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Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCOB's) - Part 1: General rules (IEC 1009-1:1991, modified)

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English version

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

(Includes amendments A1:1995, A11:1995, A2:1998, A13:1998, A14:1998, A15:1998, A17:1998 and A19:2000)

Interrupteurs automatiques à courant différentiel résiduel avec protection contre les surintensités incorporée pour installations domestiques et analogues (DD)
Partie 1: Règles générales
(Inclut les amendements A1:1995, A11:1995, A2:1998, A13:1998, A14:1998, A15:1998, A17:1998 et A19:2000)

Fehlerstrom-Schutschalter mit Überstromauslöser (RCBO's) für Hausinstallationen und für ähnliche Anwendungen
Teil 1: Allgemeine Anforderungen
(Enthält Änderungen A1:1995, A11:1995, A2:1998, A13:1998, A14:1998, A15:1998, A17:1998 und A19:2000)

This European Standard was approved by CENELEC on 1994-03-08. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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

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

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

CENELEC

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

Central Secretariat: rue de Stassart 35, B-1050 Brussels

Foreword

The text of the International Standard IEC 61009-1:1991 together with common modifications prepared by Technical Committee CENELEC TC 23E, Circuit-breakers and similar equipment for household and similar uses, was submitted to the Unique Acceptance Procedure (UAP) for acceptance as a European Standard.

As the original document did not obtain a sufficient number of positive votes, a revised draft was prepared and submitted to a second vote. The new draft was approved by CENELEC as EN 61009-1 on 1994-03-08.

The following dates were fixed:

— latest date of publication of an identical national standard (dop) 1996-07-01

— latest date of withdrawal of conflicting national standards (dow) 2000-07-01

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

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

Annex ZA (normative references), Annex ZB (special national conditions), Annex ZC (A-deviations) and Annex ZD (classification into energy limiting classes) have been added by CENELEC.

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

Foreword to amendment A1

The text of document 23E/211/DIS, future amendment 1 to IEC 61009-1:1991, prepared by SC 23E, Circuit-breakers and similar equipment for household use, of IEC TC 23, Electrical accessories, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A1 to EN 61009-1:1994 on 1995-09-20.

The following dates were fixed:

— latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1996-07-01

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

Foreword to amendment A11

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

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

The text of the draft was submitted to the formal vote and was approved by CENELEC as amendment A11 to EN 61009-1:1994 on 1995-07-04.

The following dates were fixed:

— latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1996-07-01

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

Foreword to amendment A2

The text of document 23E/246/FDIS, future amendment to IEC 61009-1:1991, prepared by SC 23E, Circuit-breakers and similar equipment for household use, of IEC TC 23, Electrical accessories, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A2 to EN 61009-1:1994 on 1996-10-01.

NOTE The text of this document was included in a new edition of IEC 61009-1; it is however published as a separate amendment by CENELEC.

The following dates were fixed:

— latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1998-07-01

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

Foreword to amendment A13

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

The text of the draft was submitted to the formal vote and was approved by CENELEC as amendment A13 to EN 61009-1:1994 on 1997-10-01.

The following dates were fixed:

— latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1998-07-01

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

Foreword to amendment A14

The text of document 23E/252/FDIS, intended to be published in a new (second) edition of IEC 61009-1, prepared by SC 23E, Circuit-breakers and similar equipment for household use, of IEC TC 23, Electrical accessories, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A14 to EN 61009-1:1994 on 1996-10-01.

The following dates were fixed:

— latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1998-07-01

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

Foreword to amendment A15

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

It comprises the text of two draft amendments, prAA and prAB, which were submitted to the Unique Acceptance Procedure and were approved together as amendment A15 to EN 61009-1:1994 on 1998-04-01.

The following dates were fixed:

— latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1998-11-01

— latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 2003-03-01

Foreword to amendment A17

At the request of the Irish electrotechnical committee, a draft for an amendment to EN 61009-1:1994 was submitted to the CENELEC members for acceptance in May 1998.

The text of the draft was accepted by CENELEC as amendment A17 to EN 61009-1:1994 on 1998-07-25.

The following dates were fixed:

— latest date by which the existence of the amendment has to be announced at national level (doa) 1998-10-25

— latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1999-01-25

Foreword to amendment A19

At the request of the Swedish electrotechnical committee, a draft for an amendment to EN 61009-1:1994 was submitted to the CENELEC members for acceptance in December 1999.

The text of the draft was accepted by CENELEC as amendment A19 to EN 61009-1:1994 on 2000-02-13.

The following dates were fixed:

— latest date by which the existence of the amendment has to be announced at national level (doa) 2000-05-13

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

Contents

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RESIDUAL CURRENT OPERATED CIRCUIT-BREAKERS WITH INTEGRAL OVERCURRENT PROTECTION FOR HOUSEHOLD AND SIMILAR USES (RCBO's)

Part 1: General rules

INTRODUCTION

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

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

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

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 RCBO's), for rated voltages not exceeding 440 V a.c., rated currents not exceeding 125 A for fixed installation and rated short-circuit capacities not exceeding 25 000 A for operation at 50 Hz or 60 Hz.

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.

RCBO's 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.

NOTES

1 The content of the present standard related to the operation under residual current conditions is based on IEC 1008.

The content of the present standard related to protection against overcurrents is based on IEC 898.

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

3 Installation and application rules of RCBO's are given in IEC 364.

RCBO's 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.

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

Note 4 – Surge arresters installed downstream of the general type of RCBO's and connected in common mode may cause unwanted tripping.

Note 5 – RCBO's within the scope of the present standard are considered as suitable for isolation (see 8.1.3, 9.7.2, 9.7.3, 9.10.3, 9.12.12.1, 9.12.12.2, 9.12.13.2).

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

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

This standard also applies to RCBO's 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.

Supplementary requirements may be necessary for RCBO's of the plug-in type.

Particular requirements are necessary for RCBO's integrated in one unit with a socket-outlet or designed exclusively for being associated locally with a socket-outlet in the same mounting box.

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

This standard does not apply to:

- RCBO's intended to protect motors;

- RCBO's the current setting of which is adjustable by means accessible to the user in normal service.

- RCBO's having more than one rated current.

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

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

A guide for the coordination of RCBO's with fuses is given in annex F.

2 Normative references

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

3 Definitions

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

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

NOTES

1 For glossary of symbols see annex IB.

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

3.1 *Definitions relating to currents flowing from live parts to earth*

3.1.1 earth fault current: Current flowing to earth due to an insulation fault.

3.1.2 earth leakage current: Current flowing from the live parts of the installation to earth in the absence of an insulation fault.

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

3.1.4 current delay angle α: The time, expressed in angular measure, by which the starting instant of current conduction is delayed by phase control.

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

3.2.1 energizing quantity: An electrical excitation quantity which, alone or in combination with other such quantities, shall be applied to a 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.

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

3.2.3 residual current (I_Δ): Vector sum of the instantaneous values of the current flowing in the main circuit of the 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.

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

3.3.1 switching device (IEV 441-14-01): A device designed to make or break the current in one or more electric circuits.

3.3.2 mechanical switching device (IEV 441-14-02): A switching device designed to close and open one or more electric circuits by means of separable contacts.

3.3.3 fuse (IEV 441-18-01): A 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.

3.3.4 circuit-breaker (IEV 441-14-20): A 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.

3.3.5 residual current operated circuit-breaker: A mechanical switching device designed for making, carrying and breaking 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): A 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): A residual current operated circuit-breaker designed to perform the functions of protection against overloads and/or short circuits.

3.3.8 RCBO's functionally independent of line voltage: RCBO's for which the functions of detection, evaluation and interruption do not depend on the line voltage.

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

3.3.9 RCBO's functionally dependent on line voltage: RCBO's for which the functions of detection, evaluation or interruption depend on the line voltage.

NOTES

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

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

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

3.3.11 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.

3.3.13 closed position (IEV 441-16-22): The position in which the predetermined continuity of the main circuit of the RCBO is secured.

3.3.14 open position (IEV 441-16-23): The position in which the predetermined clearance between open contacts in the main circuit of the RCBO is secured.

3.3.15 pole: That part of a 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: A pole provided with an overcurrent release, hereafter referred to as protected pole.

3.3.15.2 overcurrent unprotected pole: A 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.

NOTES

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

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

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

3.3.16 *deleted.*

3.3.17 **main circuit (of a RCBO):** All the conductive parts of a RCBO included in the poles (see 4.3).

3.3.18 control circuit (of a RCBO): A 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.

3.3.19 auxiliary circuit (of a RCBO) (IEV 441-15-04): All the conductive parts of a RCBO which are intended to be included in a circuit other than the main circuit and the control circuit of the RCBO.

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.

3.4 *Definitions relating to values and ranges of energizing quantities*

3.4.1 **rated value** (IEV 151-04-03): A quantity value assigned, generally by the manufacturer, for a specific operating condition of a RCBO.

3.4.2 **overcurrent:** Any current exceeding the rated current

3.4.2.1 **overload current:** An 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:** An 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:** The 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.

3.4.4 **prospective peak current:** The 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, that is 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):** The 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:** The 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:** A 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:** A 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** (IEV 441-17-07): The current in a pole of a RCBO at the instant of initiation of the arc during a breaking process.

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

3.4.8 **applied voltage** (IEV 441-17-24): The voltage which exists across the terminals of a pole of a RCBO just before the making of the current.

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** (IEV 441-17-25): The voltage which appears across the terminals of a pole of a RCBO after the breaking of the current.

NOTES

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.

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** (IEV 441-17-26): The recovery voltage during the time in which it has a significant transient character.

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

3.4.9.2 **power-frequency recovery voltage** (IEV 441-17-27): The recovery voltage after the transient voltage phenomena have subsided.

3.4.10 **opening time:** The 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.