IEC 62423

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

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

IEC 62423:2009

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

FOREWORD

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International Standard IEC 62423 has been prepared by subcommittee 23E: Circuit-breakers and similar equipment for household use, of IEC technical committee 23: Electrical accessories.

This second edition cancels and replaces the first edition published in 2007 and constitutes a technical revision. The main changes from the first edition are as follows:

– 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.

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

FDIS	Report on voting
23E/679/FDIS	23E/684/RVD

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

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

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

IEC 61008-1:1996, *Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs) – Part 1: General rules*

IEC 61009-1:1996, *Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs) – Part 1: General rules*

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

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- withdrawn,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

The contents of the corrigendum of December 2011 have been included in this copy.

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) with rated frequency 50 Hz or 60 Hz 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

The scope of IEC 61008-1 and IEC 61009-1 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. This standard can only be used together with IEC 61008-1 and IEC 61009-1.

Type F RCCBs (Residual Current Circuit Breaker) and Type F RCBOs (Residual current Circuit Breaker with Overcurrent protection) with rated frequency 50 Hz or 60 Hz 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.

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 IEC 61008-1 or IEC 61009-1 are under consideration.

For the purpose of manufacturer's declaration or verification of conformity, type tests should be carried out in test sequences in compliance with Annex A, Annex B, Annex C or Annex D of this standard.

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 Requirements for 1 pole with solid neutral are under consideration.

NOTE 3 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.

2 Normative references

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

IEC 61008-1:1996, *Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs) – Part 1: General rules* [1]
Amendment 1 (2002)
Amendment 2 (2006)

IEC 61009-1:1996, *Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs) – Part 1: General rules* [2]
Amendment 1 (2002)
Amendment 2 (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*

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

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[1] A consolidated edition (2.2) exists including IEC 61008-1 (1996), its Amendment 1 (2002) and Amendment 2 (2006).

[2] A consolidated edition (2.2) exists including IEC 61009-1 (1996), its Amendment 1 (2002) and Amendment 2 (2006).

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.

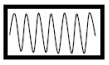
5.2.3 Values of tripping current according to frequencies which differ from the rated frequency 50/60 Hz

Table 2 – Type B RCDs – Residual non-operating and operating current according to frequencies which differ from the rated frequency 50/60 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 50/60 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.