BS EN 61009-1:2012+A13:2021

BSI Standards Publication

Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs)

Part 1: General rules

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Full document details: BS EN 61009-1:2012+A13:2021

National foreword

This British Standard is the UK implementation of EN 61009-1:2012+A13:2021. It supersedes BS EN 61009-1:2012+A12:2016, which will be withdrawn on 9 August 2026.

The text of amendment A13:2021 to BS EN 61009-1:2012 is collated in its entirety at the end of this text. BSI's policy of providing consolidated content remains unchanged; however, in the interest of expediency, in this instance BSI have chosen to collate the relevant content at the end of this document.

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 ▌C⟩ ⟨C▐.

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 ▌A1⟩ ⟨A1▐.

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 ▌C1⟩ ⟨C1▐.

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

A list of organizations represented on this committee can be obtained on request to its committee manager.

This publication has been prepared under a mandate given to the European Standards Organizations by the European Commission and the European Free Trade Association. It is intended to support requirements of the EU legislation detailed in the European Foreword. A European Annex, usually Annex ZA or ZZ, describes how this publication relates to that EU legislation.

For the Great Britain market (England, Scotland and Wales), if UK Government has designated this publication for conformity with UKCA marking (or similar) legislation, it may contain an additional National Annex. Where such a National Annex exists, it shows the correlation between this publication and the relevant UK legislation. If there is no National Annex of this kind, the relevant Annex ZA or ZZ in the body of the European text will indicate the relationship to UK regulation applicable in Great Britain. References to EU legislation may need to be read in accordance with the UK designation and the applicable UK law. Further information on designated standards can be found at www.bsigroup.com/standardsandregulation.

For the Northern Ireland market, UK law will continue to implement relevant EU law subject to periodic confirmation. Therefore Annex ZA/ZZ in the European text, and references to EU legislation, are still valid for this market.

UK Government is responsible for legislation. For information on legislation and policies relating to that legislation, consult the relevant pages of www.gov.uk.

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Amendments/corrigenda issued since publication

Date	Text affected
31 January 2015	Implementation of IEC amendment 1:2012 with CENELEC modifications
31 January 2015	Implementation of IEC amendment 2:2013 with CENELEC modifications
31 January 2015	Implementation of IEC corrigendum January 2014: Table 26 inserted into subclause 9.9.1.3
30 September 2015	Implementation of CENELEC amendment A11:2015: Annex ZB updated
30 April 2016	Implementation of CENELEC amendment A12:2016: Annex ZB updated
31 March 2022	Implementation of CENELEC amendment A13:2021

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 61009-1+A12:2016

April 2016

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English version

Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs) - Part 1: General rules

(IEC 61009-1:2010, modified)

Interrupteurs automatiques à courant différentiel résiduel avec dispositif de protection contre les surintensités incorporé pour usages domestiques et analogues (DD) -
Partie 1: Règles générales
(CEI 61009-1:2010, modifiée)

Fehlerstrom-/Differenzstrom-Schutzschalter mit eingebautem Überstromschutz (RCBOs) für Hausinstallationen und für ähnliche Anwendungen -
Teil 1: Allgemeine Anforderungen
(IEC 61009-1:2010, 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.

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 CEN-CENELEC Management Centre has the same status as the official versions.

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CENELEC

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

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Ref. No. EN 61009-1:2012 E

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Foreword

This document (EN 61009-1:2012) consists of the text of IEC 61009-1:2010 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 at national level by publication of an identical national standard or by endorsement (dop) 2013-06-18
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2017-06-18

This document supersedes EN 61009-1:2004 + corr.Jul.2006 + A11:2008 + A12:2009 + A13:2009 + A14:2012 + AC:2012.

– 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 2 and 3;

– revision of test procedure for $I_{\Delta n}$ between 5 A and 200 A;

– tests for the use of RCBOs in IT systems;

– testing procedure regarding the 6mA d.c. current superimposed to the fault current;

– improvement highlighting RCDs with multiple sensitivity;

– some alignments with EN 60898-1.

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 61009-1:2010 are prefixed “Z”.

Endorsement notice

The text of the International Standard IEC 61009-1:2010 was approved by CENELEC as a European Standard with agreed common modifications.

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Foreword to amendment A1

This document (EN 61009-1:2012/A1:2014) consists of the text of IEC 61009-1:2010/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".

The following dates are fixed:

– latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2015-08-04
– latest date by which the national standards conflicting with this document have to be withdrawn	(dow)	2017-08-04

Clauses, subclauses, notes, tables, figures and annexes which are additional to those in IEC 61009-1:2010/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 61009-1:2010/A1:2012 was approved by CENELEC as a European Standard with agreed common modifications.

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Foreword to amendment A2

This document (EN 61009-1:2012/A2:2014) consists of the text of IEC 61009-1:2010/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".

The following dates are fixed:

– latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2015-08-04

– latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2017-08-04

Clauses, subclauses, notes, tables, figures and annexes which are additional to those in IEC 61009-1:2010/A2:2013 are prefixed “Z”.

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 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 61009-1:2010/A2:2013 was approved by CENELEC as a European Standard with agreed common modifications.

Foreword to amendment A11

This document (EN 61009-1:2012/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 national level by publication of an identical national standard or by endorsement (dop) 2016-07-06

- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2018-07-06

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For the relationship with EU Directive 2004/108/EC, see informative Annex ZZ, mentioned in EN 61009-1:2012.

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

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Foreword to amendment A12

This document (EN 61009-1:2012/A12:2016) 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 national level by publication of an identical national standard or by endorsement (dop) 2017-02-11
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2019-02-11

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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).

For the relationship with EU Directive(s) see informative Annex ZZ, included in EN 61009-1:2012.

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[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.

Publication	Year	Title	EN/HD	Year
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
[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 60068-3-4	2001	Environmental testing - Part 3-4: Supporting documentation and guidance - Damp heat tests	EN 60068-3-4	2002
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	-	-
[C1] IEC 60364-4-44 (mod) + corr. May	2007 2010	Low-voltage electrical installations Part 4-44: Protection for safety - Protection against voltage disturbances and electromagnetic disturbances	HD 60364-4-444 + corr. July + AC:2012	2010 2010 2012 [C1]
IEC 60364-5-52	2001	Electrical installations of buildings - Part 5-52: Selection and erection of electrical equipment - Wiring systems	-	-
IEC 60364-5-53	2001	Electrical installations of buildings - Part 5-53: Selection and erection of electrical equipment - Isolation, switching and control	-	-
IEC 60529	-	Degrees of protection provided by enclosures (IP Code)	-	-
IEC 60664-1	2007	Insulation coordination for equipment within low-voltage systems - Part 1: Principles, requirements and tests	EN 60664-1	2007

[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]

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[C] Publication	Year	Title	EN/HD	Year
[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	-
IEC 60695-2-10	-	Fire hazard testing Part 2-10: Glowing/hot-wire based test methods - Glow-wire apparatus and common test procedure	EN 60695-2-10[1)]	-
IEC 60695-2-11 + corr. January	2000 2001	Fire hazard testing Part 2-11: Glowing/hot-wire based test methods - Glow-wire flammability test method for end-products	EN 60695-2-11	2001 [C1]
IEC 60898-1 (mod)	2002	Electrical accessories - Circuit breakers for overcurrent protection for household and similar installations - Part 1: Circuit-breakers for a.c. operation	EN 60898-1 + corr. February + A11 + A12	2003 2004 2005 2008
IEC 61009	Series	Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBO's)	EN 61009	Series
[C1] IEC 61543 - + A1 (mod) - + A2 -	1995 - 2004 - 2005 -	Residual current-operated protective devices (RCDs) for household and similar use - Electromagnetic compatibility	EN 61543 + corr. December + A11 + corr. May + A2 + A12	1995 1997 2003 2004 2006 2005 [C1]
ISO 7000	1989	Graphical symbols for use on equipment - Index and synopsis	-	- [C]

[C1] 1) EN 60695-2-10 is superseded by EN 60695-2-10:2013, which is based on IEC 60695-2-10:2013. [C1]

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〈C〉 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.

Clause	Special national condition
General	**Germany**
	In Germany the use of RCBOs of type AC is not permitted. 〈C〉
General	**Ireland**
	EN 61009-1 (referred to as Part 1) is applicable with the modifications given immediately below: For RCBOs functionally dependant on line voltage IEC 61009-2-2 applies in conjunction with Part 1. In Ireland, where neutrals are reliably at earth potential, RCBOs with unswitched neutral current paths are permitted for use in accordance with The National Rules For Electrical Installations. The requirements of these types of devices are given in the original text of IEC 61009-1. Details of the particular clauses are listed below.
3.3.16	**Ireland**
	The text remains as given in the original IEC text.
3.3.17	**Ireland**
	The text remains as given in the original IEC text.
4.3	**Ireland**
	The text remains as given in the original IEC text.
5.3.1	**Ireland**
	Only the text referring to rated voltages of 120 V is deleted.
9.7.2	**Ireland**
	The text remains as given in the original IEC text.
9.12.2	**Ireland**
	The text remains as given in the original IEC text.
9.12.7	**Ireland**
	The text remains as given in the original IEC text.
9.12.9.1	**Ireland**
	The text remains as given in the original IEC text.
9.12.11.3	**Ireland**
	The text remains as given in the original IEC text.
9.12.11.4	**Ireland**
	The text remains as given in the original IEC text.

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Clause	Special national condition
9.17.4	**Ireland** The text remains as given in the original IEC text.
9.20	**Ireland** In Paragraph 4, the last line after ‘neutral pole’ neutral path also applies.
Figure 7 and Figure 8	**Ireland** Retain as given in the original IEC text
Table A.3	**Ireland** The text remains as given in the original IEC text.
ZE.3.3	**Ireland** Only universal screwless type terminals are accepted.
ZF.1	**Ireland** The use of RCBOs with flat quick-connect terminations for rated currents up to and including 20 A is accepted.
ZF.8.2.2	**Ireland** The use for rated currents up to and including 20 A is accepted.
General	**Switzerland** In Switzerland, the use of RCBOs of type AC is not permitted.
General	**United Kingdom** In the United Kingdom, where neutrals are reliably at earth potential, RCBOs with un-switched neutral current paths are permitted. The requirements of these types of devices are given in the original text of IEC 61009-1. Details of the particular clauses are listed below.
3.3.16	**United Kingdom** The text remains as given in the original IEC text.
3.3.17	**United Kingdom** The text remains as given in the original IEC text.
4.3	**United Kingdom** The text remains as given in the original IEC text.
5.3.1	**United Kingdom** Only the text referring to rated voltages of 120 V is deleted.
9.7.2	**United Kingdom** The text remains as given in the original IEC text.
9.7.7.2	**United Kingdom** 4th paragraph, 2nd line – add ‘(or path)’ after ‘neutral pole’
9.7.7.2	**United Kingdom** 5th paragraph, 2nd line – add ‘(or path)’ after ‘neutral pole’
9.12.2	**United Kingdom** The text remains as given in the original IEC text.
9.12.7	**United Kingdom** The text remains as given in the original IEC text.
9.12.9.1	**United Kingdom** The text remains as given in the original IEC text.

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Clause	Special national condition
9.12.11.3	**United Kingdom** The text remains as given in the original IEC text.
9.12.11.4	**United Kingdom** The text remains as given in the original IEC text.
9.17.4	**United Kingdom** The text remains as given in the original IEC text.
Figure 7 & Figure 8	**United Kingdom** Retain as given in the original IEC text.
Table A.3	**United Kingdom** The text remains as given in the original IEC text.

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〖C〗 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.

Clause	Deviation
	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 61009-1 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.”
4.1	Table Z1 is not valid in Austria. 〈C〗

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⟦C⟩ Annex ZD
(normative)

Classification of RCBOs Type B and C up to and including 63A into energy limiting classes

RCBOs of B-type and C-type up to and including 63A, shall be classified into energy limiting classes 1 or 3 in accordance with Tables ZD.1 or ZD.2, as applicable, and be marked with the number of the energy limiting class in a square adjoining the symbol given in t) of Clause 6. This classification shall not be applied to RCBOs type D and to RCBOs with rated current higher than 63A.

Table ZD.1 – Permissible I^2t (let-through) values for RCBOs type B with rated current up to and including 63 A

Type B					
Rated short-circuit capacity(A) I_{cn}	Class 1	class 3			
	≤ 63A	≤ 16A	20A, 25A, 32A	40A	50A, 63A
3 000	No limits specified	15 000	18 000	21 600	28 000
4 500		25 000	32 000	38 400	48 000
6 000		35 000	45 000	54 000	65 000
10 000		70 000	90 000	108 000	135 000

Table ZD.2 – Permissible I^2t (let-through) values for RCBOs type C with rated current up to and including 63 A

Type C					
Rated short-circuit capacity(A) I_{cn}	Class 1	class 3			
	≤ 63A	≤ 16A	20A, 25A, 32A	40A	50A, 63A
3 000	No limits specified	17 000	20 000	24 000	30 000
4 500		28 000	37 000	45 000	55 000
6 000		40 000	52 000	63 000	75 000
10 000		80 000	100 000	120 000	145 000

⟦C1⟩ The maximum I^2t values measured during the test sequence F_0 or F_1 as applicable serve as reference values for the classification. ⟨C1⟧
Compliance with the requirements of Tables ZD.1 and ZD.2 is checked on the RCBOs with the highest rated current available within the range covered by each of these tables.
If these current ratings are not included in the samples submitted to test sequences F_0 or F_1 of Annex A, the appropriate number of samples of these ratings shall be additionally submitted to that test sequence. None of the values measured shall exceed the permissible I^2t value of the proposed energy limiting class in accordance with Tables ZD.1 and ZD.2.
If RCBOs rated 40 A are submitted with the range of RCBOs with rating exceeding 16 A and their measured I^2t values are lower than those indicated in Tables ZD.1 or ZD.2 for rating 32 A, no relevant test is necessary for the RCBOs rated 32 A.
If RCBOs rated 50 A or 63 A are submitted with the range of RCBOs with rating exceeding 32 A and their measured I^2t values are lower than those indicated in Tables ZD.1 or ZD.2 for rating 40 A, no relevant test is necessary for the RCBOs rated 40 A ⟨C⟧

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⟦C2⟩ Annex ZXX
(Informative)
List of clauses that require retesting

Based on EN 61009-1:2012/FprA1:2014, the following tests and/or requirements have been technically modified and may require retesting or inspection as applicable:

- 8.1.3 Clearances and creepage distances (see Annex B) ⟨C2⟧

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〈C〉 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.

———————— 〈C〉

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

RESIDUAL CURRENT OPERATED CIRCUIT-BREAKERS WITH INTEGRAL OVERCURRENT PROTECTION FOR HOUSEHOLD AND SIMILAR USES (RCBOs) –

Part 1: General rules

FOREWORD

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International Standard IEC 61009-1 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). It 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 2 and 3;
– revision of test procedure for $I_{\Delta n}$ between 5 A and 200 A;

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– tests for the use of RCBOs in IT systems;
– testing procedure regarding the 6mA d.c. current superimposed to the fault current;
– improvement highlighting RCDs with multiple sensitivity;
– some alignments with IEC 60898-1.

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

FDIS	Report on voting
23E/682/FDIS	23E/686/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 the parts in the IEC 61009 series, under the general title *Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs),* 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.

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INTRODUCTION

This part includes definitions, requirements and tests covering all types of RCBOs. For 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 RCBOs functionally independent of line voltage.

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

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RESIDUAL CURRENT OPERATED CIRCUIT-BREAKERS WITH INTEGRAL OVERCURRENT PROTECTION FOR HOUSEHOLD AND SIMILAR USES (RCBOs) –

Part 1: General rules

1 Scope

This International Standard applies to residual current operated circuit-breakers with integral overcurrent protection functionally independent of, or functionally dependent on, line voltage for household and similar uses (hereafter referred to as RCBOs), 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〗 and rated short-circuit capacities not exceeding 25 000 A. 〖C〗 They are intended for use in an environment with pollution degree 2, and overvoltage category III. 〈C〗

These devices are intended to protect people against indirect contact, the exposed conductive parts of the installation being connected to an appropriate earth electrode and to protect against overcurrents the wiring installations of buildings and similar applications. 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.

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

This standard applies to devices performing simultaneously the function 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, and also of performing the function of making, carrying and breaking overcurrents under specified conditions.

NOTE 1 The content of the present standard related to operation under residual current conditions is based on IEC 61008-1. The content of the present standard related to protection against overcurrents is based on IEC 60898-1.

NOTE 2 RCBOs are essentially intended to be operated by uninstructed persons and designed not to require maintenance. They may be submitted for certification purposes.

NOTE 3 Installation and application rules of RCBOs are given in the IEC 60364 series.

They are intended for use in an environment with pollution degree 2.

NOTE 4 For more severe overvoltage conditions, circuit-breakers complying with other standards (e.g. IEC 60947-2) should be used.

NOTE 5 For environments with higher pollution degrees, enclosures giving the appropriate degree of protection should be used.

RCBOs 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.

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

NOTE 6 Surge arresters installed downstream of the general type of RCBOs and connected in common mode may cause unwanted tripping.

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RCBOs are suitable for isolation.

RCBOs 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).

NOTE 7 For RCBOs having a degree of protection higher than IP20 special constructions may be required.

This standard also applies to RCBOs obtained by the assembly of an adaptable residual current device with a circuit-breaker. The mechanical assembly shall be effected in the factory by the manufacturer, or on site, in which case the requirements of Annex G shall apply.
〖C〗 *text deleted* 〈C〗

Supplementary requirements may be necessary for RCBOs of the plug-in type.

〖C〗 Particular requirements are necessary for RCBOs :

– integrated in one unit with a socket-outlet or designed exclusively for being associated locally with a socket-outlet in the same mounting box;

– if intended to be used at frequencies other than 50 Hz or 60 Hz. 〈C〗

〖C1〗 For RCBOs incorporated in, or intended only for association with socket-outlets, the requirements of this standard may be used, as far as applicable, in conjunction with the national requirements for socket outlets of the country where the product is placed on the market. 〈C1〗

NOTE 〖C1〗 Residual current-operated protective devices (RCDs) incorporated in, or intended only for association with socket-outlets, can either meet IEC 62640 or this standard. 〈C1〗

〖C〗 *text deleted* 〈C〗

This standard does not apply to:

– RCBOs intended to protect motors;

– RCBOs the current setting of which is adjustable by means accessible to the user in normal service.

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

RCBOs including batteries are not covered by this standard.

A guide for the coordination of RCBOs with fuses is given in Annex F.

2 Normative references

〖C〗 NOTE Normative references to international publications are listed in Annex ZA (normative). 〈C〗

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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 1 Reference to IEV definitions is also made when the terms "device" or "mechanical switching device" are replaced by the term "RCBO".

NOTE 2 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 RCBO to enable it to accomplish its function under specified conditions

3.2.2
energizing input-quantity
energizing quantity by which the RCBO is activated when it is applied under specified conditions

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

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3.2.3
residual current
I_Δ
vector sum of the instantaneous values of the current flowing in the main circuit of the RCBO (expressed as r.m.s. value)

3.2.4
residual operating current
value of residual current which causes the RCBO to operate under specified conditions

3.2.5
residual non-operating current
value of residual current at and below which the RCBO does not operate under specified conditions

3.2.6
residual current ($I_{\Delta t}$) of an RCBO
value of residual current which is the lower limit of the overcurrent instantaneous tripping range according to type B, C or D (see footnote c of Table 2)

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

3.3.1
switching device
device designed to make or break the current in one or more electric circuits

[IEV 441-14-01:1984]

3.3.2
mechanical switching device
switching device designed to close and open one or more electric circuits by means of separable contacts

[IEV 441-14-02: 1984, modified]

3.3.3
fuse
switching device that, by the melting of one or more of its specially designed and proportioned components, opens the circuit in which it is inserted by breaking the current when it exceeds a given value for a sufficient time. The fuse comprises all the parts that form the complete device

[IEV 441-18-01:1984, modified]

3.3.4
circuit-breaker
mechanical switching device, capable of making, carrying and breaking currents under normal circuit conditions and also making, carrying for a specified time and (automatically) breaking currents under specified abnormal conditions such as those of short-circuit

[IEV 441-14-20:1984, modified]

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3.3.5
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

3.3.6
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

3.3.7
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

3.3.8
RCBOs functionally independent of line voltage
RCBOs 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/TR 60755:1983 as residual current devices without auxiliary source.

3.3.9
RCBOs functionally dependent on line voltage
RCBOs 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 60755:1983.

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

3.3.10
break time of an RCBO
time which elapses between the instant when the residual operating current is suddenly attained and the instant of arc extinction in all poles

3.3.11
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 RCBO without causing it to operate

3.3.12
time-delay RCBO
RCBO specially designed to attain a pre-determined value of limiting non-actuating time, corresponding to a given value of residual current

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3.3.13
closed position
position in which the predetermined continuity of the main circuit of the RCBO is secured

[IEV 441-16-22]

3.3.14
open position
position in which the predetermined clearance between open contacts in the main circuit of the RCBO is secured

[IEV 441-16-23]

3.3.15
pole
that part of an RCBO 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

3.3.15.1
overcurrent protected pole
pole provided with an overcurrent release, hereafter referred to as protected pole

3.3.15.2
overcurrent unprotected pole
pole without an overcurrent release, but otherwise generally capable of the same performance as a protected pole of the same RCBO, hereafter referred to as unprotected pole

NOTE 1 To ensure this requirement, the unprotected pole may be of the same construction as the protected pole(s), or of a particular construction.

NOTE 2 If the short-circuit capacity of the unprotected pole is different from that of the protected pole(s), this should be indicated by the manufacturer.

3.3.15.3
switched neutral pole
pole only intended to switch the neutral and not intended to have a short-circuit capacity

3.3.16
〖C〗 Void 〖C〗

3.3.17
main circuit (of an RCBO)
all the conductive parts of an RCBO included in the 〖C〗 poles 〖C〗 (see 4.3)

3.3.18
control circuit (of an RCBO)
circuit (other than a path of the main circuit) intended for the closing operation or the opening operation, or both, of the RCBO

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

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3.3.19
auxiliary circuit (of an RCBO)
all the conductive parts of an RCBO which are intended to be included in a circuit other than the main circuit and the control circuit of the RCBO

[IEV 441-15-04]

3.3.20
RCBO type AC
RCBO for which tripping is ensured for residual sinusoidal alternating currents, whether suddenly applied or slowly rising

3.3.21
RCBO type A
RCBO for which tripping is ensured for residual sinusoidal alternating currents and residual pulsating direct currents, whether suddenly applied or slowly rising

3.3.22
test device
device incorporated in the RCBO simulating the residual current conditions for the operation of the RCBO under specified conditions

〖C〗 3.3.Z1
plug-in RCBO
RCBO 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 RCBO

3.4.2
overcurrent
any current exceeding the rated current

3.4.2.1
overload current
overcurrent occurring in an electrically undamaged circuit

NOTE An overload current may cause damage if sustained for a sufficient time.

3.4.2.2
short-circuit current
overcurrent resulting from a fault of negligible impedance between points intended to be at different potentials in normal service

NOTE A short-circuit current may result from a fault or from an incorrect connection.

3.4.3
prospective current
current that would flow in the circuit, if each main current path of the RCBO 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.

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3.4.4
prospective peak current
peak value of a prospective current during the transient period following initiation

NOTE The definition assumes that the current is made by an ideal RCBO, i.e. with instantaneous transition from infinite to zero impedance. For circuits where the current can follow several different paths, for example polyphase circuits, it further assumes that the current is established simultaneously in all poles, even if the current only in one pole is considered.

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 circuit-breaker 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 RCBO is designed to make, to carry for its opening time and to break under specified conditions

3.4.6.1
ultimate short-circuit breaking capacity
breaking capacity for which the prescribed conditions according to a specified test sequence do not include the capability of the RCBO to carry 0,85 times its non-tripping current for the conventional time

3.4.6.2
service short-circuit breaking capacity
breaking capacity for which the prescribed conditions according to a specified test sequence include the capability of the RCBO to carry 0,85 times its non-tripping current for the conventional time

3.4.7
breaking current
current in a pole of an RCBO at the instant of initiation of the arc during a breaking process

[IEV 441-17-07:1984, modified]

NOTE For a.c., reference is made to the r.m.s. value.

3.4.8
applied voltage
voltage which exists across the terminals of a pole of an RCBO just before the making of the current

[IEV 441-17-24:1984]

NOTE This definition refers to a single-pole RCBO. For a multipole RCBO, the applied voltage is the voltage across the supply terminals of the RCBO.

3.4.9
recovery voltage
voltage which appears across the terminals of a pole of an RCBO 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 one during which power-frequency voltage alone exists.

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

3.4.9.1
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 RCBO. It includes the voltage shift of the neutral of a polyphase circuit.

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

3.4.9.2
power-frequency recovery voltage
recovery voltage after the transient voltage phenomena have subsided

[IEV 441-17-27;1984]

3.4.10
opening time
time measured from the instant at which, the RCBO being in the closed position, the current in the main circuit reaches the operating value of the overcurrent release to the instant when the arcing contacts have separated in all poles

NOTE The opening time is commonly referred to as tripping time, although, strictly speaking, tripping time applies to the time between the instant of initiation of the opening time and the instant at which the opening command becomes irreversible.

3.4.11
Definitions relating to arcing time

3.4.11.1
arcing time of a pole
interval of time between the instant of initiation of the arc in a pole and the instant of final arc extinction in that pole

[IEV 441-17-37, modified]

3.4.11.2
arcing time of a multipole RCBO
interval of time between the instant of first initiation of the arc and the instant of final arc extinction in all poles

[IEV 441-17-38]

3.4.12
break time (in case of overcurrent)
interval of time between the beginning of the opening time of an RCBO and the end of the arcing time, in case of overcurrent

[IEV 441-17-39:1984, modified]

3.4.13
***I²t* (Joule integral)**
integral of the square of the current over a given time interval (t_0, t_1):

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

[IEV 441-18-23:1984]

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3.4.14
***I²t* characteristic of an RCBO**
curve giving the maximum value of I^2t as a function of the prospective current under stated conditions of operation

3.4.15
Coordination between overcurrent protective devices in series

3.4.15.1
selectivity-limit current
I_s
current coordinate of the intersection between the maximum break-time current characteristic of the protective device on the load side and the pre-arcing (for fuses) or tripping (for circuit-breakers) time-current characteristic of the other protective device

NOTE 1 The selectivity-limit current is a limiting value of current:

– below which, in the presence of two overcurrent protective devices in series, the protective device on the load side completes its breaking operation in time to prevent the other protective device from starting its operation (i.e. selectivity is ensured);

– above which, in the presence of two overcurrent protective devices in series, the protective device on the load side may not complete its breaking operation in time to prevent the other protective device from starting its operation (i.e. selectivity is not ensured).

NOTE 2 I^2t characteristics may be used instead of time-current characteristics.

3.4.15.2
take-over current
I_B
current coordinate of the intersection between the maximum break time-current characteristics of two overcurrent protective devices

NOTE 1 The take-over current is a limiting value of current above which, in the presence of two overcurrent protective devices in series, the protective device generally, but not necessarily, on the supply side, provides back-up operation for the other protective device.

NOTE 2 I^2t characteristics may be used instead of time-current characteristics.

3.4.16
conventional non-tripping current
I_{nt}
specified value of current which the RCBO can carry for a specified time (conventional time) without operating

[IEV 441-17-22 :1984]

3.4.17
conventional tripping current
I_t
specified value of current which causes the RCBO to operate within a specified time (conventional time)

3.4.18
instantaneous tripping current
minimum value of current which causes the circuit-breaker to operate automatically without intentional time-delay

3.4.19
non-operating overcurrents in the main circuit

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.

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3.4.19.1
limiting value of overcurrent in case of a load through an RCBO with two ⟦C⟩ poles ⟨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 an RCBO with two ⟦C⟩ poles ⟨C⟧ without causing it to operate

3.4.19.2
limiting value of overcurrent in case of a single phase load through a three-pole or four-pole RCBO
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 a three-pole or a four-pole RCBO without causing it to operate

3.4.20
residual making and breaking capacity
value of the a.c. component of a residual prospective current which an RCBO can make, carry for its opening time and break under specified conditions of use and behaviour

3.4.21
limiting values (U_x and U_y) of the line voltage for RCBOs functionally dependent on line voltage

3.4.21.1
U_x
minimum value of the line voltage at which an RCBO functionally dependent on line voltage still operates under specified conditions in case of decreasing line voltage (see 9.17.1)

3.4.21.2
U_y
minimum value of the line voltage below which an RCBO functionally dependent on line voltage opens automatically in the absence of any residual current (see 9.17.2)

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 RCBO

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 RCBO 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 RCBO suffers only spontaneously reversible changes, although not necessarily complying with any requirements

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3.5.6
ambient air temperature
temperature, determined under prescribed conditions, of the air surrounding the RCBO

NOTE For RCBOs installed inside an enclosure, it is the temperature of the air outside the enclosure.

[IEV 441-11-13]

3.5.7
reference ambient air temperature
ambient air temperature on which the time-overcurrent characteristics are based

3.6 Definitions relating to terminals

3.6.1
terminal
conductive part of an RCBO, provided for re-usable 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 by 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

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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.

〖C〗 **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 〈C〗

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 (i.e. make or break) is referred to as a switching operation and an operation in the mechanical sense (i.e. close or open) is referred to as a mechanical operation.

3.7.2
closing operation
operation by which the RCBO is brought from the open position to the closed position

[IEV 441-16-08:1984]

3.7.3
opening operation
operation by which the RCBO is brought from the closed position to the open position

[IEV 441-16-09:1984]

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3.7.4
dependent manual operation
operation solely by means of directly applied manual energy, such that the speed and force of the operation are dependent on the action of the operator

[IEV 441-16-13]

3.7.5
independent manual operation
stored energy operation where the energy originates from manual power, stored and released in one continuous operation, such that the speed and force of the operation are independent of the action of the operator

IEV 441-16-16]

3.7.6
trip-free RCBO
an RCBO, 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.

[IEV 441-16-31]

3.7.7
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]

3.7.8
sequence of operations
succession of specified operations with specified time intervals

3.7.9
uninterrupted duty
duty in which the main contacts of an RCBO remain closed whilst carrying a steady current without interruption for long periods (which could be weeks, months, or even years)

3.8 Definitions relating to constructional elements

3.8.1
main contact
contact included in the main circuit of an RCBO, intended to carry, in the closed position, the current of the main circuit

[IEV 441-15-07:1984]

3.8.2
arcing contact
contact on which the arc is intended to be initiated

NOTE An arcing contact may serve as a main contact. It may also be a separate contact so designed that it opens after and closes before another contact which it is intended to protect from damage.

3.8.3
control contact
contact included in a control circuit of an RCBO and mechanically operated by the RCBO

[IEV 441-15-09]

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3.8.4
auxiliary contact
contact included in an auxiliary circuit and mechanically operated by the RCBO (e.g. for indicating the position of the contacts)

[IEV 441-15-10:1984, modified]

3.8.5
release
device, mechanically connected to (or integrated into) an RCBO which releases the holding means and permits the automatic opening of the RCBO

[IEV 441-15-17, modified]

NOTE In the IEV definition, reference to closing is also made.

3.8.6
overcurrent release
release which permits an RCBO to open with or without time-delay when the current in the release exceeds a predetermined value

NOTE In some cases, this value may depend upon the rate of rise of current.

[IEV 441-16-33:1984]

3.8.7
inverse time-delay overcurrent release
overcurrent release which operates after a time-delay inversely dependent upon the value of the overcurrent

NOTE Such a release may be designed so that the time-delay approaches a definite minimum for high values of overcurrent.

[IEV 441-16-35:1984]

3.8.8
direct overcurrent release
overcurrent release directly energized by the current in the main circuit of an RCBO

[IEV 441-16-36:1984]

3.8.9
overload release
overcurrent release intended for protection against overloads

[IEV 441-16-38:1984]

3.8.10
conductive part
part which is capable of conducting current, although it may not necessarily be used for carrying service current

[IEV 441-11-09:1984]

3.8.11
exposed conductive part
conductive part which can be readily touched and which normally is not live, but which may become live under fault conditions

[IEV 441-11-10:1984]

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3.9 Definitions relating to tests

3.9.1
type test
test of one or more devices made to a certain design to show that the design meets certain requirements

3.9.2
routine test
test to which each individual device is subjected during or after manufacture to ascertain whether it complies with certain criteria

3.10 Definitions relating to insulation coordination

3.10.1
insulation coordination
mutual correlation of insulation characteristics of electrical equipment taking into account the expected micro-environment and other influencing stresses

[IEC 60664-1:2007, definition 3.1]

3.10.2
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]

3.10.3
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]

3.10.4
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]

3.10.5
overvoltage category
numeral defining a transient overvoltage condition

[IEC 60664-1:2007, definition 3.10]

3.10.6
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]

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3.10.7
micro-environment
immediate environment of the insulation which particularly influences the dimensioning of the creepage distances

[IEC 60664-1:2007, definition 3.12.2]

3.10.8
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]

3.10.9
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.

3.10.10
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]

3.10.11
isolating distance
clearance between open contacts, meeting the safety requirements specified for isolation purposes

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

3.10.12
clearance
shortest distance in air between two conductive parts along a string stretched the shortest way between these conductive parts

[IEV 441-17-31, modified]

NOTE 1 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.

NOTE 2 See also Annex B.

3.10.13
creepage distance
shortest distance along the surface of an insulating material between two conductive parts

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

NOTE 1 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.

NOTE 2 See also Annex B.

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4 Classification

RCBOs are classified in the following 〖C〗 *text deleted* 〖C〗 ways:

4.1 According to the method of operation

〖C〗 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 RCBOs according to the various applications but does not exclude the use of RCBOs of any classification for protection over and above that required by the relevant wiring rules. 〖C〗

〖C〗 Table Z1 – Survey of the types of RCBOs 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	Indirect contact and additional protection[a]	Indirect contact and additional protection[a]	Additional protection[a]	Additional protection[a b]
Service continuity [c]	Yes	Yes	No	Yes

[a] Additional protection, provided only by RCBOs 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 a socket outlet in a same mounting box.

[c] This information is given for guidance only.

〖C〗

4.1.1 RCBO functionally independent of line voltage (see 3.3.8)

4.1.2 RCBO functionally dependent on line voltage (see 3.3.9)

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

a) 〖C〗 *text deleted* 〖C〗

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 〖C〗 (additional requirements are under consideration); 〖C〗

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

〖C〗 *text deleted* 〖C〗

4.2 According to the type of installation

〖C〗 *text deleted* 〖C〗

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4.3 According to the number of poles and current paths

[C⟩ *text deleted* ⟨C]

– two-pole RCBO with one overcurrent protected pole;
– two-pole RCBO with two overcurrent protected poles;
– three-pole RCBO with three overcurrent protected poles;

[C⟩ *text deleted* ⟨C]

– four-pole RCBO with three overcurrent protected poles;
– four-pole RCBO with four overcurrent protected poles.

NOTE The pole which is not an overcurrent protected pole (see 3.3.15.1) may be:

– "unprotected" (see 3.3.15.2), or
– "switched neutral" (see 3.3.15.3).

4.4 According to the possibility of adjusting the residual operating current

[C⟩ *text deleted* ⟨C]

4.5 According to resistance to unwanted tripping due to voltage surges

– RCBOs with normal resistance to unwanted tripping (general type as in Table 2, and Table 3 if applicable);
– RCBOs with increased resistance to unwanted tripping (S type as in Table 2, and Table 3 if applicable).

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

– RCBOs of type AC;
– RCBOs of type A.

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

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

4.8 According to the protection against external influences

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

4.9 According to the method of mounting

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

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

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[C⟩ 4.10 According to the methods of connection

[C1⟩ *Text deleted* ⟨C1]

[C1⟩ – RCBOs, the electrical connections which are not associated with the mechanical mounting;

– RCBOs, the electrical connections which are associated with the mechanical mounting.

NOTE Examples of this type are:

– plug-in type;

– bolt-on type;

– screw-in type.

Some RCBOs 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. ⟨C1]

[C1⟩ *Text deleted* ⟨C1]

4.11 According to the instantaneous tripping current (see 3.4.18)

– B-type RCBO;

– C-type RCBO;

– D-type RCBO.

4.12 According to the I^2t characteristic

[C⟩ RCBOs of B-type and C-type, having rated current up to and including 63 A and having short-circuit breaking capacity of 3 000 A, 4 500 A, 6 000 A and 10 000 A, shall be classified according to the limits within which their I^2t characteristics lie, measured according to 9.12.6 (see Annex ZD).

Other ratings and D-type RCBOs cannot be classified according to this Annex ZD. ⟨C]

[A1⟩ 4.13 According to the type of terminals

– RCBOs with screw-type terminals for external copper conductors;

– RCBOs with screwless type terminals for external copper conductors;

NOTE 1 The requirements for RCBOs equipped with these types of terminals are given in Annex J.

– RCBOs with flat quick-connect terminals for external copper conductors;

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

[C1⟩ *Text deleted* ⟨C1] ⟨A1]

[C⟩ 4.Z1 According to the range of ambient air temperature

– RCBOs for use at ambient air temperatures between -5 °C and +40 °C;

– RCBOs for use at ambient air temperatures between -25 °C and +40 °C. ⟨C]

5 Characteristics of RCBOs

5.1 Summary of characteristics

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

[C⟩ *text deleted* ⟨C]

– number of poles and current paths (see 4.3);

– rated current I_n (see 5.2.2);

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– rated residual operating current $I_{\Delta n}$ (see 5.2.3);
– rated residual non-operating current $I_{\Delta no}$ (see 5.2.4);
– rated voltage U_n (see 5.2.1);
– rated frequency (see 5.2.5);
– rated short-circuit capacity I_{cn} (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);
– method of mounting (see 4.9);
– method of connection (see 4.10);
– range of instantaneous tripping overcurrent (see 4.11);
– I^2t classification (see 4.12);
– degree of protection (see IEC 60529).
[C〉 – ranges of ambient air temperature (see 5.3.Z1) 〈C]

For RCBOs functionally dependent on line voltage:

– behaviour of the RCBO 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 an RCBO is the value of voltage, assigned by the manufacturer, to which its performance is referred.

NOTE The same RCBO may be assigned a number of rated voltages and associated rated short-circuit capacities.

5.2.1.2 Rated insulation voltage (U_i)

The rated insulation voltage of an RCBO 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 RCBO. 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 RCBO shall be equal to or higher than the standard values of rated impulse withstand voltage given in [C〉 5.3.10. 〈C]

5.2.2 Rated current (I_n)

A current assigned by the manufacturer as the current which the RCBO can carry in uninterrupted duty (see 3.7.9), at a specified reference ambient air temperature.

The standard reference ambient air temperature is 30 °C. If a different reference ambient air temperature for the RCBO is used, the effect on the overload protection of cables shall be taken into account, since this is also based on a reference ambient air temperature of 30 °C, according to installation rules (see Clause 523 of IEC 60364-5-52:2001).

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

The value of residual operating current (see 3.2.4), assigned to the RCBO by the manufacturer, at which the RCBO 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 (3.2.5), assigned to the RCBO by the manufacturer, at which the RCBO does not operate under specified conditions.

5.2.5 Rated frequency

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

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

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

The rated short-circuit capacity of an RCBO is the value of the ultimate short-circuit breaking capacity (see 3.4.6.1) assigned to that RCBO by the manufacturer.

NOTE An RCBO having a given rated short-circuit capacity I_{cn} has a corresponding service short-circuit capacity (I_{cs}) (see Table 22).

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 3.4.3), assigned by the manufacturer, which an RCBO can make, carry and break under specified conditions.

〖C〗 The conditions are those specified in 9.12.11.4d) 〖C〗

〖C〗 NOTE the corresponding rated quantity of circuit-breaker is the rated making and breaking capacity of an individual pole Icn1 (see 5.2.5 of EN 60898-1:2002). 〖C〗

5.2.8 RCBO type S

A time-delay RCBO (see 3.3.12) which complies with the relevant part of Table 2 and Table 3 if applicable.

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

5.2.9.1 RCBO type AC

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

5.2.9.2 RCBO type A

An RCBO 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 〖C〗 Standard 〖C〗 values of rated voltage (U_n)

〖C〗 Standard 〖C〗 values of rated voltage are as follows:

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