

INTERNATIONAL STANDARD

**Residual current operated circuit-breakers for household and similar use –
Part 3-1: Particular requirements for RCDs with screwless-type terminals for
external copper conductors**

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**RESIDUAL CURRENT OPERATED CIRCUIT-BREAKERS
FOR HOUSEHOLD AND SIMILAR USE –****Part 3-1: Particular requirements for RCDs with screwless-
type terminals for external copper conductors**

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International Standard IEC 62873-3-1 has been prepared by subcommittee 23E: Circuit breakers and similar equipment for household use, of IEC technical committee 23: Electrical accessories.

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

| | |
|--------------|------------------|
| FDIS | Report on voting |
| 23E/964/FDIS | 23E/982/RVD |

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

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

A list of all parts of the IEC 62873 series published under the general title *Residual current operated circuit-breakers for household and similar use* can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website 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- withdrawn,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.

A bilingual version of this publication may be issued at a later date.

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INTRODUCTION

This document is part of the series described in the outline document IEC 62873-1.

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RESIDUAL CURRENT OPERATED CIRCUIT-BREAKERS FOR HOUSEHOLD AND SIMILAR USE –

Part 3-1: Particular requirements for RCDs with screwless- type terminals for external copper conductors

1 Scope

This part of IEC 62873 applies to RCDs equipped with screwless terminals, for current not exceeding 20 A primarily suitable for connecting unprepared (see 3.5) copper conductors of cross-section up to 4 mm².

This part of IEC 62873 cannot be used alone but it is intended to be applied together with an RCD product standard (IEC 61008-1 or IEC 61009-1) if an RCD is equipped with screwless terminals.

NOTE In AT, CZ, DK, NL, NO, PO, PT and CH, the upper limit of current for use of screwless terminals is 16 A.

In this part of IEC 62873, screwless terminals are referred to as terminals and copper conductors are referred to as conductors.

2 Normative references

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.

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

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

IEC 62873-2, *Residual current operated circuit-breakers for household and similar use – Part 2: Residual current devices (RCDs) – Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62873-2 and the following apply.

3.1

clamping units

parts of the terminal necessary for mechanical clamping and the electrical connection of the conductors including the parts which are necessary to ensure correct contact pressure

3.2

universal terminal

terminal for the connection and disconnection of all types of conductors (rigid and flexible)

Note 1 to entry: In the following countries, only universal screwless-type terminals are accepted: AT, BE, CN, DK, DE, ES, FR, IT, PT, SE and CH.

3.3

non-universal terminal

terminal for the connection and disconnection of a certain kind of conductor only (e.g. rigid-solid conductors only or rigid-[solid or stranded] conductors only)

3.4

push-wire terminal

non-universal terminal in which the connection is made by pushing in rigid (solid or stranded) conductors

3.5

unprepared conductor

conductor which has been cut and the insulation of which has been removed for insertion into a terminal

Note 1 to entry: A conductor the shape of which is arranged for introduction into a terminal or the strands of which are twisted to consolidate the end is considered as an unprepared conductor.

[SOURCE: IEC 60050-442:1998, 442-01-26]

4 Classification

Clause 4 of the RCD product standard applies.

5 Characteristics of RCDs

Clause 5 of the RCD product standard applies.

6 Marking and other product information

In addition to Clause 6 of the RCD product standard, the following requirements apply:

Non-universal terminals:

- terminals declared for flexible conductors shall be marked by the letter "f".

An appropriate marking indicating the length of insulation to be removed before insertion of the conductor into the terminal shall be shown on the RCD.

The manufacturer shall also provide information, in his literature, on the maximum number of conductors which may be clamped.

7 Standard conditions for operation in service and for installation

Clause 7 of the RCD product standard applies.

8 Requirements for construction and operation

8.1 General

Clause 8 of the RCD product standard applies, with the following exceptions:

In 8.1.5, only 8.1.5.1, 8.1.5.2, 8.1.5.3, 8.1.5.6 and 8.1.5.7 apply.

Compliance is checked by inspection and by the tests of 9.2 and 9.3 of this standard.

In addition, the following requirements apply.

8.2 Connection or disconnection of conductors

The connection or disconnection of conductors shall be made:

- by the use of a general purpose tool or by a convenient device integral with the terminal to open it and to assist the insertion or the withdrawal of the conductors (e.g. for universal terminals);

or, for rigid conductors:

- by simple insertion. For the disconnection of the conductors, an operation other than a pull on the conductor shall be necessary (e.g. for push-wire terminals).

Universal terminals shall accept rigid (solid or stranded) and flexible unprepared conductors.

Non-universal terminals shall accept the types of conductors declared by the manufacturer.

Compliance is checked by inspection and by the tests of 9.2 and 9.3 of this standard.

8.3 Dimensions of connectable conductors

The dimensions of connectable conductors are given in Table 1.

The ability to connect these conductors shall be checked by inspection and by the tests of 9.2 and 9.3 of this standard.

Table 1 – Connectable conductors

| Connectable conductors and their theoretical diameter | | | | | | | | | |
|---|-------|----------|-----------------|------|-------|--------------------|-------------------------------|----------|--|
| Metric | | | | | AWG | | | | |
| Rigid | | | Flexible | | Rigid | | | Flexible | |
| | Solid | Stranded | | | | Solid ^a | Class B stranded ^a | | Classes I, K, M, stranded ^b |
| mm ² | ∅ mm | ∅ mm | mm ² | ∅ mm | gauge | ∅ mm | ∅ mm | gauge | ∅ mm |
| 1,0 | 1,2 | 1,4 | 1,0 | 1,5 | 18 | 1,02 | 1,16 | 18 | 1,28 |
| 1,5 | 1,5 | 1,7 | 1,5 | 1,8 | 16 | 1,29 | 1,46 | 16 | 1,60 |
| 2,5 | 1,9 | 2,2 | 2,5 | 2,3 | 14 | 1,63 | 1,84 | 14 | 2,08 |
| 4,0 | 2,4 | 2,7 | 4,0 | 2,9 | 12 | 2,05 | 2,32 | 12 | 2,70 |

NOTE Diameters of the largest rigid and flexible conductors are based on IEC 60228, and, for AWG conductors, on ASTM B 172-01a.

^a Nominal diameter + 5 %.

^b Largest diameter + 5 % for any of the three classes I, K and M.

8.4 Connectable cross-sectional areas

The nominal cross-sections to be clamped are defined in Table 2.

Table 2 – Cross-sections of copper conductors connectable to screwless-type terminals

| Rated current A | Nominal cross-sections to be clamped mm ² |
|---------------------------------|---|
| Up to and including 13 | 1 up to and including 2,5 |
| Above 13 up to and including 20 | 1,5 up to and including 4 |

Compliance is checked by inspection and by the tests of 9.2 and 9.3 of this standard.

8.5 Insertion and disconnection of conductors

The insertion and disconnection of the conductors shall be made in accordance with the manufacturer's instructions.

Compliance is checked by inspection.

8.6 Design and construction of terminals

Terminals shall be so designed and constructed that:

- each conductor is clamped individually;
- during the operation of connection or disconnection the conductors can be connected or disconnected either at the same time or separately;
- inadequate insertion of the conductor is avoided.

It shall be possible to clamp securely any number of conductors up to the maximum provided for.

Compliance is checked by inspection and by the tests of 9.2 and 9.3 of this standard.

NOTE Examples are given in Figure 2.

8.7 Resistance to ageing

The terminals shall be resistant to ageing.

Compliance is checked by the test of 9.3.2.

9 Tests

9.1 General

Clause 9 of the RCD product standard applies, with the exception of 9.4 and 9.5.

9.2 Test of reliability of screwless terminals

9.2.1 Reliability of screwless system

The test is carried out on three terminals of poles of new samples, with copper conductors of the rated cross-sectional area in accordance with Table 2. The types of conductors shall be in accordance with 8.2.

The connection and subsequent disconnection shall be made five times with the smallest diameter conductor and successively five times with the largest diameter conductor.

New conductors shall be used each time, except for the fifth time, when the conductor used for the fourth insertion is clamped at the same place. Before insertion into the terminal, wires of stranded rigid conductors shall be re-shaped and wires of flexible conductors shall be twisted to consolidate the ends.

For each insertion, the conductors are either pushed as far as possible into the terminal or shall be inserted so that adequate connection is obvious.

After each insertion, the conductor being inserted is rotated 90° along its axis at the level of the clamped section and subsequently disconnected.

After these tests, the terminal shall not be damaged in such a way as to impair its further use.

9.2.2 Test of reliability of connection

Three terminals of poles of new samples are fitted with new copper conductors of the type and of the rated cross-sectional area according to Table 2.

The types of conductors shall be in accordance with 8.2.

Before insertion into the terminal, wires of stranded rigid conductors and flexible conductors shall be reshaped and wires of flexible conductors shall be twisted to consolidate the ends.

It shall be possible to fit the conductor into the terminal without undue force in the case of universal terminals and with the force necessary by hand in the case of push-wire terminals.

The conductor is either pushed as far as possible into the terminal or shall be inserted so that adequate connection is obvious.

After the test, no wire of the conductor shall have escaped outside the terminal.

9.3 Tests of reliability of terminals for external conductors

9.3.1 Mechanical strength

For the pull-out test, three terminals of poles of new samples are fitted with new conductors of the type and of the minimum and maximum cross-sectional areas according to Table 2.

Before insertion into the terminal, wires of stranded rigid conductors and flexible conductors shall be reshaped and wires of flexible conductors shall be twisted to consolidate the ends.

Each conductor is then subjected to a pull force of the value shown in Table 3. The pull is applied without jerks for 1 min in the direction of the axis of the conductor.

Table 3 – Pull forces

| Cross-sectional area mm ² | Pull force N |
|---|-----------------|
| 1,0 | 35 |
| 1,5 | 40 |
| 2,5 | 50 |
| 4,0 | 60 |

During the test, the conductor shall not slip out of the terminal.

9.3.2 Cycling test

The test is made with new copper conductors having cross section according to Table 10 of the RCD product standard.

NOTE 1 Tables 6, 10, 11 (in IEC 61008-1:2010) and Tables 8, 13, 14 (in IEC 61009-1:2010) have been replaced by the harmonized new numbers: 9, 10, 11.

The test is carried out on new samples (a sample is one pole), the number of which is defined below, according to the type of terminals:

- universal terminals for rigid (solid and stranded) and flexible conductors: three samples each (six samples in total);
- non-universal terminals for solid conductors only: three samples;
- non-universal for rigid (solid and stranded) conductors: three samples each (six samples);

NOTE 2 In case of rigid conductors, solid conductors are used (if solid conductors are not available in a given country, stranded conductors can be used).

- non-universal for flexible conductors only: three samples.

A conductor having the cross section defined in Table 10 of the RCD product standard is connected in series as in normal use to each of the three samples as defined in Figure 1.

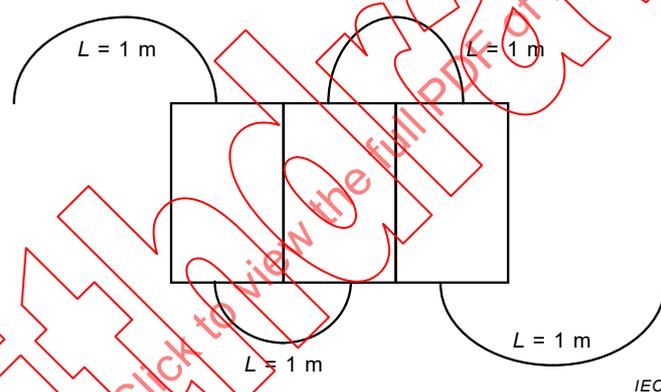


Figure 1 – Connecting samples

The sample is provided with a hole (or equivalent) in order to measure the voltage drop on the terminal.

The whole test arrangement, including the conductors, is placed in a heating cabinet which is initially kept at a temperature of $(20 \pm 2) ^\circ\text{C}$.

To avoid any movement of the test arrangement until all the following voltage drop tests have been completed, the poles should be fixed on a common support.

Except during the cooling period, a test current corresponding to the rated current of the circuit breaker is applied to the circuit.

The samples shall be then subjected to 192 temperature cycles, each cycle having a duration of approximately 1 h, as follows:

The air temperature in the cabinet is raised to $40 ^\circ\text{C}$ in approximately 20 min. It is maintained within $\pm 5 ^\circ\text{C}$ of this value for approximately 10 min.

The samples are then allowed to cool down in approximately 20 min to a temperature of approximately $30 ^\circ\text{C}$, forced cooling being allowed. They are kept at this temperature for

approximately 10 min and, if necessary for measuring the voltage drop, allowed to cool down further, to a temperature of $(20 \pm 2) ^\circ\text{C}$.

The maximum voltage drop, measured at each terminal, at the end of the 192nd cycle, with the rated current shall not exceed the smaller of the two following values:

- either 22,5 mV;
- or 1,5 times the value measured after the 24th cycle.

The measurement shall be made as near as possible to the area of contact on the terminal.

If the measuring points cannot be positioned closely to the point of contact, the voltage drop within the part of the conductor between the ideal and the actual measuring points shall be deducted from the voltage drop measured.

The temperature in the heating cabinet shall be measured at a distance of at least 50 mm from the samples.

After this test, an inspection with the naked eye, by normal or corrected vision, without additional magnification, shall show no changes evidently impacting further use, such as cracks, deformations or the like.

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