

BS EN 61008-1:2012+A12:2017

Incorporating corrigenda January 2014 and May 2016



BSI Standards Publication

Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs)

Part 1: General rules (IEC 61008-1:2010,
modified)

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National foreword

This British Standard is the UK implementation of EN 61008-1:2012+A12:2017. It is derived from IEC 61008-1:2010, incorporating amendment 1:2012, amendment 2:2013, corrigendum January 2014 and corrigendum May 2016. It supersedes BS EN 61008-1:2012+A11:2015, which is withdrawn.

The CENELEC common modifications have been implemented at the appropriate places in the text. The start and finish of each common modification is indicated in the text by tags Ⓒ Ⓒ.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to IEC text carry the number of the IEC amendment. For example, text altered by IEC amendment 1 is indicated by Ⓐ Ⓐ.

Where a common modification to an IEC amendment has been introduced, the tags carry the number of the amendment. For example, the common modifications introduced by CENELEC to IEC amendment 1 are indicated by Ⓒ Ⓒ.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to CENELEC text carry the number of the CENELEC amendment. For example, text altered by CENELEC amendment A11 is indicated by Ⓒ Ⓒ.

The UK participation in its preparation was entrusted by Technical Committee PEL/23, Electrical accessories, to Subcommittee PEL/23/1, Circuit breakers and similar equipment for household use.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

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30 November 2014	Implementation of IEC corrigendum January 2014: Table 20 inserted at the end of subclause 9.9.3.1
31 October 2015	Implementation of CENELEC amendment 11:2015: Annex ZB updated
30 June 2016	Implementation of IEC corrigendum May 2015: Table A.1 (rows E and F) corrected
30 April 2017	Implementation of CENELEC amendment 12:2017: Annex ZC updated

Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs) -

Part 1: General rules
(IEC 61008-1:2010, modified)

Interrupteurs automatiques à courant différentiel résiduel sans dispositif de protection contre les surintensités incorporé pour usages domestiques et analogues (ID) -
Partie 1: Règles générales
(CEI 61008-1:2010, modifiée)

Fehlerstrom-/Differenzstrom-Schutzschalter ohne eingebauten Überstromschutz (RCCBs) für Hausinstallationen und für ähnliche Anwendungen -
Teil 1: Allgemeine Anforderungen
(IEC 61008-1:2010, modifiziert)

This European Standard was approved by CENELEC on 2012-06-18. 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 CEN-CENELEC Management Centre or to any CENELEC member.

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CENELEC

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

Management Centre: Avenue Marnix 17, B - 1000 Brussels

European foreword

This document (EN 61008-1:2012) consists of the text of IEC 61008-1:2010 prepared by IEC/TC 23E "Circuit-breakers and similar equipment for household use", together with the common modifications prepared by CLC/TC 23E "Circuit breakers and similar devices for household and similar applications".

The following dates are fixed:

- latest date by which this document has to be implemented (dop) 2013-06-18
at national level by publication of an identical
national standard or by endorsement
- latest date by which the national standards conflicting (dow) 2017-06-18
with this document have to be withdrawn

This document supersedes EN 61008-1:2004 + A11:2007 + A12:2009 + A13:2012 + AC:2012 + IS1:2007.

EN 61008-1:2012 includes the following significant technical changes with respect to EN 61008-1:2004:

- complete revision of EMC sequences, including the new test T.2.6 already approved in EN 61543;
- clarification of RCDs current/time characteristics reported in Tables 1 and 2;
- revision of test procedure for $I_{\Delta n}$ between 5 A and 200 A;
- testing procedure regarding the 6mA d.c. current superimposed to the fault current;
- improvement highlighting RCDs with multiple sensitivity;
- tests for the use of RCCBs in IT systems.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For the relationship with EU Directive(s) see informative Annex ZZ, which is an integral part of this document.

Clauses, subclauses, notes, tables, figures and annexes which are additional to those in IEC 61008-1:2010 are prefixed "Z".

Endorsement notice

The text of the International Standard IEC 61008-1:2010 was approved by CENELEC as a European Standard with agreed common modifications.

Foreword to amendment A1

This document (EN 61008-1:2012/A1:2014) consists of the text of IEC 61008-1:2010/A1:2012 prepared by SC 23E "Circuit-breakers and similar equipment for household use" of IEC/TC 23 "Electrical accessories", together with the common modifications prepared by CLC/TC 23E "Circuit breakers and similar devices for household and similar applications".

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document have to be withdrawn

Clauses, subclauses, notes, tables, figures and annexes which are additional to those in IEC 61008-1:2010/A1:2012 are prefixed "Z".

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This standard covers the Principle Elements of the Safety Objectives for Electrical Equipment Designed for Use within Certain Voltage Limits (LVD - 2006/95/EC).

This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

Endorsement notice

The text of the International Standard IEC 61008-1:2010/A1:2012 was approved by CENELEC as a European Standard with agreed common modifications.

Foreword to amendment A2

This document (EN 61008-1:2012/A2:2014) consists of the text of IEC 61008-1:2010/A2:2013 prepared by SC 23E "Circuit-breakers and similar equipment for household use" of IEC/TC 23 "Electrical accessories", together with the common modifications prepared by CLC/TC 23E "Circuit breakers and similar devices for household and similar applications".

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by endorsement
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document have to be withdrawn

Clauses, subclauses, notes, tables, figures and annexes which are additional to those in IEC 61008-1:2010/A2:2013 are prefixed "Z".

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This standard covers the Principle Elements of the Safety Objectives for Electrical Equipment Designed for Use within Certain Voltage Limits (LVD - 2006/95/EC).

This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

Endorsement notice

The text of the International Standard IEC 61008-1:2010/A2:2013 was approved by CENELEC as a European Standard with agreed common modifications.

Foreword to amendment A11

This document (EN 61008-1:2012/A11:2015) has been prepared by CLC/TC 23E "Circuit breakers and similar devices for household and similar applications".

The following dates are fixed:

- latest date by which the document has to be implemented at (dop) 2016-07-06
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standard or by endorsement
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the document have to be withdrawn

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For the relationship with EU Directive 2004/108/EC, see informative Annex ZZ, mentioned in EN 61008-1:2012.

This standard covers the Principle Elements of the Safety Objectives for Electrical Equipment Designed for Use within Certain Voltage Limits (LVD - 2006/95/EC).

Foreword to amendment A12

This document (EN 61008-1:2012/A12:2017) has been prepared by CLC/TC 23E "Circuit breakers and similar devices for household and similar applications".

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- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2018-02-14
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2020-02-14

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For the relationship with EU Directive 2004/108/EC, see informative Annex ZZ, mentioned in EN 61008-1:2012.

[C] Annex ZA (normative)

Normative references to international publications with their corresponding European publications

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

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
CISPR 14-1 + corr. January	2005 2009	Electromagnetic compatibility - Requirements for household appliances, electric tools and similar apparatus - Part 1: Emission	EN 55014-1	2006
IEC 60038	-	IEC standard voltages	EN 60038	-
[C1] Text deleted [C1]				
IEC 60060-1 + corr. March + corr. March	1989 1990 1992	High-voltage test techniques - Part 1: General definitions and test requirements	HD 588.1 S1 ¹⁾	1991
IEC 60060-2	1994	High-voltage test techniques - Part 2: Measuring systems	EN 60060-2 ²⁾	1994
IEC 60068-2-30	2005	Environmental testing - Part 2-30: Tests - Test Db: Damp heat, cyclic (12 h + 12 h cycle)	EN 60068-2-30	2005
IEC 60112 + corr. October + corr. June	2003 2003 2003	Method for the determination of the proof and the comparative tracking indices of solid insulating materials	EN 60112	2003
[C1] IEC 60228	2004	Conductors of insulated cables	EN 60228 + corr. May	2005 2005 [C1]
IEC 60364	Series	Low-voltage electrical installations	HD 60364	Series
IEC 60417	Data- base	Graphical symbols for use on equipment	-	-
IEC 60529	-	Degrees of protection provided by enclosures (IP Code)	EN 60529	-
IEC 60664-1	2007	Insulation coordination for equipment within low-voltage systems - Part 1: Principles, requirements and tests	EN 60664-1	2007
[C1] IEC 60664-3	-	Insulation coordination for equipment within low-voltage systems - Part 3: Use of coating, potting or moulding for protection against pollution	EN 60664-3	- [C1]

¹⁾ HD 588.1 S1 is superseded by EN 60060-1:2010, which is based on IEC 60060-1:2010.

²⁾ EN 60060-2 is superseded by EN 60060-2:2011, which is based on IEC 60060-2:2010. [C]

 Publication	Year	Title	EN/HD	Year
IEC 60695-2-10	2000	Fire hazard testing - Part 2-10: Glowing/hot-wire based test methods - Glow-wire apparatus and common test procedure	EN 60695-2-10	2001
IEC 60884-1	-	Plugs and socket-outlets for household and - similar purposes - Part 1: General requirements	-	-
IEC 61009	Series	Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs)	EN 61009	Series
 IEC 61543	1995	Residual current operated protective	EN 61543	1995
-	-	devices (RCDs) for household and	+ corr. December	1997
+ A1 (mod)	2004	similar use Electromagnetic	+ A11	2003
-	-	compatibility	+ corrMay	2004
+ A2	2005		+ A2	2006
-	-		+ A12	2005 
ISO 7000	1989	Graphical symbols for use on equipment - Index and synopsis 	-	-

Annex ZB (normative)

Special national conditions

Special national condition: National characteristic or practice that cannot be changed even over a long period, e.g. climatic conditions, electrical earthing conditions.

NOTE If it affects harmonization, it forms part of the European Standard / Harmonization Document.

For the countries in which the relevant special national conditions apply these provisions are normative, for other countries they are informative.

<u>Clause</u>	<u>Special national condition</u>
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General	Germany
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In Germany, the use of RCCBs of type AC is not permitted. 

General	Ireland
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EN 61008-1 (referred to as Part 1) is applicable with the modifications given below.

For RCCBs, functionally dependant on line voltage IEC 61008-2-2 applies in conjunction with Part 1.

General	Switzerland
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In Switzerland, the use of RCCBs of type AC is not permitted. 

Annex ZC (informative)

A-deviations

A-deviation: National deviation due to regulations, the alteration of which is for the time being outside the competence of the CENELEC member.

This European Standard falls under Directive 2004/108/EC.

NOTE (from CEN/CENELEC IR Part 2:2011 , 2.17) Where standards fall under EC Directives, it is the view of the Commission of the European Communities (OJ No C 59, 1982-03-09) that the effect of the decision of the Court of Justice in case 815/79 Cremonini/Vrankovich (European Court Reports 1980, p. 3583) is that compliance with A-deviations is no longer mandatory and that the free movement of products complying with such a standard should not be restricted except under the safeguard procedure provided for in the relevant Directive.

A-deviations in an EFTA-country are valid instead of the relevant provisions of the European Standard in that country until they have been removed.

<u>Clause</u>	<u>Deviation</u>
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Austria

Regulations for electrical low voltage installations, statutory order BGBl. II/223/2010, issued 12. July 2010.

4.1	The content of the note of IEC 61008-1 Ed. 3 remains with the adaption to national reference: "The selection of the various types is made according to the requirements of OVE/ONORM E 8001-1:2010."
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4.1	Table Z1 is not valid in Austria. 
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General	Belgium
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The Belgian regulation for Electrical Installation (Art 251, part 5) requires that RCCB's ≤ 40 A installed at the head-end in household electrical installation, upstream the first overcurrent protection, shall withstand an I^2t value not less than 22,5 kA²s at 3000 A and shall be additionally marked with at least the following data: "3000 A, 22,5 kA²s".

This marking shall remain visible after installation.

Annex ZZ (informative)

Coverage of Essential Requirements of EU Directives

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and within its scope the standard covers all relevant essential requirements as given in Article 1 of Annex I of the EU Directive 2004/108/EC.

Compliance with this standard provides one means of conformity with the specified essential requirements of the Directive(s) concerned.

WARNING: Other requirements and other EU Directives may be applicable to the products falling within the scope of this standard. 

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**RESIDUAL CURRENT OPERATED CIRCUIT-BREAKERS
WITHOUT INTEGRAL OVERCURRENT PROTECTION
FOR HOUSEHOLD AND SIMILAR USES (RCCBs) –****Part 1: General rules**

FOREWORD

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International Standard IEC 61008-1 has been prepared by subcommittee 23E: Circuit-breakers and similar equipment for household use, of IEC technical committee 23: Electrical accessories.

This third edition cancels and replaces the second edition published in 1996, amendment 1 (2002) and amendment 2 (2006). This edition constitutes a technical revision.

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

- complete revision of EMC sequences, including the new test T.2.6 already approved in IEC 61543;
- clarification of RCDs current/time characteristics reported in Tables 1 and 2;
- revision of test procedure for $I_{\Delta n}$ between 5 A and 200 A;

- testing procedure regarding the 6mA d.c. current superimposed to the fault current;
- improvement highlighting RCDs with multiple sensitivity;
- tests for the use of RCCBs in IT systems.

The text of this standard is based on the following documents:

FDIS	Report on voting
23E/681/FDIS	23E/685/RVD

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

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

A list of all parts of the IEC 61008 series, published under the general title, *Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs)*, can be found on the IEC website.

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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

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

Part 2-1: Applicability of the general rules to RCCBs functionally independent of line voltage.

Part 2-2: Applicability of the general rules to RCCBs functionally dependent on line voltage.

RESIDUAL CURRENT OPERATED CIRCUIT-BREAKERS WITHOUT INTEGRAL OVERCURRENT PROTECTION FOR HOUSEHOLD AND SIMILAR USES (RCCBs) –

Part 1: General rules

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 RCCBs), for rated voltages not exceeding 440 V a.c. [C] *text deleted* [C] and rated currents not exceeding 125 A, [C] for fixed installations, [C] 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.

RCCBs 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 RCCBs are in line with the general requirements of IEC 60755. RCCBs 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 RCCBs are given in the IEC 60364 series.

They are intended for use in an environment with pollution degree 2 [C] and overvoltage category III. [C].

They are suitable for isolation.

RCCBs complying with this standard [C] *text deleted* [C] are suitable for use in IT systems.

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 60364-4-44).

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

NOTE 3 Surge arresters installed downstream of the general type of RCCBs and connected in common mode may cause unwanted tripping.

NOTE 4 For RCCBs 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 61009-1);
- Ⓒ – RCCBs integrated in one unit with a socket-outlet or designed exclusively for being associated locally with a socket-outlet in the same mounting box. Ⓒ
- Ⓒ – RCCBs intended to be used at frequencies other than 50 Hz. Ⓒ

Ⓐ₁ For RCCBs incorporated in, or intended only for association with socket-outlets, the requirements of this standard may be used, as far as applicable, in conjunction Ⓒ₁ *Text deleted* Ⓒ₁ or the national requirements Ⓒ₁ for socket outlets Ⓒ₁ of the country where the product is placed on the market. Ⓐ₁

NOTES 5 Ⓐ₁ RCCBs incorporated in, or intended only for association with socket-outlets, can either meet IEC 62640 or this standard. Ⓐ₁

Ⓒ *text deleted* Ⓒ

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

RCCBs including batteries are not covered by this standard.

2 Normative references

Ⓒ₁ *Text deleted* Ⓒ₁

3 Terms and definitions

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

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

NOTE For a 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 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

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

electrical excitation quantity which alone, or in combination with other such quantities, shall be applied to an 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

NOTE These conditions that 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 functions of residual current circuit-breakers

3.3.1

residual current operated circuit-breaker

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 overcurrent protection

RCCB

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

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

3.3.4

RCCBs functionally independent of line voltage

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

3.3.5

RCCBs functionally dependent on line voltage

RCCBs for which the functions of detection, evaluation or interruption depend on the line voltage

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

3.3.6

switching device

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

[IEV 441-14-01:1984]

3.3.7

mechanical switching device

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

[IEV 441-14-02, modified]

3.3.8

trip-free RCCB

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 an RCCB

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

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

[IEV 441-16-22]

3.3.13

open position

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

[IEV 441-16-23]

3.3.14

pole

that part of an 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

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

3.3.16

main circuit (of an RCCB)

all the conductive parts of an RCCB included in the $\square$ poles $\square$ (see 4.3)

3.3.17

control circuit (of an RCCB)

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 an RCCB)

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

[IEV 441-15-04]

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

[C] 3.3.Z1

plug-in RCCB

a RCCB having one or more plug-in terminals (see 3.6.Z1) and designed for use with appropriate means for the plug-in connection **[C]**

3.4 Definitions relating to values and ranges of energizing quantities

3.4.1

rated value

quantity value assigned by the manufacturer for a specific operating condition of an 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 **[C] a two pole RCCB **[C]**** 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 **[C]** a two pole RCCB **[C]** 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

current that would flow in the circuit, if each main  pole  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

maximum prospective peak current (of an a.c. circuit)

prospective peak current, when the initiation of the current takes place at the instant which leads to the highest possible value

NOTE For a multipole RCCB in a polyphase circuit, the maximum prospective peak current refers to a single pole only.

3.4.6

short-circuit (making and breaking) capacity

alternating component of the prospective current, expressed by its r.m.s. value, which the RCCB is designed to make, to carry for its opening time and to break under specified conditions

3.4.7

making capacity

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

3.4.8

breaking capacity

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

3.4.9

residual making and breaking capacity

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

3.4.10

conditional short-circuit current

value of the a.c. component of a prospective current, which an 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

3.4.11

conditional residual short-circuit current

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

3.4.12

limiting values (U_x and U_y) of the line voltage for RCCBs functionally dependent on line voltage

3.4.12.1

U_x

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

3.4.12.2

U_y

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

3.4.13

I^2t (Joule integral)

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

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

[IEV 441-18-23:1984]

3.4.14

recovery voltage

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

[IEV 441-17-25:1984]

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 interval 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.

3.4.14.1

transient recovery voltage

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.

[IEV 441-17-26:1984, modified]

3.4.14.2

power-frequency recovery voltage

recovery voltage after the transient voltage phenomena have subsided

[IEV 441-17-27:1984]

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 an RCCB

3.5.2

reference value of an influencing quantity

value of an influencing quantity to which the characteristics stated by the manufacturer 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

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

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

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 subcommittee 23F on terminals is completed.

3.6.1

terminal

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

3.6.2

screw-type terminal

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

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)

NOTE 1 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 2 Examples of pillar terminals are shown in Figure IC.1 of Annex IC.

3.6.4

screw terminal

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.2a of Annex IC.

3.6.5

stud terminal

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

NOTE 1 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 2 Examples of stud terminals are shown in Figure IC.2b.

3.6.6

saddle terminal

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.

3.6.7

lug terminal

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.

3.6.8

screwless terminal

connecting terminal for the connection and subsequent disconnection of one conductor or the dismountable 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

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

NOTE 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

tapping screw having an uninterrupted thread

NOTE 1 It is not a function of this thread to remove material from the hole.

NOTE 2 An example of a thread forming tapping screw is shown in Figure 1.

3.6.11

thread cutting tapping screw

tapping screw having an interrupted thread

NOTE 1 It is a function of this thread to remove material from the hole.

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

3.6.Z1

plug-in terminal

terminal the electrical connection and disconnection of which can be effected without displacing the conductors of the corresponding circuit

The connection is effected without the use of a tool and is provided by the resilience of the fixed and/or moving parts and/or by springs. 

3.7 Definitions relating to conditions of operation

3.7.1

operation

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

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

[IEV 441-16-08:1984]

3.7.3

opening operation

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

[IEV 441-16-09:1984]

3.7.4

operating cycle

succession of operations from one position to another and back to the first position through all other positions, if any

[IEV 441-16-02]

3.7.5

sequence of operations

succession of specified operations with specified time intervals

3.8 Definitions relating to tests

3.8.1

type test

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

3.8.2

routine test

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

3.9 Definitions relating to insulation coordination

3.9.1

insulation coordination

mutual correlation of insulation characteristics of electrical equipment taking into account the expected micro-environment and the influencing stresses

[IEC 60664-1:2007, definition 3.1]

3.9.2

working voltage

highest r.m.s. value of the a.c. or d.c. voltage across any particular insulation which can occur when the equipment is supplied at rated voltage

NOTE 1 Transients are disregarded.

NOTE 2 Both open circuit conditions and normal operating conditions are taken into account.

[IEC 60664-1:2007, definition 3.5]

3.9.3

overvoltage

any voltage having a peak value exceeding the corresponding peak value of maximum steady-state voltage at normal operating conditions

[IEC 60664-1:2007, definition 3.7]

3.9.4

impulse withstand voltage

highest peak value of impulse voltage of prescribed form and polarity, which does not cause breakdown of the insulation under specific conditions

[IEC 60664-1:2007, definition 3.8.1]

3.9.5

overvoltage category

numeral defining a transient overvoltage condition

[IEC 60664-1:2007, definition 3.10]

3.9.6

macro-environment

environment of the room or other location, in which the equipment is installed or used

[IEC 60664-1:2007, definition 3.12.1]

3.9.7

micro-environment

immediate environment of the insulation which particularly influences the dimensioning of the creepage distances

[IEC 60664-1:2007, definition 3.12.2]

3.9.8

pollution

any addition of foreign matter, solid, liquid or gaseous that can result in a reduction of electric strength or surface resistivity of the insulation

[IEC 60664-1:2007, definition 3.11]

3.9.9

pollution degree

numeral characterizing the expected pollution of the micro-environment

[IEC 60664-1:2007, definition 3.13]

NOTE The pollution degree to which equipment is exposed may be different from that of the macro-environment where the equipment is located because of protection offered by means such as an enclosure or internal heating to prevent absorption or condensation of moisture.

3.9.10

isolation (isolating function)

function intended to cut off the supply from the whole installation or a discrete section of it by separating it from every source of electrical energy for reasons of safety

[IEC 60947-1:2007, definition 2.1.19, modified]

3.9.11

isolating distance

clearance between open contacts, meeting the safety requirements specified for isolation purposes

[IEV 441-17-35:1984, modified]

3.9.12

clearance (see Annex B)

shortest distance in air between two conductive parts along a string stretched the shortest way between these conductive parts

[IEV 441-17-31:1984, modified]

NOTE For the purpose of determining a clearance to accessible parts, the accessible surface of an insulating enclosure should 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.

3.9.13

creepage distance (see Annex B)

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

[IEV 604-03-61:1987, modified]

NOTE For the purpose of determining a creepage distance to accessible parts, the accessible surface of an insulating enclosure should 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.

4 Classification

RCCBs are classified:

4.1 According to the method of operation

NOTE The selection of the various types is made according to HD 60364 and non conflicting national wiring rules. Table Z1 lists the types of RCCBs according to the various applications but does not exclude the use of RCCBs of any classification for protection over and above that required by the relevant wiring rules." 

 **Table Z1 – Survey of the types of RCCBs according to their method of operation**

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



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)  text deleted 

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

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.

 text deleted 

4.2 [C] Void [C]

[C] text deleted [C]

4.3 According to the number of poles [C] text deleted [C]

[C] text deleted [C]

- two-pole RCCB;
- three-pole RCCB;

[C] text deleted [C]

- four-pole RCCB.

4.4 [C] Void [C]

[C] text deleted [C]

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, and Table 2 if applicable);
- RCCBs with increased resistance to unwanted tripping (S type as in Table 1, and Table 2 if applicable).

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

- RCCBs of type AC;
- RCCBs 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

[A1] – RCCBs, the electrical connections of which are not associated with the mechanical mounting;

- RCCBs, the electrical connections of which are associated with the mechanical mounting.

NOTE Examples of this type are:

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

Some RCCBs 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. [A1]

4.11 According to the type of terminals:

- RCCBs with screw-type terminals for external copper conductors;
- RCCBs with screwless type terminals for external copper conductors;

NOTE 1 The requirements for RCCBs equipped with this type of terminals are given in Annex J.

- RCCBs with flat quick-connect terminals for external copper conductors;

NOTE 2 The requirements for RCCBs equipped with these types of terminals are given in Annex K. **A1**

C1 *Text deleted* **C1**

C2 *Text deleted* **C2**

4.21 According to the range of ambient air temperature **C1**

- C** – RCCBs for use at ambient air temperatures between -5 °C and +40 °C;
- RCCBs for use at ambient air temperatures between -25 °C and +40 °C. **C**

5 Characteristics of RCCBs

5.1 Summary of characteristics

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

C *text deleted* **C**

- number of poles **C** *text deleted* **C** (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);
- degree of protection (see IEC 60529);
- rated conditional short-circuit current I_{nc} (see 5.4.2);
- rated conditional residual short-circuit current $I_{\Delta c}$ (see 5.4.3);
- method of mounting (see 4.9);
- method of connection (see 4.10).
- C** – ranges of ambient air temperature (see 5.3.Z1) **C**

For RCCBs 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 (U_n)

5.2.1.1 Rated operational voltage (U_e)

The rated operational voltage (hereafter referred to as "rated voltage") of an 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 an 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.

5.2.1.3 Rated impulse withstand voltage (U_{imp})

The rated impulse withstand voltage of an RCCB shall be equal to or higher than the standard values of rated impulse withstand voltage given in [\[C\] 5.3.13 \[C\]](#).

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.

[\[C\] text deleted \[C\]](#)

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

The value of residual non-operating current (see 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 an 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 an 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 an 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, and Table 2 if applicable.

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

5.2.9.1 RCCB type AC

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

5.2.9.2 RCCB type A

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

5.3 Standard and preferred values

5.3.1 Standard values of rated voltage (U_n)

 Standard  values of rated voltage are as follows:

 RCCB	Rated voltage of RCCBs for use in systems 230 V, 230 V/400 V, 400V	
Two-pole	230 V	
	400 V	
Three-pole	400 V	
Four-pole	400 V	



NOTE In Japan, phase to neutral conductor and phase to earthed conductor (grounded conductor) is thought differently because single phase 2-wire system supplied from 2-wire system source do not have a neutral point.

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 – 1 A.

text deleted

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 value of rated frequency

The preferred value of rated frequency is 50 Hz.

text deleted

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 19.

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 19.

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 19.

☐ text deleted ☐

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 19.

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 RCCBs incorporated in or intended for association with socket-outlets.

The associated power factors are specified in Table 19.

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 19.

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

5.3.12 Limit values of break time and non-actuating time for RCCB of type AC and A

5.3.12.1 Limit values of break time and non-actuating time for alternating residual currents (r.m.s. values) for type AC and A

Limit values of break time and non-actuating time for alternating residual currents (r.m.s. values) for type AC and A RCCB are given in Table 1.

[C] text deleted [C]

Table 1 – Limit values of break time and non-actuating time for alternating residual currents (r.m.s. values) for type AC and A RCCB

			Limit values of break time and non-actuating time (s) for type AC and A RCCB in event of alternating residual currents (r.m.s. values) equal to						
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 - 200 A ^b	500 A	
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	
		> 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	[C] Minimum non- actuating times [C]
		> 0,03	0,13	0,06	0,05		0,04	0,04	

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

^b The tests are only made during the verification of the correct operation as mentioned in 9.9.2.4.

[C] 5.3.Z1 Standard ranges of ambient air temperature

The standard ranges of ambient air temperature are:

- -5 °C to +40 °C;
- -25 °C to +40 °C [C]

5.3.12.2 Maximum values of break time for half-wave residual currents (r.m.s. values) for type A

Maximum values of break time for half-wave pulsating residual currents (r.m.s. values) for type A RCCB are given in Table 2.

Table 2 – Maximum values of break time for half-wave pulsating residual currents (r.m.s. values) for type A RCCB

			Maximum values of break time(s) for type A RCCB in 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
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

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

[C] Standard value of the rated impulse voltage (U_{imp}) is 4 kV. [C]

Table 3 –  Void 

5.4 Coordination with short-circuit protective devices (SCPDs)

5.4.1 General

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

Coordination between RCCBs 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 RCCBs against short-circuit currents up to the conditional short-circuit current I_{nc} and up to the conditional residual short-circuit current $I_{\Delta c}$.

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

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

The conditions are those specified in 9.11.2.4 a).

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

The value of the 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 9.11.2.4 c).

6 Marking and other product information

6.Z1 Standard marking

Each RCCB shall be marked in a durable manner according to the following Table Z3.

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

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 SCPDs in his catalogues and in a sheet accompanying each RCCB.

For RCCBs 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 RCCBs 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 for this indication are allowed. Provisionally the use of national indications only is allowed. These indications shall be readily visible when the RCCB is installed. 

- Ⓒ For RCCBs 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 Ⓒ₁ conductor Ⓒ₁ shall be indicated by the letter N.

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

NOTE The symbol  (IEC 60417-5017 a)), previously recommended, shall be progressively superseded by the preferred symbol IEC 60417-5019 a), given above.

The suitability for isolation, which is provided by all RCCBs of this standard, may be indicated by the symbol  on the device. When affixed, this marking may be included in a wiring diagram, where it may be combined with symbols of other functions, (e.g. other symbols of IEC TC 3). When the symbol is used on its own (i.e. not in a wiring diagram), combination with symbols of other functions is not allowed.

The base for plug-in RCCBs shall be marked with the following:

- rated current or maximum rated current;
- trade mark.

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.

Ⓒ₁ For universal terminals (for rigid-solid, rigid-stranded and flexible conductors):

- no marking.

For non-universal terminals:

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

The markings should appear on the RCCB or, if the space available is not sufficient, on the smallest package unit or in technical information. Ⓒ₁

6.22 Additional marking

Additional marking to other standards (EN or IEC or other) or additional requirements are 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 6.21.

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. Ⓒ

Table Z3 – Requirements for marking

Marking and other product information	Marking on the RCCB itself			Product information in the catalogue
	If, for small devices the space available does not allow all the data to be marked, at least the following information shall be marked and visible when the device is installed.	The following information may be marked on the side or on the back of the device and be visible only before the device is installed..	Alternatively the following information may be on the inside of any cover which has to be removed in order to connect the supply wires.	
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"				Any remaining information not marked shall be given in the manufacturer's catalogues.
a) the manufacturer's name or trademark;		X		
b) type designation, catalogue number or serial number;		X		
c) rated voltage(s) with the symbol ~;		X		
d) rated frequency, if the RCCB is designed frequencies other than 50 Hz		X		
e) rated current	X			
f) rated residual operating current ($I_{\Delta n}$) in A or in mA	X			
g) deleted				
h) rated making and breaking capacity (I_m)				X (*)
j) the degree of protection (only if different from IP20);				X
k) the position of use ( Text deleted ), if necessary;		X		
l) rated residual making and breaking capacity ($I_{\Delta m}$), if different from rated short-circuit capacity (I_m)				X (*)
m) the symbol  (S in a square) for type S devices;	X			
n) symbol of the method of operation according to table Z1 of 4.1 if the RCCB is functionally dependent on the line voltage;		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 		X		
- RCCBs of type A with the symbol 	X			



s)	RCCBs according to 4.1.1 shall be marked with the symbol  (the value -25 included in the snow flake symbol according to Figure 0027 of ISO 7000) if relevant		X		
t)	Indication of the terminal for the neutral with "N"		X		
u)	Additional marking of performance to other standards or additional requirements according to 6.Z.2		X		
(*) $I_{\Delta n}$ and I_n (if different of $I_{\Delta n}$) may be anywhere on the device or in the catalogue but shall be together. (**) It is recommended to advise the user to test the device regularly.					



7 Standard conditions for operation in service and for installation

7.1 Standard conditions

RCCBs complying with this standard shall be capable of operating under the standard conditions shown in Table 4.

Table 4 – Standard conditions for operation in service

Influencing quantity	Standard range of application	Reference value	Test tolerances ⁶⁾
Ambient temperature ^{1) 7)}	–5 °C to +40 °C ²⁾ [C] –25 °C to 40 °C ²⁾ [C]	20 °C	±5 °C
Altitude	Not exceeding 2 000 m		
Relative humidity maximum value 40 °C	50 % ³⁾		
External magnetic field	Not exceeding 5 times the earth's magnetic field in any direction	Earth's magnetic field	⁴⁾
Position	As stated by the manufacturer, with a tolerance of 2° in any direction ⁵⁾	As stated by the manufacturer	2° in any direction
Frequency	Reference value ±5 % ⁶⁾	Rated value	±2 %
Sinusoidal wave distortion	Not exceeding 5 %	Zero	5 %

¹⁾ The maximum value of the mean daily temperature is +35 °C.

²⁾ Values outside the range are admissible where more severe climatic conditions prevail, subject to agreement between manufacturer and user.

³⁾ Higher relative humidities are admitted at lower temperature (for example 90 % at 20 °C).

⁴⁾ When an RCCB is installed in proximity of a strong magnetic field, supplementary requirements may be necessary.

⁵⁾ The device shall be fixed without causing deformation liable to impair its functions.

⁶⁾ The tolerances given apply unless otherwise specified in the relevant test.

⁷⁾ [C] Extreme limits of –20 °C and + 60 °C, for RCCBs for use in the range of –5 °C to +40 °C and of –35 °C and + 60 °C, for RCCBs 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. [C]

⁸⁾ For installations at higher altitudes, it is necessary to take into account the reduction of the dielectric strength and of the cooling effect of the air. RCCBs intended to be so used shall be designed specially or used according to an agreement between manufacturer and user. Information given in the manufacturer's catalogue may take the place of such an agreement. [C]

7.2 Conditions of installation

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

7.3 Pollution degree

RCCBs complying with this standard are intended for environment with pollution degree 2, i.e.: normally, only non-conductive pollution occurs; occasionally, however, a temporary conductivity caused by condensation may be expected.

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. [C] text deleted [C]

[C] text deleted [C] It shall not be possible to disable or inhibit the RCCB function by any means.

[C] text deleted [C]

8.1.2 Mechanism

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

The switched neutral pole (see 3.3.15) of four-pole RCCBs shall not close after and shall not open before the other poles (see 3.3.14).

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

RCCBs shall have a trip-free mechanism.

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

RCCBs 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.

RCCBs shall provide in the open position (see 3.3.13) an isolation distance in accordance with the requirements necessary to satisfy the isolating function (see 8.3).

Indication of the position of the main contacts shall be provided by one or both of the following means

- the position of the actuator (this being preferred), or
- a separate mechanical indicator [C] text deleted [C] .

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

NOTE 1 [C] text deleted [C]

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

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

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

[C] Compliance is checked by inspection and by the tests of 9.9 and 9.11. [C]

When means are provided or specified by the manufacturer to lock the operating means in the open position, locking in that position shall only be possible when the main contacts are in the open position.

NOTE 2 Locking of the operating means in the closed position is permitted for particular applications.

Compliance is checked by inspection, taking into account the instructions of the manufacturer.

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.

[C] text deleted [C]

NOTE 3 [C] text deleted [C]

When an indicator light is used, this shall be lit when the RCCB is in a closed position and be of a 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.

NOTE 4  text deleted 

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)

-  The minimum required clearances and creepage distances are given in Table 5 which is based on the RCCB being designed for operating in an environment with pollution degree 2.

Compliance for item 1 in Table 5 is checked by measurement and by the test of 9.7.7.4.1 and 9.7.7.4.2. The test is carried out with samples not submitted to the humidity treatment described in 9.7.1.

-  The clearances of items 2 and 4 (except accessible surface after installation, see Note 1) may be reduced provided that the measured clearances are not shorter than the minimum allowed in IEC 60664-1 for homogenous field conditions. 

-  NOTE 1 Accessible surface after installation means any surface accessible by the user when the RCD is installed according to the manufacture's instructions. The test finger can be applied to determine whether a surface is accessible or not. 

In this case, after the humidity treatment described in 9.7.1, compliance for items 2, 4 and 5 and arrangements of 9.7.2 items b), c), d) and e) is checked in the following order:

- Tests according to 9.7.2 to 9.7.6 as applicable,
- Test according to 9.7.7.2 is applied with test voltages given in Table 16 with test arrangements of 9.7.2 items b), c), d), e).

If measurement does not show any reduced clearance, test in 9.7.7.2 is not applied.

Compliance for item 3 in Table 5 is checked by measurement.

-  NOTE 2  All measurements required in 8.1.3 are carried out in Test sequence A on one sample and the tests of 9.7.7.2 are carried out  Text deleted  on three samples of Test sequence B.

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

The insulating materials are classified into material groups on the basis of their comparative tracking index (CTI) according to 4.8.1 of IEC 60664-1:2007.

-  NOTE 3  Information on the requirements for design of solid insulation and appropriate testing is provided in IEC 60664-1:2007, 5.3 and 6.1.3.

-  NOTE 4  For clearances on printed wiring material, the following Note 3 Table F.2 in 60664-1:2007 can be used: "For printed wiring material, the values for pollution degree 1 apply except that the value shall not be less than 0,04 mm, as specified in Table F.4." For creepage distances on printed wiring material, distances in Table F.4 in 60664-1:2007 can be used if protected with a coating meeting IEC 60664-3 requirements and tests.

-  NOTE 5  The dimensioning of clearances and creepage distances for spacings equal to or less than 2 mm for printed wiring board may be optimised under certain conditions in case of use of IEC 60664-3. Only humidity levels HL2 and HL3 are considered. 

Table 5 – Minimum clearances and creepage distances

	Minimum clearances mm			Minimum creepage distances ^{e, f} mm											
				Group IIIa ^h (175 V ≤ CTI < 400 V) ^d				Group II (400 V ≤ CTI < 600 V) ^d				Group I (600 V ≤ CTI) ^d			
	Rated voltage V			Working voltage ^e V											
	<i>U_{imp}</i>														
	2,5 kV	4 kV	4 kV												
Description	⌈C⌋ 230/400 230 400			>25 ≤50 ⁱ	120	250	400	>25 ≤50 ⁱ	120	250	400	>25 ≤50 ⁱ	120	250	400
1. Between live parts which are separated when the main contacts are in the open position ^a	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	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 ⌈C⌋	8,0				3,0	6,0	8,0		3,0	6,0	8,0		3,0	6,0	8,0
				Rated voltage V											
				120 / 240		230 / 400		120 / 240		230 / 400		120 / 240		230 / 400	
4. Between live parts and - accessible surfaces of operating means - screws or other means for fixing covers which have to be removed when mounting the RCCB - surface on which the RCCB is mounted ^b - screws or other means for fixing the RCCB ^b - metal covers or boxes ^b - other accessible metal parts ^c - metal frames supporting flush-type RCCBs	3,0			1,5	4,0	1,5	3,0	1,5	3,0	1,5	3,0				
⌈C ₁ ⌋ <i>text deleted</i> ⌋C ₁ ⌋															
	⌋C⌋														
NOTE 1 The values given for 400 V are also valid for 440 V.															
NOTE 2 ⌈C⌋ The parts of the neutral pole, if any, are considered to be live parts. ⌋C⌋															
NOTE 3 ⌈C ₁ ⌋ <i>text deleted</i> ⌋C ₁ ⌋															
NOTE 4 ⌈C⌋ <i>text deleted</i> ⌋C⌋															

Table 5 (continued)

a	For auxiliary and control contacts the values are given in the relevant standard.
b	The values are doubled if clearances and creepage distances between live parts of the device and the metallic screen or the surface on which the RCCB is mounted are not dependent on the design of the RCCB only, so that they can be reduced when the RCCB is mounted in the most unfavourable condition.
c	Ⓒ Including a metal foil in contact with the surfaces of insulating material which are accessible after installation for normal use. The foil is pushed into corners, grooves, etc., by means of a straight jointed test finger according to 9.6 (see Figure 3).” Ⓒ
d	See IEC 60112.
e	Ⓐ ₁ When interpolating, linear interpolation shall be used and values shall be rounded to the same number of digits as the values picked up from the tables. For determination of creepage distances, see Annex B. Ⓐ ₁
f	Creepage distances cannot be less than the associated clearances.
g	To cover all different voltages including ELV in an auxiliary contact.
h	For material group IIIb ($100 \text{ V} \leq \text{CTI} < 175 \text{ V}$), the values for material group IIIa multiplied by 1,6 apply.
i	For working voltages up to and including 25 V, reference may be made to IEC 60664-1.
j	This applies also to clearance and creepage distances between live parts of different polarity of the RCCB and equipments mounted close to it. Ⓒ

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 1 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 an RCCB.

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

NOTE 2 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 Ⓒ₁ Current-carrying parts including parts intended for protective conductors, if any, shall be made of a metal having, under the conditions occurring in the equipment, mechanical strength, electrical conductivity and resistance to corrosion adequate for their intended use.

Examples of suitable materials are given below:

- copper;
- an alloy containing at least 58 % copper for parts worked cold, or at least 50 % copper for other parts;
- other metal or suitably coated metal, no less resistant to corrosion than copper and having mechanical properties no less suitable. Ⓒ₁