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BSI Standards Publication

Type F and type B residual current operated circuit-breakers with and without integral overcurrent protection for household and similar uses

National foreword

This British Standard is the UK implementation of EN 62423:2012. It is derived from IEC 62423:2009, incorporating corrigendum December 2011.

The start and finish of text introduced or altered by corrigendum is indicated in the text by tags. Text altered by IEC corrigendum December 2011 is indicated in the text by ⟦AC1⟩ ⟨AC1⟧.

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

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

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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English version

Type F and type B residual current operated circuit-breakers with and without integral overcurrent protection for household and similar uses

(IEC 62423:2009, modified + corrigendum Dec. 2011)

Interrupteurs automatiques à courant différentiel résiduel de type B et de type F avec et sans protection contre les surintensités incorporée pour usages domestiques et analogues
(CEI 62423:2009, modifiée + corrigendum déc. 2011)

Fehlerstrom-/Differenzstrom-Schutzschalter Typ F und Typ B mit und ohne eingebautem Überstromschutz für Hausinstallationen und für ähnliche Anwendungen
(IEC 62423:2009, modifiziert + corrigendum Dez. 2011)

CENELEC

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Foreword

This document (EN 62423:2012) consists of the text of IEC 62423:2009 + corrigendum 2011 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) 2013-06-19
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2017-06-19

This document supersedes EN 62423:2009.

EN 62423:2012 includes the following significant technical changes with respect to EN 62423:2009:

– requirements and tests for Type F RCD have been introduced;

– requirements and tests for two-pole Type B RCD have been introduced;

– new additional requirements and tests for Type B RCDs have been introduced to cover requirements and tests for Type F too.

This European Standard is to be read in conjunction with the following standards:

EN 61008-1:2012, *Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs) – Part 1: General rules*

EN 61009-1:2012, *Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs) – Part 1: General rules*

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.

Endorsement notice

The text of the International Standard IEC 62423:2009 + corrigendum 2011 was approved by CENELEC as a European Standard with agreed common modifications.

CONTENTS

INTRODUCTION

RCCBs and RCBOs designed according to IEC 61008-1 and IEC 61009-1 are suitable in most of the applications. IEC 61008-1 and 61009-1 provide appropriate requirements and tests for general use in household and similar uses. However, the use of new electronic technology in equipment may result in particular residual currents not covered in IEC 61008-1 or IEC 61009-1. This standard covers specific applications where additional requirements and testing are needed.

This standard includes definitions, additional requirements and tests for Type F and Type B RCCBs and/or RCBOs to cover particular situations.

The tests shall first be applied according to IEC 61008-1 for Type F or Type B RCCBs and according to IEC 61009-1 for Type F or Type B RCBOs.

After completion of the tests given either in IEC 61008-1 or IEC 61009-1 the additional tests given in this standard shall be applied in order to show conformity to this standard (see Annex A, Annex B for Type F or Annex C, Annex D for Type B respectively).

The number of samples to be submitted and test sequences to be applied for verification of conformity for Type F RCCBs and Type F RCBOs are given in Annex A and Annex B respectively.

The number of samples to be submitted and test sequences to be applied for verification of conformity for Type B RCCBs and Type B RCBOs are given in Annex C and Annex D respectively.

This standard introduces Type F RCDs (F for Frequency) *Text deleted* intended for protection of circuits with frequency inverters supplied between phase and neutral or phase and earthed middle conductor taking into account the necessary features for these particular situations in addition to the cases covered by type A RCDs. Type F RCDs cannot be used where electronic equipment with double bridge rectifiers supplied from two phases is found or if a smooth d.c. residual current can occur.

In case of a frequency inverter, e.g. used for motor speed control, supplied between phase and neutral, a composite residual current including the power frequency, the motor frequency and the chopper clock frequency of the frequency inverter may occur in addition to alternating or pulsating d.c. residual currents.

This standard introduces Type B RCDs to be used in case of residual pulsating rectified direct current which results from one or more phases, and smooth d.c. residual current in addition to the cases covered by Type F RCDs. For these applications, two, three or four pole Type B RCDs can be used.

TYPE F AND TYPE B RESIDUAL CURRENT OPERATED CIRCUIT-BREAKERS WITH AND WITHOUT INTEGRAL OVERCURRENT PROTECTION FOR HOUSEHOLD AND SIMILAR USES

1 Scope

[C] The scope of EN 61008-1 and EN 61008-2-1 or EN 61009-1 and EN 61009-2-1 applies with the following additions.

This standard specifies requirements and tests for Type F and Type B RCDs (Residual current devices). Requirements and tests given in this standard are in addition to the requirements of Type A residual current devices according to EN 61008-2-1 or EN 61009-2-1. This standard can only be used together with EN 61008-1 and EN 61009-1.[C]

Type F RCCBs (Residual Current Circuit Breaker) and Type F RCBOs (Residual current Circuit Breaker with Overcurrent protection) [C]*Text deleted*[C] are intended for installations when frequency inverters are supplied between phase and neutral or phase and earthed middle conductor and are able to provide protection in case of alternating residual sinusoidal at the rated frequency, pulsating direct residual currents and composite residual currents that may occur.

Type B RCCBs and Type B RCBOs are able to provide protection in case of alternating residual sinusoidal currents up to 1 000 Hz, pulsating direct residual currents and smooth direct residual currents.

[C] Type F and type B RCDs have high resistance against unwanted tripping even if the surge voltage causes a flashover and a follow-on current occurs and in case of inrush residual currents with a maximum duration of 10 ms which can occur in case of switching ON electronic equipment or EMC-filters.[C]

RCDs according to this standard are not intended to be used in d.c. supply systems.

Further requirements and tests for products to be used in situations where the residual current was not intended to be covered in [C]EN[C] 61008-1 or [C]EN[C] 61009-1 are under consideration.

The complete test sequence for type test of Type F RCCBs and Type F RCBOs is given in Tables A.1 and B.1 respectively. The complete test sequence for type test of Type B RCCBs and Type B RCBOs is given in Tables C.1 or D.1 respectively.

NOTE 1 Throughout the document, the term RCD refers to RCCBs and RCBOs.

NOTE 2 [C]*Deleted*[C]

[AC1] NOTE 3 Type F and type B RCDs have high resistance against unwanted tripping, even if the surge voltage voltage causes a flashover and a follow-on current occurs, and in case of inrush residual currents with a maximum duration of 10 ms which can occur in case of switching ON electronic equipment or EMC-filters. [AC1]

2 Normative references

[C] Normative references to international publications are listed in Annex ZA [C]

3 Terms and definitions

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

3.1
smooth direct current
a direct current which is ripple free

3.2
Type B residual current device
residual current device for which tripping is ensured as for Type F according to this standard and in addition:

– for residual sinusoidal alternating currents up to 1 000 Hz,
– for residual alternating currents superimposed on a smooth direct current
– for residual pulsating direct currents superimposed on a smooth direct current
– for residual pulsating rectified direct current which results from two or more phases
– for residual smooth direct currents whether suddenly applied or slowly increased independent of polarity

3.3
Type F residual current device
residual current device for which tripping is ensured as for Type A according to IEC 61008-1 or IEC 61009-1, as applicable, and in addition:

– for composite residual currents, whether suddenly applied or slowly rising intended for circuit supplied between phase and neutral or phase and earthed middle conductor
– for residual pulsating direct currents superimposed on smooth direct current

4 Classification

According to IEC 61008-1 or IEC 61009-1, as applicable with the following addition:

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

– Type F RCDs
– Type B RCDs

5 Characteristics

5.1 Type F residual current device

Residual current device for which tripping is ensured as for Type A according to IEC 61008-1 or IEC 61009-1, as applicable, and in addition,

– for composite residual currents, whether suddenly applied or slowly rising intended for circuit supplied between phase and neutral or phase and earthed middle conductor (see 8.1);

– and for residual pulsating direct currents superimposed on smooth direct current of 0,01 A (see 8.3.3).

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

5.2 Type B residual current device

5.2.1 General

Residual current device for which tripping is ensured as for Type F and in addition

− for residual sinusoidal alternating currents up to 1 000 Hz (see 8.2.1.1),

− for residual alternating currents superimposed on a smooth direct current of 0,4 times the rated residual current ($I_{\Delta n}$) (see 8.2.1.2),

− for residual pulsating direct currents superimposed on a smooth direct current of 0,4 times the rated residual current ($I_{\Delta n}$) or 10 mA, whichever is the highest value (see 8.2.1.3),

− for residual direct currents which may result from rectifying circuits, i.e.,

  – two-pulse bridge connection line to line for 2-, 3- and 4-pole devices (see 8.2.1.4),

  – three-pulse star connection or six-pulse bridge connection for 3- and 4-pole devices (see 8.2.1.5),

− for residual smooth direct currents (see 8.2.1.6).

  NOTE In NL, this characteristic is modified.

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

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

Table 1 – Type B RCDs – Standard values of break time and non-actuating time for residual direct currents which result from rectifying circuits and for residual smooth direct current

Type	I_n A	$I_{\Delta n}$ A	Standard values of break time and non-actuating time at a residual operating current (I_Δ) equal to s				
			2 $I_{\Delta n}$	4 $I_{\Delta n}$	10 $I_{\Delta n}$	5 A,10 A, 20 A, 50 A, 100 A, 200 A [a]	
General	Any value	Any value	0,3	0,15	0,04	0,04	Maximum break times
S	≥ 25	> 0,030	0,5	0,2	0,15	0,15	Maximum break times
			0,13	0,06	0,05	0,04	Minimum non-actuating times

For Type B RCBOs any value exceeding the lower limit of the overcurrent instantaneous tripping range are not tested.
[a] The tests are only made during the verification of the correct operation as mentioned in 9.2.1.5 b) according to Figure 6a, and 9.2.1.6 b) according to Figure 6b.

5.2.3 Values of tripping current according to frequencies which differ from the rated frequency 50 Hz

Table 2 – Type B RCDs – Residual non-operating and operating current according to frequencies which differ from the rated frequency 50 Hz

Frequency Hz	Residual non-operating current $I_{\Delta n}$	Residual operating current $I_{\Delta n}$
150	0,5 $I_{\Delta n}$	2,4 $I_{\Delta n}$ [a]
400	0,5 $I_{\Delta n}$	6 $I_{\Delta n}$ [a]
1 000	$I_{\Delta n}$	14 $I_{\Delta n}$ [a b]

NOTE 1 The definitions of “residual non-operating current and of “operating currents” are those of IEC 61008-1 and IEC 61009-1.

NOTE 2 The waveform for the given frequencies is sinusoidal.

NOTE 3 The maximum permissible earthing impedance at a frequency f_x depends on the upper limit of the operating currents of the RCD at that frequency.

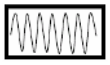
NOTE 4 The relationship between the frequency of the acceptable touch voltages and the dissipated power in the human body are under consideration. Until final values are fixed the maximum allowed touch voltage of 50 V for 50 Hz is recommended.

[a] The values correspond to the threshold of ventricular fibrillation according to IEC/TS 60479-1 in combination with the frequency factor for ventricular fibrillation according to IEC/TS 60479-2.

[b] IEC 60479 series gives no factors for frequencies above 1 kHz.

6 Marking and other product information

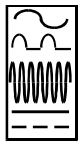
6.1 Marking for Type F RCDs

Add the following symbol  adjacent to the symbol for Type A, e.g.  

Alternatively the following symbol may be used 

6.2 Marking for Type B RCDs

Add the following symbol  adjacent to the symbol for Type F, e.g.: 

Alternatively the following symbol may be used: 

NOTE Where a 4-pole RCBO is used for single phase supply the device should be connected and installed according to the manufacturer’s instructions.

7 Standard conditions for operation in service and for installation

According to IEC 61008-1 or IEC 61009-1, as applicable.

8 Conditions for construction and operation

8.1 Conditions for Type F and Type B RCDs – Requirements for operation in case of sinusoidal residual currents comprising of multi-frequency components resulting from control equipment supplied from single phase

a) Type F and Type B RCDs shall operate in response to a steady increase of residual current within the limits given in Table 4.

Compliance is checked by the tests of 9.1.2.

b) Type F and Type B RCDs shall operate in response to a sudden appearance of the residual operating current.

For residual currents greater than 5 times the upper limit of Table 4 the maximum break time of RCDs of the general type shall be 0,04 s, and, for RCDs Type S, the minimum non-actuating time shall be equal to or greater than 0,05 s and the maximum break time shall not exceed 0,15 s.

Compliance is checked by the tests of 9.1.3.

8.2 Conditions for Type B RCDs

8.2.1 Operation in response to the type of residual current

8.2.1.1 Residual sinusoidal alternating currents up to 1 000 Hz

Type B RCDs shall comply with the values given in Table 2 of this standard.

Compliance is checked by the tests of 9.2.1.2a).

Type B RCDs shall operate in response to a sudden appearance of the residual operating current given in Table 2. The maximum break time of RCDs of the general type shall be 0,3 s, and for RCDs type S the minimum non-actuating time shall be equal to or not lower than 0,13 s and the maximum break time shall not exceed 0,5 s.

Compliance is checked by the tests of 9.2.1.2b).

8.2.1.2 Residual alternating current superimposed on a residual smooth direct current

Type B RCDs shall operate in case of residual alternating currents of the rated frequency superimposed on a residual smooth direct current of 0,4 times the rated residual current ($I_{\Delta n}$) or 10 mA whichever is the highest value.

The alternating tripping current shall be equal or lower than $I_{\Delta n}$.

Compliance is checked by the tests of 9.2.1.3.

8.2.1.3 Residual pulsating direct current superimposed on a smooth direct current

Type B RCDs shall operate in case of residual pulsating direct currents superimposed on a residual smooth direct current of 0,4 times the rated residual current ($I_{\Delta n}$) or 10 mA, whichever is the highest value.

The tripping current shall not be higher than 1,4 $I_{\Delta n}$ for RCDs with $I_{\Delta n} > 0{,}01$ A, or 2 $I_{\Delta n}$ for RCD with $I_{\Delta n} \leq 0{,}01$ A.

NOTE The tripping current 1,4 $I_{\Delta n}$ or 2 $I_{\Delta n}$, as applicable, is the r.m.s. value due to the half-wave pulsating direct current.

Compliance is checked by the tests of 9.2.1.4.

8.2.1.4 Residual pulsating direct currents which may result from rectifying circuits supplied from two phases

Type B RCDs shall operate in response to a steady increase of residual pulsating direct current resulting from rectifying circuits within the limits of 0,5 $I_{\Delta n}$ to 2 $I_{\Delta n}$.

Compliance is checked by the tests of 9.2.1.5a).

Type B RCDs shall operate in response to a sudden appearance of residual pulsating direct current resulting from rectifying circuits according to the limits specified in Table 1.

Compliance is checked by the tests of 9.2.1.5b).

8.2.1.5 Residual pulsating direct currents which may result from rectifying circuits supplied from three phases

Type B RCDs shall operate in response to a steady increase of residual pulsating direct current resulting from rectifying circuits within the limits of 0,5 $I_{\Delta n}$ to 2 $I_{\Delta n}$.

Compliance is checked by the tests of 9.2.1.6a).

Type B RCDs shall operate in response to a sudden appearance of residual pulsating direct current resulting from rectifying circuits according to the limits specified in Table 1.

Compliance is checked by the tests of 9.2.1.6b).

8.2.1.6 Residual smooth direct current

Type B RCDs shall operate in response to a steady increase of smooth direct residual current within the limits of 0,5 $I_{\Delta n}$ to 2 $I_{\Delta n}$.

NOTE In NL this subclause is not applicable.

Compliance is checked by the tests of 9.2.1.7.1a) and 9.2.1.7.2.

Type B RCDs shall operate in response to a sudden appearance of smooth direct residual current according to the limits specified in Table 1 of this standard.

Compliance is checked by the tests of 9.2.1.7.1b).

8.2.1.7 Behaviour of the correct operation for three- and four- pole Type B RCDs powered on two poles only

Three- and four-pole RCDs shall be able to operate if they are powered on only two poles.

Compliance is checked by the tests of 9.2.3 for Type B RCDs.

8.3 Behaviour of Type F and Type B RCDs

8.3.1 Behaviour of RCDs in the case of surge residual currents

RCDs shall show adequate resistance against unwanted tripping in case of current surges to earth due to the loading of the capacitances of the installation and the current surges to earth due to flashover in the installation.

Compliance is checked by the tests of 9.1.5.

8.3.2 Behaviour of RCDs in the case of inrush residual currents

RCDs shall adequately withstand inrush residual currents with a maximum duration of 10 ms which can occur in case of switching on electronic equipment or EMC-filters.

Compliance is checked by the tests of 9.1.6.

8.3.3 Behaviour in case of residual pulsating direct currents in presence of a standing smooth direct current of 0,01 A

RCDs shall operate in case of residual pulsating direct currents superimposed on a residual smooth direct current of 0,01 A.

Compliance is checked by the tests of 9.1.7 for Type F.

Compliance is checked by the tests of 9.2.1.3 for Type B.

9 Tests

9.1 Tests for Type F and Type B RCDs

9.1.1 General

All tests shall be carried out with the RCD supplied at U_n, with the rated frequency and without load.

Unless otherwise specified tests are made according to Figure 1.

9.1.2 Verification of the correct operation in case of a steady increase of composite residual current

Table 3 provides frequency component values for calibration purposes as well as the starting current values to verify the RCD operation in case of a steady increased residual current.

Table 4 provides the limit operating values of the composite residual current.

The test frequency has a tolerance of ± 2 %.

Table 3 – Different frequency component values of test currents and starting current values (I_Δ) for verifying the operating in case of steady increased residual current

Different frequency component values of test currents for calibration (RMS)			Composite starting current value (RMS)
I at rated frequency	I 1 kHz	I F motor (10 Hz)	I_Δ
0,138 $I_{\Delta n}$	0,138 $I_{\Delta n}$	0,035 $I_{\Delta n}$	0,2 $I_{\Delta n}$
NOTE 1 $I_{\Delta n}$ corresponds to the rated residual operating current of the device at the rated frequency. NOTE 2 For the test purposes the values of 10 Hz and 1 kHz have been used for the output and clock frequency respectively representing the most severe condition.			

To verify the operation of the RCD in the presence of composite currents, the starting composite residual current value given in Table 3 shall be increased at a linear rate. The RCD shall trip within the limits of Table 4.

In any case the ratios of the different frequencies shall be maintained from the initial value up to the operating value.

Table 4 – Operating current ranges for composite residual current

Operating current (RMS)	
Lower limit	**Upper limit**
0,5 $I_{\Delta n}$	1,4 $I_{\Delta n}$
NOTE 1 $I_{\Delta n}$ corresponds to the rated residual operating current of the device at the rated frequency. NOTE 2 Operating currents are composed of the ratio of frequency components given in Table 3.	

The test switches S_1 and S_2 and the RCD being in the closed position, the residual current is steadily increased, starting from a value not higher than the starting composite value given in Table 3 trying to attain the upper limit of residual operating current given in Table 4 within 30 s.

The test is repeated three times through one pole chosen at random. Operating values shall be within the limits of Table 4.

9.1.3 Verification of the correct operation in case of sudden appearance of composite residual current

Tests are carried out to verify the break time of the RCD, the test current being calibrated at 5 times the upper limit value given in Table 4.

The test switch S1 and the RCD being in the closed position, the residual current is suddenly established by closing the test switch S2.

Three measurements of the break time are made.

For general type RCDs, the break times shall be less than 0,04 s.

For RCDs Type S the break time shall be less than 0,15 s.

RCDs Type S shall be tested additionally with the test current which is suddenly established by closing the test switch S_2 for the minimum non-actuating time of 0,05 s, with a tolerance of $^{0}_{-5}$ %.

Each of the three applications of residual current shall be separated from the previous one by an interval of at least 1 min.

The RCD shall not trip during any of the tests.

9.1.4 Verification of the correct operation for four-pole Type F RCD powered on two poles only

Tests shall be performed with a four-pole RCD according to 9.1.2, but the RCD is only supplied between the neutral terminal and one-phase terminal chosen at random with rated frequency and without load.

9.1.5 Verification of behaviour at surge currents up to 3 000 A (8/20 µs surge current test)

9.1.5.1 Test conditions

The test conditions are given in IEC 61008-1 Subclause 9.19.2.1 or IEC 61009-1 Subclause 9.19.2.1, as applicable.

9.1.5.2 Test results

During the tests the RCD shall not trip.

After the surge current tests the correct operation of RCCBs is verified by a test according to IEC 61008-1 Subclause 9.9.2.3 or for RCBOs according to IEC 61009-1 Subclause 9.9.1.2.c), at $I_{\Delta n}$ only, with the measurement of the break time.

9.1.6 Verification of behaviour in the case of inrush residual currents

The test is carried out with a circuit according to Figure 2, all switches and the RCD being in closed position.

The generator (G) is able to produce a single sinusoidal half-wave pulse 50 Hz or 60Hz ($^{+0}_{-1}$ ms).

A pulse with a peak current of 10 times $I_{\Delta n}$ is established on one pole chosen at random. Six measurements are made 3 times in positive and 3 times in negative polarity. The polarity is changed after each test. The time between two pulses shall be 30 s.

During the tests the RCD shall not trip.

9.1.7 Verification of the correct operation in case of residual pulsating direct currents in presence of a standing smooth direct current of 0,01 A

The RCD is tested according to 9.21.1.4 of IEC 61008-1 or 9.21.1.4 of IEC 61009-1 but the smooth direct current of 0,006 A is replaced by 0,01 A.

NOTE For Type B this test is replaced by the test of 9.2.1.4.

9.2 Tests for Type B RCDs

9.2.1 Verification of the operating characteristic at the reference temperature (20 ± 5) °C

9.2.1.1 General

The RCD is installed as for normal use.

All tests shall be carried out with the RCD supplied first at 0,85 U_n and then at 1,1 U_n with rated frequency and unless otherwise specified, without load.

[C]*Text deleted*[C]

9.2.1.2 Verification of the correct operation in case of residual sinusoidal alternating currents up to 1 000 Hz

The test shall be performed according to Figure 3.

a) The test switches S_1 and S_2 and the RCD being in the closed position the residual current is steadily increased, starting from a value not higher than 0,2 $I_{\Delta n}$, trying to attain the value of residual operating current given in Table 2 within 30 s, the tripping current being measured.

[AC1]*The test is carried out on one pole taken at random at each frequency given in Table 2 and repeated twice; the tripping values shall be in compliance with Table 2.*[AC1]

[C] *b) The maximum break time shall not exceed 0,3 s for general type RCDs and for S-type RCDs and for S-type RCDs the maximum break time shall not exceed 0,5 s.*[C]

9.2.1.3 Verification of the correct operation in the case of a residual alternating current superimposed on a residual smooth direct current

The test shall be performed according to Figure 4.

The test switches S_1 and S_2 and the RCD being in the closed position, the residual smooth direct current is applied through one pole chosen at random and is adjusted to 0,4 $I_{\Delta n}$ or 10 mA, whichever is the highest value.

[AC1] NOTE In the particular case of a $I_{\Delta n}$ 10 mA type B RCD, the value of 5 mA smooth DC is used [AC1]

The residual alternating current of the rated frequency is applied to another pole and is steadily increased, starting from a value not higher than 0,2 $I_{\Delta n}$, trying to attain the value of $I_{\Delta n}$ within 30 s, the tripping current being measured.

The test is made twice at each position I and II of S_3.

The alternating tripping current shall be equal or lower than $I_{\Delta n}$.

9.2.1.4 Verification of the correct operation in the case of a residual pulsating direct current superimposed on a residual smooth direct current

The test shall be performed according to Figure 5.

The test switches S_1 and S_2 and the RCD being in the closed position, the residual smooth direct current is applied through one pole chosen at random and is adjusted to 0,4 $I_{\Delta n}$ or 10 mA, whichever is the highest value.

The residual pulsating direct current is applied to another pole chosen at random with a current delay angle α of 0° and is steadily increased, starting from a value not higher than 0,2 $I_{\Delta n}$, trying to attain the value of 1,4 $I_{\Delta n}$ for RCDs with $I_{\Delta n} > 0,01$ A, or 2 $I_{\Delta n}$ for RCDs with $I_{\Delta n} \leq 0,01$ A within 30 s, the tripping current being measured.

The RCD is tested, twice at each positions I and II of S_3 and S_4.

The RCD shall trip before the residual pulsating direct current reaches a value not exceeding 1,4 $I_{\Delta n}$ for RCDs with $I_{\Delta n} > 0,01$ A, or 2 $I_{\Delta n}$ for RCDs with $I_{\Delta n} \leq 0,01$ A.

9.2.1.5 Verification of the correct operation in case of residual direct currents which may result from rectifying circuits supplied from two phases

a) *The test shall be performed according to Figure 6a.*

   The test switches S_1 and S_2 and the RCD being in the closed position, the residual pulsating direct current is steadily increased, starting from a value not higher than 0,2 $I_{\Delta n}$, trying to attain the value of 2 $I_{\Delta n}$ within 30 s, the tripping current being measured.

   The test circuit is connected to the RCD at two-line terminals chosen at random.

   [AC1] *The RCD is tested twice at each positions I and II of S_3.* [AC1]

   The RCD shall trip within the limits of 0,5 $I_{\Delta n}$ to 2 $I_{\Delta n}$.

b) *A second series of tests is made to verify the break time.*

   The test circuit being successively calibrated at each current value given in Table 1, the test switch S_1 and the RCD being in the closed position, the residual current is suddenly established by closing the test switch S_2.

[AC1] *With the RCD connected at two-line terminals chosen at random, two measurements of the break time are made at any three values of residual current given in Table1 taken at random at each position I and II of S_3.* [AC1]

The break times shall be in compliance with the values given in Table 1.

9.2.1.6 Verification of the correct operation in case of residual direct currents which may result from rectifying circuits supplied from three phases

This test does not apply to 2-pole Type B RCDs.

a) The test shall be performed according to Figure 6b.

The test switches S_1 and S_2 and the RCD being in the closed position, the residual pulsating direct current is steadily increased, starting from a value not higher than 0,2 $I_{\Delta n}$, trying to attain the value of 2 $I_{\Delta n}$ within 30 s, the tripping current being measured.

[AC1] *The RCD is tested twice at each positions I and II of S_3.* [AC1]

The RCD shall trip within the limits of 0,5 $I_{\Delta n}$ to 2 $I_{\Delta n}$.

b) A second series of tests is made to verify the break time.

The test circuit being successively calibrated at each current value given in Table 1, the test switch S_1 and the RCD being in the closed position, the residual current is suddenly established by closing the test switch S_2.

[AC1] *Twe measurements of the break time are made at 2 $I_{\Delta n}$ and any other two randomly chosen values of residual current given in Table 1 at each position I and II of S_3.* [AC1]

The break times shall be in compliance with the values given in Table 1 of this standard.

9.2.1.7 Verification of the correct operation in case of residual smooth direct current

9.2.1.7.1 Verification of the correct operation in case of residual smooth direct current without load

The test shall be performed according to Figure 7.

[C] NOTE The open circuit voltage of the DC source should be high enough to guarantee stable smoth d.c. current (e.g. more than 24 V) [C]

a) The test switches S_1 and S_2 and the RCD being in the closed position, the residual smooth direct current is steadily increased, starting from a value not higher than 0,2 $I_{\Delta n}$, trying to attain the value of 2 $I_{\Delta n}$ within 30 s, the tripping current being measured.

One pole of the RCD, chosen at random and exemplified in Figure 7, is tested twice at each position I and II of S_3.

The RCD shall trip within the limits of 0,5 $I_{\Delta n}$ to 2 $I_{\Delta n}$.

b) A second series of tests is made to verify the break time.

The test circuit being successively calibrated at each residual operating current value given in Table 1 (except 5 A, 10 A, 20 A, 50 A, 100 A and 200 A), the test switch S_1 and the RCD being in the closed position, the residual current is suddenly established by closing the test switch S_2. The test switch S_3 is in position I or II chosen at random.

Two measurements of the break time are made at one pole chosen at random at each residual operating current.

The break times shall be in compliance with the values given in Table 1 of this standard.

9.2.1.7.2 Verification of the correct operation in case of residual smooth direct current with load

The test of 9.2.1.7.1 a) is repeated, the RCD being loaded with the rated current as in normal service for a sufficient time so as to reach thermal steady-state conditions.

NOTE The loading with rated current is not shown in Figure 5.

9.2.2 Tests at the temperature limits

The RCD shall perform the tests specified in 9.2.1.5 b), 9.2.1.6 b) and 9.2.1.7.1 b) under the following conditions, successively:

a) ambient temperature: –5 °C, off-load;

b) ambient temperature: +40 °C, the RCD having been previously loaded with the rated current, at any convenient voltage, until it attains thermal steady-state conditions.

In practice these conditions are reached when the variation of temperature-rise does not exceed 1 K per hour.

〖C〗*Text deleted*〖C〗

NOTE Preheating may be made at reduced voltage but auxiliary circuits should be connected to their normal operating voltage (particularly for components depending on the line voltage).

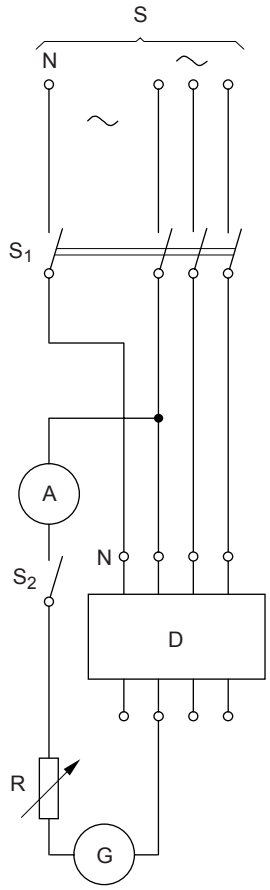
9.2.3 Verification of the correct operation for three- and four-pole Type B RCDs powered on two poles only

Tests shall be performed according to 9.2.1.2 and 9.2.1.7.1, but the RCD is only supplied between the neutral terminal and one-phase terminal chosen at random for four-pole devices or between 2-phase terminals chosen at random for 3-pole devices with rated frequency and without load.

9.2.4 Verification of the RCD after test sequences

The RCD shall trip with a test current of 2,5 $I_{\Delta n}$ with smooth direct current.

One test only is made without measurement of break time.



S supply

S_1 all-pole switch (optional)

S_2 single-pole switch

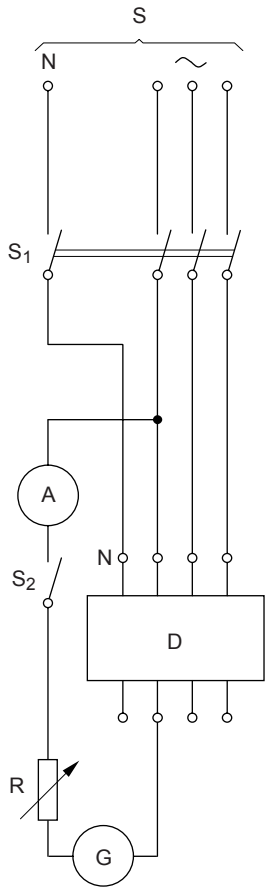
D RCD under test

R e.g. 10 Ω (any suitable value)

G arbitrary waveform generator (combination of 10 Hz, 50 Hz and 1 kHz)

A amperemeter

Figure 1 – Example of a test circuit for the verification of correct operation in case of residual sinusoidal alternating currents composed of multi-frequency components resulting from single-phase supplied speed motor control equipment



S supply

S_1 all-pole switch

S_2 single-pole switch

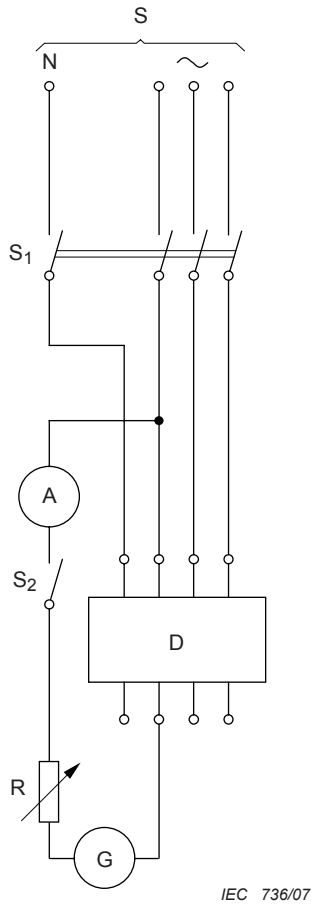
D RCD under test

R e.g. 10 Ω (any suitable value)

G single half-wave pulse generator (50 Hz [C]*Text deleted*[C])

A amperemeter

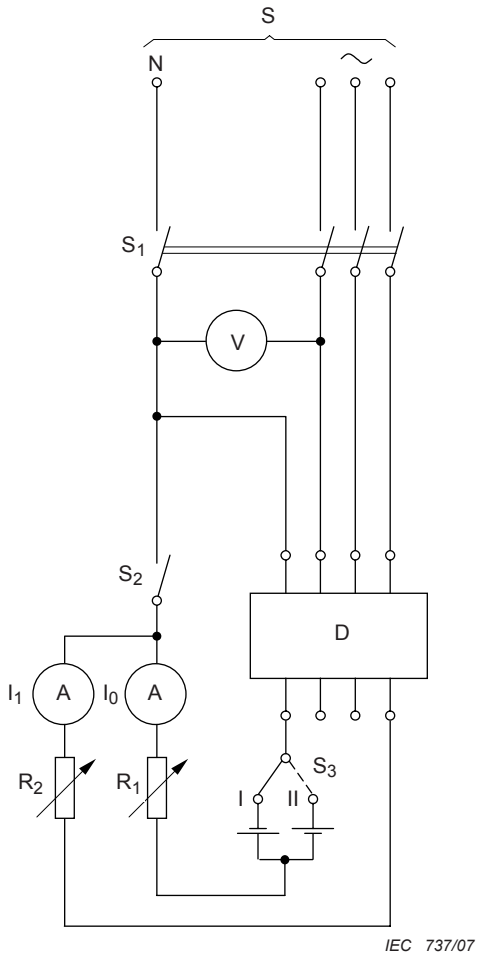
Figure 2 – Test circuit for the verification of the behaviour of the RCD in case of inrush residual currents



Components

S	supply
A	ammeter (measuring r.m.s. values)
S_1	all-pole switch
S_2	single-pole switch
D	RCD under test
R	variable resistor
G	generator

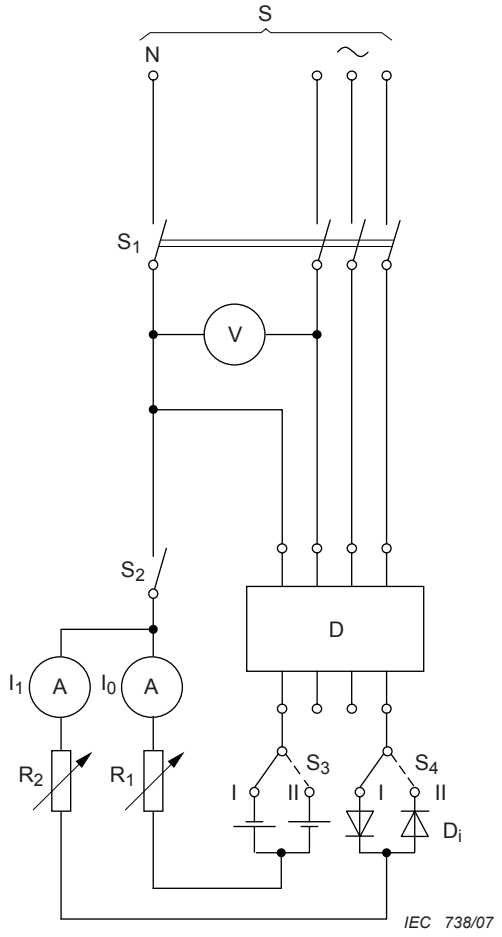
Figure 3 – Test circuit for the verification of correct operation in case of residual sinusoidal alternating current up to 1 000 Hz



Components

S	supply
V	voltmeter
A	ammeter (measuring r.m.s. values)
D	RCD under test
R_1, R_2	variable resistor
S_1	multipole switch
S_2	single-pole switch
S_3	two-way switch

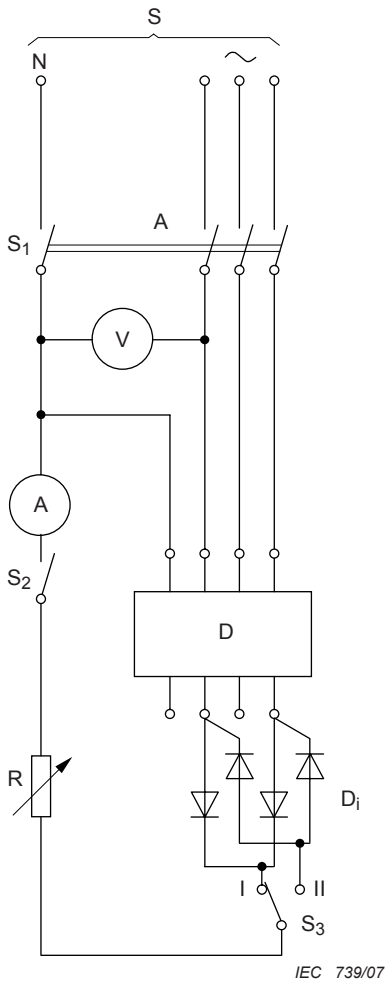
Figure 4 – Test circuit for 2-, 3- and 4-pole Type B RCD to verify the correct operation in case of a residual alternating current superimposed on a smooth direct current



Components

S	supply
V	voltmeter
A	ammeter (measuring r.m.s. values)
D	RCD under test
D_i	diodes
R_1, R_2	variable resistor
S_1	multipole switch
S_2	single-pole switch
S_3 and S_4	two-way switch

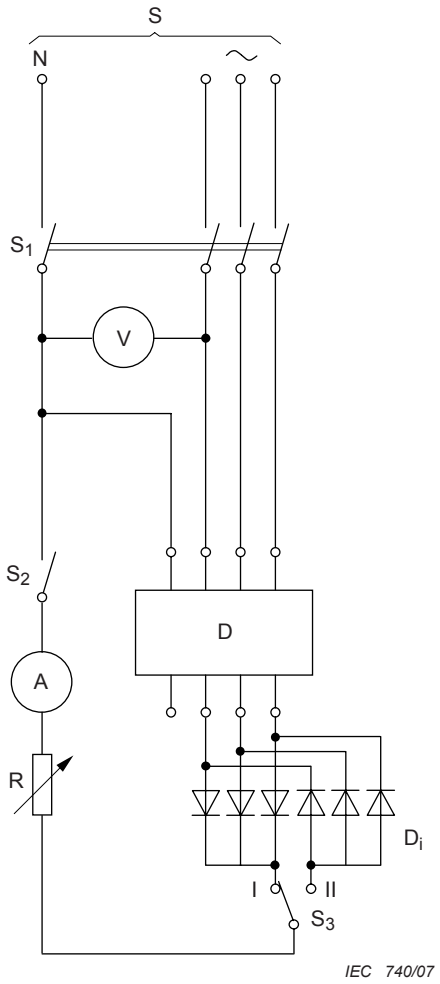
Figure 5 – Test circuit for 2-, 3- and 4-pole Type B RCD to verify the correct operation in case of a residual pulsating direct current superimposed on a smooth direct current



Components

Point A	supply by 2 phases chosen at random
S	supply
V	voltmeter
A	ammeter (measuring r.m.s. values)
D	RCD under test
D_i	diodes
R	variable resistor
S_1	multipole switch
S_2	single-pole switch
S_3	two-way switch

Figure 6a – Test circuit for 2-, 3- and 4-pole Type B to verify the correct operation in case of residual pulsating direct currents which may result from rectifying circuits supplied from two phases

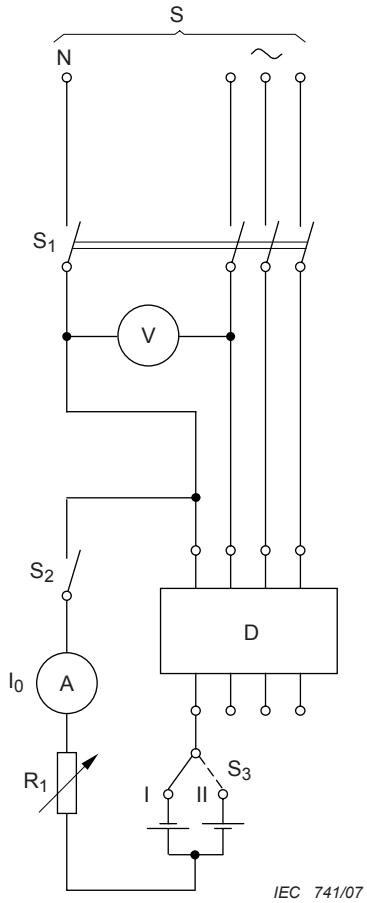


Components

S	supply
V	voltmeter
A	ammeter (measuring r.m.s. values)
D	RCD under test
D_i	diodes
R	variable resistor
S_1	multipole switch
S_2	single-pole switch
S_3	two-way switch

Figure 6b – Test circuit for 3- and 4-pole Type B RCD to verify the correct operation in case of residual pulsating direct currents which may result from rectifying circuits supplied from three phases

Figure 6 – Test circuit for Type B RCD to verify the correct operation in case of residual pulsating direct currents which may result from rectifying circuits



Components

S	supply
V	voltmeter
A	ammeter (measuring r.m.s. values)
D	RCD under test
R_1	variable resistor
S_1	multipole switch
S_2	single-pole switch
S_3	two-way switch

Figure 7 – Test circuit for 2-, 3- and 4-pole Type B RCD to verify the correct operation in case of a residual smooth direct current

Annex A
(normative)

Number of samples to be submitted and test sequences to be applied for verification of conformity for type F RCCBs

〈C〉 Verification of conformity may be made

– by the manufacturer for the purpose of suppliers declaration (13.5.1 of ISO/IEC Guide 2);

– by an independent body for certification (13.5.2 of ISO/IEC Guide 2).

According to the terminology of ISO/IEC Guide 2 the term "certification" can be used for the second case only.

The tests are made according to Table A.1 below, where the tests in each sequence are carried out in the order indicated.

The sampling procedure is given in A.2 and A.3 of EN 61008-1:2012.〈C〉

Table A.1 – Test sequences for Type F RCCBs

Test sequence		Tests according to 〈C〉EN 61008-1 and EN 61008-2-1〈C〉	Additional tests according to this standard	Test (or Inspection)
A		6	6	Marking
		8.1.1	No	General
		8.1.2	No	Mechanism
		9.3	No	Indelibility of marking
		8.1.3	No	Clearance and creepage distances (external parts only)
		9.15	No	Trip-free mechanism
		9.4	No	Reliability of screws, current-carrying parts and connections
		9.5	No	Reliability of terminals for external conductors
		9.6	No	Protection against electric shock
		9.13.1	No	Resistance to heat
		9.13.2 9.13.3	No	
		8.1.3	No	Clearances and creepage distances (internal parts)
		9.14	No	Resistance to abnormal heat and to fire
B		9.7	No	Test of dielectric properties
		9.8	No	Temperature rise
		9.20	No	Resistance of insulation against impulse voltages
		9.22.2	No	Reliability at 40 °C
		9.23	No	Ageing of electronic components
C		9.10	No	Mechanical and electrical endurance
D		9.9		Residual operating characteristics
	D_0		9.1.2	Verification of the correct operation in case of a steady increase of composite residual current
			9.1.3	Verification of the correct operation in case of sudden appearance of composite residual current
	D_1	9.19	9.1.5	Unwanted tripping Behaviour in the case of surge currents

		……	9.1.6	Behaviour in the case of inrush residual currents
			9.1.4	Correct operation for RCD powered on two poles only
		9.21	9.1.7	Type A residual current devices
		9.11.2.3 [C] a) and b) [C]	No	Performance at $I_{\Delta m}$
		9.16	No	Test device
		9.12	No	Resistance to mechanical shock and impact
		9.18	No	Non-operating current under overcurrent conditions
	[C] D_2	9.11.2.3 c)	No	Verification of the suitability in IT system [C]
	E	9.11.2.4 a)	No	Coordination at I_{nc}
		9.11.2.2	No	Performance at I_m
	F	9.11.2.4 b)	No	Coordination at I_m
		9.11.2.4 c)	No	Coordination at $I_{\Delta c}$
	G_0	9.22.1	No	Reliability (climatic tests)
[C]	G_1	9.Z1	No	Verification of correct operation at low ambient air temperature of RCCBs for use in the range of .-25 °C to +40 °C
	H[a]	EN 61543:1995, Table 4 -T1.1 EN 61543:1995, Table 4 -T1.2 EN 61543:1995, Table 5 -T2.3	No	Harmonics, interharmonics Signalling voltage Conducted unidirectional transients of the ms and μs time scale
	I	EN 61543:1995, Table 5 -T2.1 EN 61543:1995, Table 5 -T2.5 EN 61543:1995, Table 5 -T2.2	No	Conducted oscillatory voltages or currents Radiated high-frequency phenomena Conducted unidirectional transients of the ns time scale (burst)
	J	EN 61543:1995, Table 5 -T2.6 EN 61543:1995, Table 6 -T3.1	No	Conducted common mode disturbances in the frequency range lower than 150 kHz Electrostatic discharges [C]

[a] For devices containing a continuously operating oscillator, the test of CISPR 14-1 shall be carried out on the samples prior to the tests of this sequence.

Annex B
(normative)

Number of samples to be submitted and test sequences to be applied for verification of conformity for Type F RCBOs

〈C〉 Verification of conformity may be made

– by the manufacturer for the purpose of suppliers declaration (13.5.1 of ISO/IEC Guide 2);

– by an independent body for certification (13.5.2 of ISO/IEC Guide 2).

According to the terminology of ISO/IEC Guide 2 the term "certification" can be used for the second case only.

The tests are made according to Table B.1 below, where the tests in each sequence are carried out in the order indicated.

The sampling procedure is given in A.2 and A.3 of EN 61009-1:2012. 〈C〉

Table B.1 – Test sequences for Type F RCBOs

Test sequence		Tests according to EN 61009-1 〈C〉 and EN 61009-2-1 〈C〉	Additional tests according to this standard	Test (or Inspection)
A		6	6	Marking
		8.1.1	No	General
		8.1.2	No	Mechanism
		9.3	No	Indelibility of marking
		8.1.3	No	Clearance and creepage distances (external parts only)
		8.1.6	No	Non-interchangeability
		9.11	No	Trip-free mechanism
		9.4	No	Reliability of screws, current-carrying parts and connections
		9.5	No	Reliability of terminals for external conductors
		9.6	No	Protection against electric shock
		9.14.1	No	Resistance to heat
		9.14.2 9.14.3	No	
		8.1.3	No	Clearances and creepage distances (internal parts)
		9.15	No	Resistance to abnormal heat and to fire
B		9.7	No	Dielectric properties
		9.8	No	Temperature rise
		9.20	No	Resistance of insulation against impulse voltages
		9.22.2	No	Reliability at 40 °C
		9.23	No	Ageing of electronic components
〈C〉 C		9.10	No	Mechanical and electrical endurance
	C_1	9.12.11.2.1 (and 9.12.12)	No	Performance at reduced short-circuit currents (Verification of the RCBO after the short-circuit tests)
	C_2	9.12.11.2.2 (and 9.12.12)	No	Short-circuit test for verifying the suitability of RCBOs for use in IT systems (Verification of the RCBO after the short-circuit tests) 〈C〉
D	D_0	9.9.1		Operating characteristics under residual current conditions

			9.1.2	Verification of the correct operation in case of a steady increase of composite residual current
			9.1.3	Verification of the correct operation in case of sudden appearance of composite residual current
	D_1	9.19	9.1.5	Unwanted tripping Behaviour in the case of surge currents.
		…	9.1.6	Behaviour in the case of inrush residual currents
			9.1.4	Correct operation for RCD powered on two poles only
		9.21.1	9.1.7	Type A residual current devices
		9.16	No	Test device
E	E_0	9.9.2	No	Overcurrent operating characteristics
		9.18	No	
	E_1	9.13	No	Resistance to mechanical shock and impact
		9.12.11.3 (and 9.12.12)	No	Short-circuit performance at 1 500 A
F	F_0	9.12.11.4 b) (and 9.12.12)	No	Performance at service short-circuit capacity
	F_1	9.12.11.4 c) (and 9.12.12.2)	No	Performance at rated short-circuit capacity
	F_2	9.12.11.4 d) (and 9.12.12.2)	No	Performance at $I_{\Delta m}$ (Verification of RCBO after short-circuit test)
G	G_0	9.22.1	No	Reliability (climatic tests)
	G1	9.Z1	No	Verification of correct operation at low ambient air temperature of RCBOs for use in the range of .-25 °C to +40 °C
H[a]		IEC 61543:1995, Table 4 - T1.1 IEC 61543:1995, Table 4 - T1.2 IEC 61543:1995, Table 5 - T2.3	No	Harmonics, interharmonics Signalling voltage Conducted unidirectional transients of the ms and μs time scale
I		IEC 61543:1995, Table 5 - T2.1 IEC 61543:1995, Table 5 - T2.5 IEC 61543:1995, Table 5 - T2.2	No	Conducted sine-wave voltages or currents Radiated high-frequency phenomena Fast Conducted unidirectional transients of the ns time scale (burst)
J		IEC 61543:1995, Table 5 - T2.6 IEC 61543:1995, Table 6 - T3.1	No	Conducted common mode disturbances in the frequency range lower than 150 kHz Electrostatic discharges

a) For devices containing a continuously operating oscillator, the test of CISPR 14-1 shall be carried out on the samples prior to the tests of this sequence.

Annex C
(normative)

Number of samples to be submitted and test sequences to be applied for verification of conformity for Type B RCCBs

〖C〗 Verification of conformity may be made

– by the manufacturer for the purpose of suppliers declaration (13.5.1 of ISO/IEC Guide 2);

– by an independent body for certification (13.5.2 of ISO/IEC Guide 2).

According to the terminology of ISO/IEC Guide 2 the term "certification" can be used for the second case only.

The tests are made according to Table C.1 below, where the tests in each sequence are carried out in the order indicated.

The sampling procedure is given in A.2 and A.3 of EN 61008-1:2012.〖C〗

Table C.1 – Test sequences for Type B RCCBs

Test sequence		Tests according to 〖C〗EN 61008-1 and EN 61008-2-1〖C〗	Additional tests according to this standard	Test (or inspection)	
A		6	6	Marking	
		8.1.1	No	General	
		8.1.2	No	Mechanism	
		9.3	No	Indelibility of marking	
		8.1.3	No	Clearance and creepage distances (external parts only)	
		9.15	No	Trip-free mechanism	
		9.4	No	Reliability of screws, current-carrying parts and connections	
		9.5	No	Reliability of terminals for external conductors	
		9.6	No	Protection against electric shock	
		9.13.1	9.2.4	Verification of the RCD after test sequence	Resistance to heat
		9.13.2 9.13.3	No		
		8.1.3	No	Clearances and creepage distances (internal parts)	
		9.14	No	Resistance to abnormal heat and to fire	
B		9.7	No	Test of dielectric properties	
		9.8	No	Temperature rise	
		9.20	No	Resistance of insulation against impulse voltages	
		9.22.2	No	Reliability at 40 °C	
		9.23	No	Ageing of electronic components	
		--	9.2.4	Verification of the RCD after test sequence	
C		9.10	No	Mechanical and electrical endurance	
		--	9.2.4	Verification of the RCD after test sequence	
D	D_0	9.9	No	Residual operating characteristics	
			9.1.2	Verification of the correct operation in case of a steady increase of composite residual current	
			9.1.3	Verification of the correct operation in case of sudden appearance of composite residual current	

			9.2.1.7.1	Verification of the correct operation in case of residual smooth direct current without load for ratings of $I_{\Delta n}$ not tested in D_1
	D_1	9.17	No	Behaviour in the case of failure of the line voltage
		9.19	9.1.5	Behaviour in the case of surge currents
			9.1.6	Behaviour in the case of inrush residual currents
			9.1.4	Correct operation for RCD powered on two poles only
			9.2.3	Correct operation for RCD powered on two poles only
		9.21.1 [a]	9.1.7	Type A residual current devices
			9.2.1	Type B residual current devices
			9.2.2	Tests at temperature limits
		9.11.2.3 a) and b)	No	Performance at $I_{\Delta m}$
		9.16	No	Test device
		9.12	No	Resistance to mechanical shock and impact
		9.18	No	Non-operating current under overcurrent conditions
		--	9.2.4	Verification of the RCD after test sequence
	D2	9.11.2.3 c)	No	Verification of the suitability in IT system
		--	9.2.4	Verification of the RCD after test sequence
	E	9.11.2.4 a)	No	Coordination at I_{nc}
		9.11.2.2	No	Performance at I_m
		--	9.2.4	Verification of the RCD after test sequence
	F	9.11.2.4 b)	No	Coordination at I_m
		9.11.2.4 c)	No	Coordination at $I_{\Delta c}$
		--	9.2.4	Verification of the RCD after test sequence
	G_0	9.22.1	No	Reliability (climatic tests)
		--	9.2.4	Verification of the RCD after test sequence
	G_1	9.Z1	No	Verification of correct operation at low ambient air temperature of RCCBs for use in the range of .-25 °C to +40 °C
			9.2.4	Verification of the RCD after test sequence
	H[b]	EN 61543:1995, Table 4 -T1.1 EN 61543:1995, Table 4 -T1.2 EN 61543:1995, Table 5 -T2.3	No	Harmonics, interharmonics Signalling voltage Conducted unidirectional transients of the ms and μs time scale
	I	EN 61543:1995, Table 5 -T2.1 EN 61543:1995,Table 5 -T2.5 EN 61543:1995, Table 5 -T2.2	No	Conducted oscillatory voltages or currents Radiated high-frequency phenomena Conducted unidirectional transients of the ns time scale (burst)
	J	EN 61543:1995, Table 5 -T2.6 EN 61543:1995, Table 6 –T3.1	No	Conducted common mode disturbances in the frequency range lower than 150 kHz Electrostatic discharges

[a] For devices having different residual current detection systems, for which the test according to 9.21.1 was made without supply voltage, an additional test according to 9.21.1.1 shall be made with a supply voltage of 1,1 U_n to verify that there is no interference between the different systems. Only the lower limits of the tripping currents are verified.

[b] For devices containing a continuously operating oscillator, the test of CISPR 14-1 shall be carried out on the samples prior to the tests of this sequence.

Annex D
(normative)

Number of samples to be submitted and test sequences to be applied for verification of conformity for Type B RCBOs

〖C〗 Verification of conformity may be made

– by the manufacturer for the purpose of suppliers declaration (13.5.1 of ISO/IEC Guide 2);

– by an independent body for certification (13.5.2 of ISO/IEC Guide 2).

According to the terminology of ISO/IEC Guide 2 the term "certification" can be used for the second case only.

The tests are made according to Table D.1 below, where the tests in each sequence are carried out in the order indicated.

The sampling procedure is given in A.2 to A.5 of EN 61009-1:2012.〖C〗

Table D.1 – Test sequences for Type B RCBOs

Test sequence		Tests according to 〖C〗EN 61009-1 and EN 61009-2-1〖C〗	Additional tests according to this standard	Test (or Inspection)	
A		6	6	Marking	
		8.1.1	No	General	
		8.1.2	No	Mechanism	
		9.3	No	Indelibility of marking	
		8.1.3	No	Clearance and creepage distances (external parts only)	
		8.1.6	No	Non-interchangeability	
		9.11	No	Trip-free mechanism	
		9.4	No	Reliability of screws, current-carrying parts and connections	
		9.5	No	Reliability of terminals for external conductors	
		9.6	No	Protection against electric shock	
		9.14.1	9.2.4	Verification of the RCD after test sequence	Resistance to heat
		9.14.2 9.14.3	No		
		8.1.3	No	Clearances and creepage distances (internal parts)	
		9.15	No	Resistance to abnormal heat and to fire	
B		9.7	No	Dielectric properties	
		9.8	No	Temperature rise	
		9.20	No	Resistance of insulation against impulse voltages	
		9.22.2	No	Reliability at 40 °C	
		9.23	No	Ageing of electronic components	
		--	9.2.4	Verification of the RCD after test sequence	
C	〖C〗 C_1 〖C〗	9.10	No	Mechanical and electrical endurance	
		--	9.2.4	Verification of the RCD after test sequence	
		〖C〗 9.12.11.2.1 〖C〗 (and 9.12.12)	No	Performance at reduced short-circuit currents 〖C〗 (Verification of the RCBO after the short-circuit tests) 〖C〗	

[C]		C_2	9.12.11.2.2 (and 9.12.12)	No	Short-circuit test for verifying the suitability of RCBOs for use in IT systems (Verification of the RCBO after the short-circuit tests) [C]
D		D_0	9.9.1	No	Operating characteristics under residual current conditions
				9.1.2	Verification of the correct operation in case of a steady increase of composite residual current
				9.1.3	Verification of the correct operation in case of sudden appearance of composite residual current
				9.2.1.7.1	Verification of the correct operation in case of residual smooth direct current without load for ratings of $I_{\Delta n}$ not tested in D_1
		D_1	9.17	No	Behaviour in the case of failure of the line voltage
			9.19	9.1.5	Behaviour in the case of surge currents
			[C]	9.1.6	Behaviour in the case of inrush residual currents
				9.1.4	Correct operation for RCD powered on two poles only [C]
				9.2.3	Correct operation for RCD powered on two poles only
			[C] 9.21[a] [C]	[C] 9.1.7 [C]	Type A residual current devices
				9.2.1	Type B residual current devices
				9.2.2	Tests at temperature limits
			9.16	No	Test device
			--	9.2.4	Verification of the RCD after test sequence
	E_0		9.9.2	No	Overcurrent operating characteristics
	E_1		9.13	No	Resistance to mechanical shock and impact
			9.12.11.3 (and 9.12.12)	No	Short-circuit performance at 1 500 A
	F_0		9.12.11.4 b) (and 9.12.12)	No	Performance at service short-circuit capacity
	F_1		9.12.11.4 c) (and 9.12.12.2)	No	Performance at rated short-circuit capacity
[C]	F_2		9.12.11.4 d) (and 9.12.12.2)	No	Performance at $I_{\Delta m}$ (Verification of RCBO after short-circuit test) [C]
	[C] G_0 [C]		9.22.1	No	Reliability (climatic tests)
			--	9.2.4	Verification of the RCD after test sequence
[C]	G_1		9.Z1	No	Verification of correct operation at low ambient air temperature of RCBOs for use in the range of .-25 °C to +40 °C
				9.2.4	Verification of the RCD after test sequence
	H [b]		EN 61543:1995, Table 4 -T1.1 EN 61543:1995, Table 4 -T1.2 EN 61543:1995 Table 5 -T2.3	No	Harmonics, interharmonics Signalling voltage Conducted unidirectional transients of the ms and μs time scale
	I		EN 61543:1995, Table 5 -T2.1 EN 61543:1995, Table 5 -T2.5 EN 61543:1995, Table 5 -T2.2	No	Conducted oscillatory voltages or currents Radiated high-frequency phenomena Conducted unidirectional transients of the ns time scale (burst)
	J		EN 61543:1995, Table 5 -T2.6 EN 61543:1995, Table 6 –T3.1	No	Conducted common mode disturbances in the frequency range lower than 150 kHz Electrostatic discharges [C]

[a] For devices having different residual current detection systems, for which the test according to 9.21.1 was made without supply voltage, an additional test according to 9.21.1.1 shall be made with a supply voltage of 1,1 U_n to verify that there is no interference between the different systems. Only the lower limits of the tripping currents are verified.

[b] For devices containing a continuously operating oscillator, the test of CISPR 14-1 shall be carried out on the samples prior to the tests of this sequence.

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
IEC/TS 60479-1	-	Effects of current on human beings and livestock - Part 1: General aspects	-	-
IEC/TS 60479-2	-	Effects of current on human beings and livestock - Part 2: Special aspects	-	-
IEC 61008	Series	Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCB's)	EN 61008	Series
IEC 61009	Series	Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBO's)	EN 61009	Series
IEC 61543	1995	Residual current-operated protective devices (RCDs) for household and similar use - Electromagnetic compatibility	EN 61543 + corr. December + A12	1995 1997 2005

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

The Netherlands

Scope — Add the following:

This standard together with these requirements apply for 2 pole type B RCD for use in TN and TT distribution systems for protection of line and neutral circuits (L-N).

Modify note 2 reading: additional requirements for 1 pole devices for use in TN-S or TN-C-S systems and 2 pole devices (L-L) for use between phases are under consideration

3.2 — Modify as follows

3.2 residual current devices for which tripping is ensured as for type A according to EN 61008-1 or EN 61009-1, as applicable, and in addition for the following residual currents:

3.2.1 Type B residual current devices with 3 or 4 poles

Existing text

3.2.2 Type B residual current devices with 2 poles

Residual current devices for which tripping is ensured as for RCD type A according EN 61008-1 or EN 61009-1, as applicable , and in addition:

- for residual sinusoidal alternating currents up to 1 000 Hz,
- for residual pulsating direct currents,
- for residual alternating currents superimposed on a smooth direct current,
- for residual pulsating rectified d.c which results from 2 phases,
- for residual d.c currents that may result from inverter circuits.

NOTE The above 5th dash refers to fault conditions in micro generators, such as fuel cells or PV systems, being connected through an inverter to the electrical installation connected in turn to another supply source (in general the public supply system).

5.1 Add to the last dash:

- for 3 and 4 pole residual current devices only.

Add a following new dash:

- for residual direct currents originating from invertors connected to the supply system.

5.4 Add the following new subclause

5.4 Standard values of break time and non-actuating time for general type 2 pole B type RCDs in case of residual pulsating direct currents which may result from an inverter circuit connected to the supply system.

Table 3 – Standard values of non-operating current and break times for general type 2-pole B type RCDs in case of residual pulsating direct currents which may result from an inverter circuit connected to the supply system

	Standard values of break time (s) at a residual current composed by a smooth dc current and a half wave rectified sinusoidal current having opposite polarity			
	$I_{\Delta 1}$	$I_{\Delta 2}$	$I_{\Delta 3}$	$I_{\Delta 4}$
Smooth residual current	+ 1,5 $I_{\Delta n}$	+ 3 $I_{\Delta n}$	+ 6 $I_{\Delta n}$	+ 15 $I_{\Delta n}$
Half wave sinusoidal residual current (peak value) *1*	- 1,125 $I_{\Delta n}$	- 2,25 $I_{\Delta n}$	- 4,5 $I_{\Delta n}$	- 11,25 $I_{\Delta n}$
Break time	Non-tripping	0,3	0,15	0,04

8.1.4 Add to this clause the following text (Not applicable for 2 pole devices L-N).

8.1.5 Add to this clause the following text (Not applicable for 2 pole devices).

8.1.6 Add to this clause the following text (Not applicable for 2 pole devices).

8.1.7 Add the following new subclause

8.1.7 Residual pulsating direct currents originating from a single phase inverter circuit connected to the supply system

2 pole type B RCDs shall operate in response to a steady increase of residual pulsating direct currents resulting from an inverter connected to the supply system within the limits of the composed residual current according to table 3 between the values $I_{\Delta 1}$ *and* $I_{\Delta 2}$.

2 pole type B RCDs shall operate in response to a sudden appearance of residual pulsating direct currents resulting from an inverter connected to the supply system within the time limits specified in table 3 for the currents $I_{\Delta 2}$, $I_{\Delta 3}$ *and* $\geq I_{\Delta 4}$.

Compliance is checked by the test of 9.1.7.1 and 9.1.7.2.

9.1.6 Modify the heading reading

9.1.6 Verification of the correct operation of 3 and 4 pole type B RCDs in case of residual smooth direct current

9.1.7 Add a following new clause

9.1.7 Verification of the correct operation of 2 pole type B RCDs in case of residual direct currents when protecting a single phase inverter circuit connected to the supply

The RCD is connected as shown in Figure 1 and supplied with rated voltage.

9.1.7.1 Slowly rising residual pulsating current

The test circuit being connected to line and neutral terminal or if applicable to the line terminals, the RCD and test switch S_1 being closed

The test currents I_1 and I_2 are set to 0,2 x the values as given for the tripping current $I_{\Delta 2}$.

Current I_1 is increased to the value 0,3 x the value of the smooth residual current applicable for $I_{\Delta 2}$ followed by increasing the half wave pulsating residual current I_2 to 0,3 times the value as given for $I_{\Delta 2}$

Subsequently the currents are further increased in steps to 0,4 times, 0,5 times, 0,6 times etc of the residual operating current $I_{\Delta 2}$.

The RCD shall not trip before the current reaches the value $I_{\Delta 1}$ and shall trip before this current exceeds the value $I_{\Delta 2.}$

9.1.7.2 Suddenly appearing residual pulsating current

The RCD is initially closed but bypassed by calibration links $B_{L.}$ With switches S and S_1 closed the currents I_1 and I_2 are set in turn to the values as applicable for $I_{\Delta 2}$, $I_{\Delta 3}$ and $I_{\Delta 4}$, respectively, as given in Table 3.

Switches S and S_1 are then opened and the calibration links are removed.

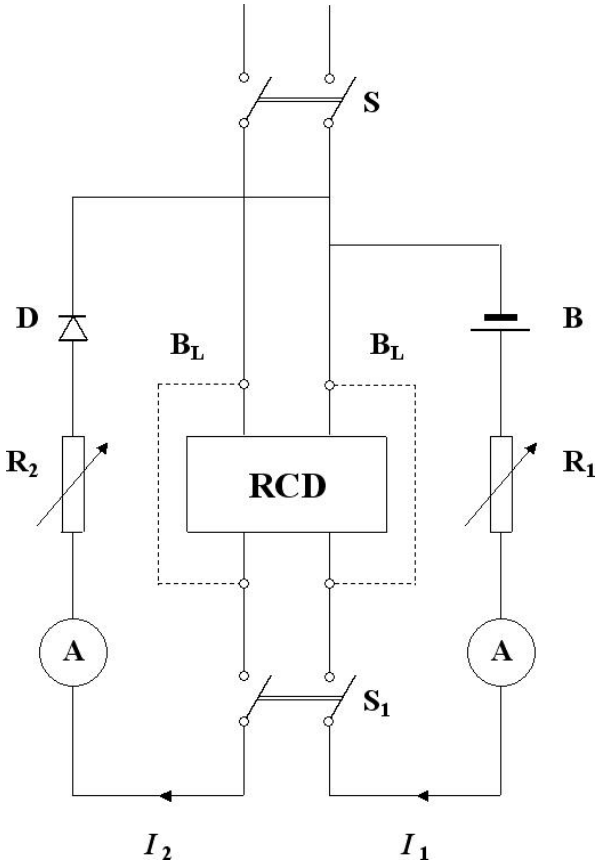
Switch S is first closed, then S_1 is closed and the residual currents start to flow.

The break time is measured for each value and shall not exceed the specified break times given in Table 3. This test is repeated 3 times for each of the residual current values.

9.3 *Modify this clause as follows:*

2 pole B type RCD shall trip within 0,3 s with the composite residual test current $I_{\Delta 2}$ as specified in Table 2.

3 and 4 pole type B RCD shall trip with a test current of 2,5 $I_{\Delta n}$ with smooth direct current.



Key

A	ammeters
S and S_1	all-pole switch
R_1 and R_2	adjustable resistors
D	diode
B	d.c supply
RCD	2-pole RCD under test
B_L	bridging links for the RCD for calibration of the test currents of 9.1.7.2 and 9.3

Figure 1 – Test circuit for the verification of correct operation of 2 pole type B RCD for protection of single phase inverter circuit connected to a supply L-N.

Annex A Modify or add the following items in Table A1:

Test sequence		Test according to EN 61008-1	Additional test according to this standard	Test (or inspection)
D	D_0		9.1.6.1	Verification of correct operation of 3 and 4 pole type B RCCB in case of residual smooth direct current without load for ratings of $I_{\Delta n}$ not tested in D_1
			9.1.7	Verification of correct operation of 2 pole type B RCCB in case of residual currents when protecting a single phase inverter circuit connected to the supply

Annex B Modify or add the following items in Table B1:

Test sequence		Test according to EN 61009-1	Additional test according this standard	Test (or inspection)
D	D_0		9.1.6.1	Verification of correct operation of 3 and 4 pole type B RCBO in case of residual smooth direct current without load for ratings of $I_{\Delta n}$ not tested in D_1
			9.1.7	Verification of correct operation of 2 pole type B RCBO in case of residual currents when protecting a single phase inverter circuit connected to the supply

Annex C Modify and add the following items in Annex C

Add to the beginning of the 3rd paragraph the wording: *"In case of 3 or 4 pole RCD".*

Introduce the following new 4th paragraph:

In case of 2 pole RCD a d.c residual current composed by a smooth d.c. current having the value I and a half wave pulsating residual current with power frequency and having the peak value of – 0,75 I is passed through one pole. The type B RCCB or type B RCBO, as applicable, shall not trip at a current less than or equal to the value specified for $I_{\Delta n1}$ and shall trip at the current $I_{\Delta n2}$ within the time specified in Table 3.

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.

Bibliography

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

IEC 61008-2-2, *Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCB's) – Part 2-2: Applicability of the general rules to RCCB's functionally dependent on line voltage*

IEC 61009-2-1, *Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBO's) – Part 2-1: Applicability of the general rules to RCBO's functionally independent of line voltage*

IEC 61009-2-2, *Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBO's) – Part 2-2: Applicability of the general rules to RCBO's functionally dependent on line voltage*

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