is designed for frequencies other than 50 Hz (see 5.3.7);
- e) rated current;
- f) rated residual operating current ($I_{\Delta n}$) in A or mA;
- g) *deleted*;
- h) rated making and breaking capacity (I_m);
- j) the degree of protection (only if different from IP20);
- k) the position of use (symbol according to IEC 51), if necessary;
- l) rated residual making and breaking capacity ($I_{\Delta m}$), if different from rated making and breaking capacity;
- m) the symbol **S** (S in a square) for type S devices;
- n) symbol of the method of operation according to Table Z1 of 4.1 if the RCCB is functionally dependent on the line voltage;
- o) operating means of the test device, by the letter T;
- p) wiring diagram unless the correct mode of connection is evident;

r) operating characteristic in presence of residual currents with d.c. components

— RCCB's of type AC with the symbol 

— RCCB's of type A with the symbol 

s) RCCB's for use in the range -25°C to $+40^{\circ}\text{C}$ with the symbol  (snowflake enclosing -25)

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

If, for small devices the space available does not allow all the above data to be marked, at least the information under e), f), m), o) and r) (for A type only) shall be marked and visible when the device is installed. The information under a), b), c), k), p), r) (for AC type only) and s) 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 under p) may be on the inside of any cover which has to be removed in order to connect the supply wires. The information under h) (I_m) and l) ($I_{\Delta m}$) can be anywhere (on the device or in the catalogues), but both shall be indicated together. Any remaining information not marked shall be given in the manufacturer's catalogues.

If the degree of protection IP is marked on the device itself, all parts shall comply with the relevant IP requirements (EN 60529). The IP indications in the catalogue or instruction sheets may take into account various methods of installation (e.g. additional covers, terminal covers, enclosures...).

The manufacturer shall state the Joule integral I^2t and the peak current I_p withstand capabilities of the RCCB. Where these are not stated, minimum values as given in Table 15 apply. The manufacturer shall give the reference of one or more suitable SCPD's in his catalogues and in a sheet accompanying each RCCB.

For RCCB's classified according to 4.1.2.1 and opening with delay in case of failure of the line voltage the manufacturer shall state the range of such delay.

For RCCB's other than those operated by means of push-buttons the open position shall be indicated by the symbol "O" and the closed position by the symbol "I" (a short straight line).

Additional national symbols are allowed. Provisionally the use of national indications only is allowed. These indications shall be readily visible when the RCCB is installed.

For RCCB's 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 RCCB. 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.

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

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

Terminals intended for the protective conductor, if any, shall be indicated by the symbol  [IEC 417-5019a)].

NOTE The symbol  [IEC 417-5017a)], previously recommended, shall be progressively superseded by the preferred symbol IEC 417-5019a), given above.

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.

Specifications on appropriate recommendations to the user to regularly operate the test device are under consideration.

6.2 Additional marking

Additional marking to other standards (European or International Standards or other) is allowed under the following conditions:

- The RCCB shall comply with all the requirements of the additional standard.
- The relevant standard to which the additional marking refers shall be indicated adjacent to this marking and shall be clearly differentiated or separated from the standard marking according to **6.1**.

Compliance is checked by inspection and by carrying out all the test sequences required by the relevant standard. Equivalent or less severe test sequences need not be repeated.

6.3 Guidance table for marking

6	Marking and other product information Each RCCB shall be marked in a durable manner with all or, for small apparatus, part of the following data: The minimum requirements are indicated by the symbol “X”	Marking may be on the RCCB itself			Marking in the catalogue
		Marking, visible when the device is installed, in case of small devices where the space available does not allow all the above data to be marked.	Marking allowed on the side or on the back of the device, visible before the device is installed.	Alternatively the information may be on the inside of any cover which has to be removed in order to connect the supply wires.	Remaining information to be given in the manufacturer’s catalogues , if not marked on the device.
a)	the manufacturer’s name or trademark;		X		
b)	type designation, catalogue number or serial number;		X		
c)	rated voltage(s);		X		
d)	rated frequency, if the RCCB is designed for frequencies other than 50 Hz (see 5.3.7)				X
e)	rated current;	X			
f)	rated residual operating current (I_n) in A ^a in mA	X			
h)	rated making and breaking capacity (I_m)				X ^a
j)	the degree of protection (only if different from IP20);				X
k)	the position of use (symbol according to IEC 51), if necessary;		X		
l)	rated residual making and breaking capacity ($I_{\Delta m}$), if different from rated making and breaking capacity (I_m),				X ^b
NOTE Specifications on appropriate recommendations to the user to regularly operate the test device are under consideration.					
^a $I_{\Delta m}$ and I_m (if different from $I_{\Delta m}$) can be anywhere (on the device or in the catalogues), but shall be together. ^b Under consideration.					

6	Marking and other product information Each RCCB shall be marked in a durable manner with all or, for small apparatus, part of the following data: The minimum requirements are indicated by the symbol “X”	Marking may be on the RCCB itself			Marking in the catalogue
		Marking, visible when the device is installed, in case of small devices where the space available does not allow all the above data to be marked.	Marking allowed on the side or on the back of the device, visible before the device is installed.	Alternatively the information may be on the inside of any cover which has to be removed in order to connect the supply wires.	Remaining information to be given in the manufacturer's catalogues , if not marked on the device.
m)	The symbol  (S in a square) for type S devices;	X			
n)	Indication that the RCCB is functionally dependent on line voltage, if applicable;		X	X	
o)	Operating means of the test device, by the letter T;	X			
p)	Wiring diagram unless the correct mode of operation is evident,		X	X	
r)	operating characteristic in presence of residual currents with d.c. components — RCCBs of type AC with the symbol  — RCCBs of type A with the symbol 	X	X		
s)	RCCB's according to 4.Z1.2 shall be marked with the symbol  (snowflake enclosing –25)		X		
	Indication of the terminal for the neutral with “N”		X		
	Additional marking on performance to other standards				
	Symbol for rated short-circuit capacity in combination with a fuse ^b	X ^b			
NOTE Specifications on appropriate recommendations to the user to regularly operate the test device are under consideration.					
^a $I_{\Delta m}$ and I_m (if different from $I_{\Delta m}$) can be anywhere (on the device or in the catalogues), but shall be together. ^b Under consideration.					

7 Standard conditions for operation in service and for installation

7.1 Standard conditions

RCCB's complying with this standard shall be capable of operating under the standard conditions shown in Table 2.

Table 2 — Standard conditions for operation in service

Influencing quantity	Standard range of application	Reference value	Test tolerances ^f
Ambient temperature ^a and ^g	–5 °C to +40 °C ^b –25 °C to +40 °C ^b	20 °C	±5 °C
Altitude	Not exceeding 2 000 m		
Relative humidity maximum value at 40 °C	50 % ^c		
External magnetic field	Not exceeding 5 times the earth's magnetic field in any direction	Earth's magnetic field	^d
Position	As stated by the manufacturer, with a tolerance of 2° in any direction ^e	As stated by the manufacturer	2° in any direction
Frequency	Reference value ±5 % ^f	Rated value	±2 %
Sinusoidal wave distortion	Not exceeding 5 %	Zero	5 %

^a The maximum value of the mean daily temperature is +35 °C.

^b Values outside the range are admissible where more severe climatic conditions prevail, subject to agreement between manufacturer and user.

^c Higher relative humidities are admitted at lower temperature (for example 90 % at 20 °C)

^d When a RCCB is installed in proximity of a strong magnetic field, supplementary requirements may be necessary.

^e The device shall be fixed without causing deformation liable to impair its functions.

^f The tolerances given apply unless otherwise specified in the relevant test.

^g Extreme limits of –20 °C and 60 °C, for RCCB's for use in the range of –5 °C to +40 °C and of –35 °C and 60 °C, for RCCB's for use in the range of –25 °C to +40 °C, are admissible during storage and transportation. These conditions should be taken into account in the design of the device.

7.2 Conditions of installation

RCCB's shall be installed in accordance with the manufacturer's instructions.

8 Requirements for construction and operation

8.1 Mechanical design

8.1.1 General

The residual current detection and the residual current release shall be located between the incoming and outgoing terminals of the RCCB.

It shall not be possible to alter the operating characteristics of the RCCB by means of external interventions other than those specifically intended for changing the setting of the residual operating current.

In case of a RCCB having multiple settings of residual operating current the rating refers to the highest setting.

8.1.2 Mechanism

The moving contacts of all poles of multipole RCCB's shall be so mechanically coupled that all poles except the switched neutral, if any, make and break substantially together, whether operated manually or automatically.

A switched neutral pole (see 3.3.15) shall open after and close before the other pole(s).

RCCB's shall have a trip-free mechanism.

It shall be possible to switch the RCCB on and off by hand. For plug-in RCCB's without operating handle, this requirement is not considered met by the fact that the RCCB can be removed from its base.

RCCB's shall be so constructed that the moving contacts can come to rest only in the closed position (see **3.3.12**) or in the open position (see **3.3.13**), even when the operating means is released in an intermediate position.

RCCB's shall be provided with means for indicating their closed and open positions, which shall be easily discernible from the front of the RCCB when fitted with its cover(s) or cover-plate(s), if any (see clause **6**).

Where the operating means is used to indicate the position of the contacts, the operating means, when released, shall automatically take up the position corresponding to that of the moving contacts; in this case, the operating means shall have two distinct rest positions corresponding to the position of the contacts, but, for automatic opening, a third distinct position of the operating means may be provided, in which case it shall be necessary to reset the RCCB manually before reclosing is possible.

When an indicator light is used, this shall be lit when the RCCB is in closed position and be of bright colour. The indicator light shall not be the only means to indicate the closed position.

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

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

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

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

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

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

8.1.3 Clearances and creepage distances (see Annex B)

Clearances and creepage distances shall be not less than the values shown in Table 3, when the RCCB is mounted as for normal use.

NOTE A revision of the values of Table 3 is under consideration.

Table 3 — Clearances and creepage distances

Description	Distance mm
<i>Clearances^a</i>	
1. between live parts which are separated when the RCCB is in the open position ^b	3
2. between live parts of different polarity ^{cd}	3
3. between live parts and	
— metal operating means	3
— screws or other means for fixing covers which have to be removed when mounting the RCCB	3
— the surface on which the base is mounted ^e	6 (3)
— screws or other means for fixing the RCCB ^e	6 (3)
— metal covers or boxes ^e	6 (3)
— other accessible metal parts ^f	3
— metal frames supporting flush-type RCCB's	3
4. between metal parts of the mechanism and	
— accessible metal parts ^f	3
— screws or other means for fixing the RCCB	3
— metal frames supporting flush-type RCCB's	3
<i>Creepage distances^a</i>	
1. between live parts which are separated when the RCCB is in the open position ^b	3
2. between live parts of different polarity ^{cd}	
— for RCCB's having a rated voltage not exceeding 250 V	3
— for other RCCB's	4
3. between live parts and	
— metal operating means	3
— screws or other means for fixing covers which have to be removed when mounting the RCCB	3
— screws or other means for fixing the RCCB ^e	6 (3)
— accessible metal parts ^f	3
^a Clearances and creepage distances of the secondary circuit and between the primary windings of the RCCB transformer are not considered. ^b Not applicable to auxiliary and control contacts. ^c Care should be taken for providing adequate spacing between live parts of different polarity of RCCB's of the plug-in type mounted close to one another. Values are under consideration. ^d ^e If clearances and creepage distances between live parts of the device and the metallic screen or the surface on which the RCCB is mounted are dependent on the design of the RCCB only, so that they cannot be reduced when the RCCB is mounted in the most unfavourable position (even in a metallic enclosure), the values in brackets are sufficient. ^f Including a metal foil in contact with the surfaces of insulating material which are accessible after installation as for normal use. The foil is pushed into corners, grooves, etc., by means of a straight jointed test finger according to 9.6.	

8.1.4 Screws, current-carrying parts and connections

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

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

NOTE Screws (or nuts) which are operated when mounting the RCCB include screws for fixing covers or cover-plates, but not connecting means for screwed conduits and for fixing the base of a RCCB.

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

NOTE Screwed connections are considered as checked by the tests of 9.8, 9.11, 9.12, 9.13 and 9.23.

8.1.4.2 For screws in engagement with a thread of insulating material and which are operated when mounting the RCCB 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.

NOTE 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 in respect of the stability of the dimensions.

8.1.4.4 Current-carrying parts including parts intended for protective conductors, if any, shall be of

- 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.

NOTE New requirements and appropriate tests for determining the resistance to corrosion are under consideration. These requirements should permit other materials to be used if suitably coated.

The requirements of this subclause do not apply to contacts, magnetic circuits, heater elements, bimetals, shunts, part of electronic devices nor to screws, nuts, washers, clamping plates, similar parts of terminals and parts of the test circuit.

8.1.5 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.

In this standard, screw-type terminals for external copper conductors only are considered.

NOTE Requirements for flat quick-connect terminations, screwless terminals and terminals for the connection of aluminium conductors are under consideration.

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 and by the tests of 9.5.

8.1.5.2 RCCB's shall be provided with terminals which shall allow the connection of copper conductors having nominal cross-sectional areas as shown in Table 4.

NOTE Examples of possible designs of terminals are given in Annex IC.

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.

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.

Compliance is checked by inspection.

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

8.1.5.5 Terminals shall have adequate mechanical strength.

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

Compliance is checked by inspection and by the tests of 9.4 and 9.5.1.

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

Compliance is checked by inspection and by the test of 9.5.2.

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

Compliance is checked by inspection and by the tests of 9.4 and 9.5.1.

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

This requirement does not apply to lug terminals.

Compliance is checked by the test of 9.5.3.

Table 4 — Connectable cross-sections of copper conductors for screw-type terminals

Rated current A		Range of nominal cross-section to be clamped ^a mm ²	
Greater than	Up to and including	Rigid (solid or stranded) 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	24 to 50	25 to 35

^a 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.

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

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

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

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

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