IEC 60947-2

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

AMENDMENT 1
AMENDEMENT 1

Low-voltage switchgear and controlgear – Part 2: Circuit-breakers

Appareillage à basse tension – Partie 2: Disjoncteurs

IEC 60947-2: 2016-06/AMD1:2019-07(en-fr)

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Low-voltage switchgear and controlgear – Part 2: Circuit-breakers

Appareillage à basse tension – Partie 2: Disjoncteurs

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

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FOREWORD

This amendment has been prepared by subcommittee 121A: Low-voltage switchgear and controlgear, of IEC technical committee 121: Switchgear and controlgear and their assemblies for low voltage.

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

FDIS	Report on voting
121A/286/FDIS	121A/302/RVD

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

The committee has decided that the contents of this amendment and the base 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- withdrawn,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.

1.1 Scope and object

Replace the existing first paragraph by the following:

This part of IEC 60947 series applies to circuit-breakers, intended to be installed and operated by instructed or skilled persons, the main contacts of which are intended to be connected to circuits, the rated voltage of which does not exceed 1 000 V a.c. or 1 500 V d.c.; it also contains additional requirements for integrally fused circuit-breakers.

Replace the 16th existing paragraph by the following:

For certain specific applications (for example traction, rolling mills, marine service, downstream of variable frequency drives, use in explosive atmospheres), particular or additional requirements may be necessary.

1.2 Normative references

Replace the existing references to IEC 61000-4-2, IEC 61140, and CISPR 11 by the following new references:

IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) – Part 4-2: Testing and measurement techniques – Electrostatic discharge immunity test*

IEC 61140:2016, *Protection against electric shock – Common aspects for installation and equipment*

CISPR 11:2015, *Industrial, scientific and medical equipment – Radio-frequency disturbance characteristics – Limits and methods of measurement*
CISPR 11:2015/AMD1:2016

Delete the existing references to IEC 60364 (all parts), IEC 61000-3-2, IEC 61000-3-3 and CISPR 22.

Add the following new normative references to the existing list:

IEC 60228, *Conductors of insulated cables*

IEC 61545, *Connecting devices – Devices for the connection of aluminium conductors in clamping units of any material and copper conductors in aluminium bodied clamping units*

CISPR 32:2015, *Electromagnetic compatibility of multimedia equipment – Emission requirements*

Add, after the existing definition 2.22, the following new definition:

2.23
closing release
closing coil
release, energized by a source of voltage, which triggers the closing of the circuit-breaker

Note 1 to entry: A closing release is an auxiliary device of the circuit-breaker, and is different from the "closing device" mentioned in the figures of Annex A, and in IEC 60947-1, which is part of the test setup and is intended to establish the short-circuit current.

4.7.1 Types

Renumber existing item "4) other releases." *to item* "5) other releases.".

Add new item "4) closing release;".

4.7.2 Characteristics

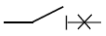
Change existing item 1) to read "1) shunt release and undervoltage release (for opening), and closing release:"*, keeping dashed items unchanged.*

5.2 Marking

Replace the existing text, including all lettered items, by the following new text and Table 13:

Each circuit-breaker shall be marked in a durable manner; data to be provided and corresponding locations are indicated in Table 13.

Table 13 – Product information

Item	Information	Marking location
1.1	rated current (I_n)	Visible
1.2	suitability for isolation, if applicable, with the symbol  (IEC 60617-S00288:2001-07 combined with IEC 60617-S00219:2001-07)	Visible
1.3	indication of the open and closed position with O (IEC 60417-5008;2002-10) and I (IEC 60417-5007;2002-10) respectively, if symbols are used (see 7.1.6.1 of IEC 60947-1:2007)	Visible
2.1	manufacturer's name or trade mark	Marked
2.2	type designation or catalogue reference	Marked
2.3	IEC 60947-2, if the manufacturer claims compliance with the standard	Marked
2.4	selectivity category A or B	Marked
2.5	rated operational voltage(s) U_e (see 4.3.2.1 and, where applicable, Annex H)	Marked
2.6	unsuitability for IT systems, if applicable, with the symbol  (IEC 60417-6363:2016-07)	Marked
2.7	rated impulse withstand voltage (U_{imp})	Marked
2.8	value (or range) of the rated frequency, and/or the indication "d.c." (or the symbol ⎓ (IEC 60417-5031:2002-10))	Marked
2.9	rated service short-circuit breaking capacity (I_{cs}) at the corresponding rated voltage (U_e)	Marked
2.10	rated ultimate short-circuit breaking capacity (I_{cu}) at the corresponding rated voltage (U_e)	Marked
2.11	rated short-time withstand current (I_{cw}), and associated short-time delay, for selectivity category B	Marked
2.12	range of the current setting (I_r) of the adjustable overload release	Marked [a]
2.13	range of the rated instantaneous short-circuit current setting (I_i), for adjustable releases	Marked [a]
2.14	reference temperature for non-compensated thermal releases, if different from 30 °C	Marked
2.15	terminals identification, according to 7.1.8.4 of IEC 60947-1:2007	Marked
2.16	line and load terminals, if applicable	Marked
2.17	neutral pole terminals, if applicable, by the letter N	Marked
2.18	protective earth terminal, where applicable, by the symbol  (IEC 60417-5019:2006-08) (see 7.1.10.3 of IEC 60947-1:2007)	Marked
3.1	rated short-circuit making capacity (I_{cm}), if higher than that specified in 4.3.6.1	Literature
3.2	rated insulation voltage (U_i), if higher than the maximum rated operational voltage	Literature
3.3	pollution degree if other than 3	Literature
3.4	conventional enclosed thermal current (I_{the}) if different from the rated current	Literature
3.5	IP code, where applicable (see Annex C of IEC 60947-1:2007/AMD1:2010)	Literature
3.6	minimum enclosure size and ventilation data (if any) to which marked ratings apply	Literature
3.7	details of minimum distance between circuit-breaker and earthed metal parts for circuit-breakers intended for use without enclosures	Literature
3.8	suitability for environment A or environment B per Annex J, as applicable	Literature
3.9	RMS sensing, if applicable, in accordance with F.4.1.1	Literature
3.10	minimum cable cross-section, if different from Table 9 of IEC 60947-1:2007, for ratings ≤ 20 A according to rated ultimate short-circuit breaking capacity I_{cu}	Literature
3.11	values of tightening torque for the circuit-breaker terminals	Literature

Item	Information	Marking location
3.12	current derating for terminals and connections, if applicable	Literature
4.1	for closing releases (see 2.23) and/or motor-operators, rated control circuit voltage, kind of current and rated frequency for a.c.	Aux
4.2	rated control circuit voltage of the shunt release and/or of the under-voltage release (or of the no-voltage release), kind of current and rated frequency for a.c.	Aux
4.3	rated current of indirect over-current releases	Aux
4.4	number and type of auxiliary contacts, rated operational currents at the rated operational voltages, and rated frequency for a.c.	Aux

Key

Visible: visible from the front when the circuit-breaker is installed as in service and the actuator is accessible

Marked: marked on the circuit-breaker

Literature: provided in the manufacturer's literature

Aux: marked on the auxiliaries or on the circuit-breaker, if marking space is sufficient; additionally, data shall be made available in the manufacturer's literature

[a] Where applicable, I_r and I_i ranges may be displayed instead of being marked on the circuit-breaker.

5.3 Instructions for installation, operation and maintenance

Replace the existing text by the following new text:

Subclause 5.3 of IEC 60947-1:2007/AMD2:2014 applies with the following addition:

Additional information for the decommissioning and dismantling of the circuit-breaker shall be provided to the user in the case of a foreseeable hazardous condition, for example due to stored energy or hazardous substances.

7.1.1 General

Replace the existing text by the following new text:

Subclause 7.1 of IEC 60947-1:2007/AMD1:2010/AMD2:2014 applies with the following modifications:

The requirements of 7.1.2 of IEC 60947-1:2007/AMD1:2010/AMD2:2014 do not apply to parts with a mass lower than 2 g (insignificant mass, in accordance with 3.14 of IEC 60695-2-11:2014). For products containing a plurality of small parts, the total mass of non-tested parts located in close proximity to each other shall not exceed 10 g. Proximity shall be based on engineering judgment that takes into consideration the risk of propagation of fire.

Where, in 7.1.2.2 of IEC 60947-1:2007/AMD1:2010/AMD2:2014, the test temperature is to be specified, the value required by this document for the parts necessary to retain in position current-carrying parts is:

– 960 °C for the main circuit;
– 850 °C for the other circuits.

7.2.2.3 Main circuit

Replace the existing text by the following new text:

The main circuit of a circuit-breaker, including the over-current releases that may be associated with it, shall be capable of carrying its rated current I_n, under the conditions of Clause 8, without the temperature rises exceeding the limits specified in Table 7.

8.3 Type tests

Replace the last existing paragraph by the following new paragraph:

In order to facilitate locating a particular test condition or test, an alphabetical index is given below, using the terms most likely to be used (not necessarily the exact terms appearing in the relevant subclause heading).

8.3.1.3 Applicability of sequences according to the relationship between short-circuit ratings

Replace, in the alphabetical index of tests, in line "Overload releases (verification)", *reference* "8.3.4.5" *by* "8.3.4.6".

Table 9 – Overall schema of test sequences[a]

Replace, in test sequence IV row, the existing text of 2nd column by the following new text:

Circuit-breakers of selectivity category B [b] and circuit-breakers of selectivity category A with an assigned short-time withstand current (see 4.4)

Table 9b – Applicability of tests or test sequences to 1, 2 and 4-pole circuit-breakers according to the alternative programme 1 of 8.3.1.4

Replace the existing text of the table footnote "c" *by the following new text*:

[c] Test at maximum kVA rating (I_{cu} × corresponding U_e).

Table 9c – Applicability of tests or test sequences to 1, 2 and 3-pole circuit-breakers according to the alternative programme 2 of 8.3.1.4

Replace the existing text of the table footnote "c" *by the following new text*:

[c] Test at maximum kVA rating (I_{cu} × corresponding U_e).

8.3.2.1 General requirements

Replace the existing second paragraph after the note by the following new paragraph:

For the tests in free air concerning overload performance, short-circuit, and short-time withstand current where applicable, a metallic screen shall be placed on all sides of the circuit-breaker in accordance with the manufacturer's instructions. Details, including distances of the metallic screen from the circuit-breaker, shall be stated in the test report.

Replace the existing fifth paragraph before Table 10 by the following:

The tightening torques to be applied to the terminal screws shall be in accordance with the manufacturer's instructions (see Table 13, item 3.11).

Table 10 – Number of samples for test

Replace, in the existing table footnote "e", "test" *by* "testing.

8.3.2.5 Test conditions for temperature-rise tests

Replace the existing fifth paragraph by the following:

For four-pole circuit-breakers, a test shall first be carried out on the 3-phase poles; for the neutral pole, the additional single-phase test of 8.3.3.3.4 of IEC 60947-1:2007 applies only when there is a construction break between the neutral pole and the phase poles (see 7.1.6), in which case the test current is the rated current of the neutral pole.

8.3.2.6.4.2 Tests on one-, two- and three-pole circuit-breakers

Replace the existing title of this subclause by the following new title:

8.3.2.6.4.2 Common tests on one-, two-, three- and four-pole circuit-breakers

8.3.2.6.4.3 Tests on four-pole circuit-breakers

Replace the existing title of this subclause by the following new title:

8.3.2.6.4.3 Additional tests on four-pole circuit-breakers

Delete the existing first paragraph.

Replace the existing second and third paragraphs by the following new paragraphs:

Additional sequences of operations on one or more new samples, in accordance with Table 10, shall be carried out on the fourth pole and its adjacent pole, according to test sequences III or V, as applicable, and test sequence IV if applicable. This requirement applies even when test sequence III is replaced by test sequence II (I_{cu} = I_{cs}) or test sequence IV is replaced by test sequence VI (I_{cw} = I_{cs}), i.e. additional tests according to test sequence III or V, and test sequence IV, as applicable, are required.

Alternatively, at the request of the manufacturer, these tests may be combined with the tests of 8.3.2.6.4.2 and made on the same samples, in which case the test in each relevant test sequence shall comprise

– the test on three adjacent poles,
– the test on the fourth pole and the adjacent pole.

8.3.3.2.2 Short-circuit releases

Replace, in the existing fifth paragraph, third sentence, "indivudal" *by* "individual".

8.3.3.2.3 Overload releases

a) Instantaneous or definite time-delay releases

Replace, in the existing last paragraph, "(see 8.3.3.2.3)" *by* "(see 8.3.3.2.1)".

b) Inverse time-delay releases

Replace, in the existing second paragraph, "(see 8.3.3.2.4)" *by* "(see 8.3.3.2.1)".

Replace, in the existing third paragraph, "see 4.7.3 and 5.2 item b)" *by* "see 4.7.3 and Table 13 item 2.14".

8.3.3.4.2.2 Mechanical operation

Replace, in the existing first dashed item, "closing device" *with* "closing release".

8.3.3.4.3 Operational performance capability without current

Replace, in the existing second sentence of the 7th paragraph, "closing devices" *with* "closing releases".

8.3.3.4.4 Operational performance capability with current

Replace, in the existing second sentence of the 6th paragraph, "closing devices" *with* "closing releases".

8.3.3.6.2 Test voltage

Replace the existing first paragraph with the following:

Subclause 8.3.3.4.1, item 4) b), of IEC 60947-1:2007/AMD1:2010 applies.

Delete the existing second paragraph.

8.3.6.5 Test of short-circuit breaking capacity at the maximum short-time withstand current

Add at the end of the existing last paragraph, the following new sentence:

"; this exception also applies to the test on the fourth pole and the adjacent pole, in accordance with 8.3.2.6.4.3."

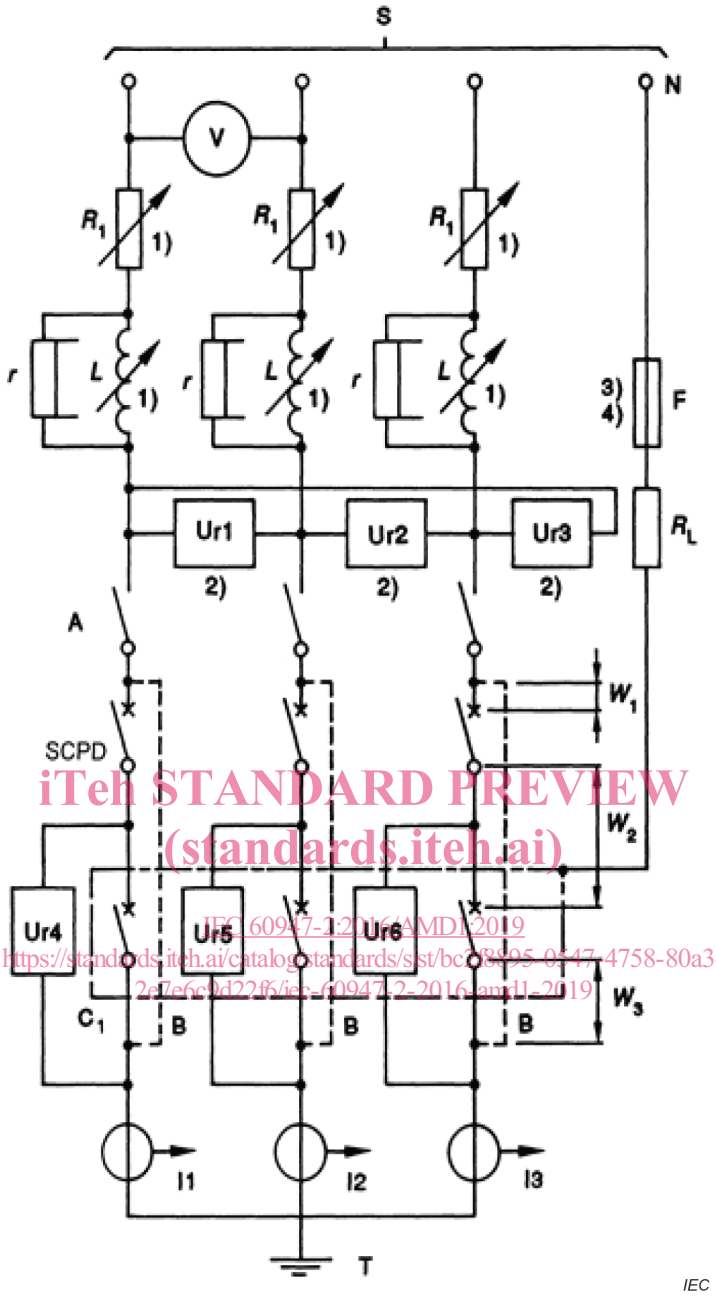
Annex A – Co-ordination between a circuit-breaker and another short-circuit protective device associated in the same circuit

A.1 General

Add, in last but two existing paragraph, a closing bracket ")" after "*2.17.3*".

Figure A.4 – Example of test circuit for conditional short-circuit breaking capacity tests showing cable connections for a 3-pole circuit-breaker (C_1)

Replace the existing figure by the following new figure:



Replace, the existing first paragraph by the following new text:

Adjustable loads *L* and R_1 may be located either on the high voltage side or on the low voltage side of the supply circuit.

Figure A.5 – Example of test circuit for the verification of selectivity

Replace, the existing first paragraph by the following new text:

Adjustable loads *L* and R_1 may be located either on the high voltage side or on the low voltage side of the supply circuit.

Annex B – Circuit-breakers incorporating residual current protection

Replace the existing annex by the following new annex:

Annex B
(normative)

Circuit-breakers incorporating residual current protection

B.1 General

B.1.1 Preamble

To provide protection against the effects of electric shock hazards, devices reacting to residual differential currents are used as protective systems. Such devices are frequently used in conjunction with or as an integral part of a circuit-breaker to achieve a two-fold goal, i.e.:

– providing protection of installations against overloads and short-circuit currents;

– providing protection of persons against indirect contact, i.e. hazardous increases of ground potential due to defective insulation.

NOTE 1 In IEC 61140:2016, the term “protection of persons against indirect contact” is replaced by “fault protection”.

Residual current devices may also provide additional protection against fire and other hazards, which may develop as a result of an earth fault of a lasting nature that cannot be detected by the over-current protective device.

Residual current devices having a rated residual current not exceeding 30 mA are also used as a means for additional protection against direct contact in the event of failure of the relevant protective means.

NOTE 2 In IEC 61140:2016, the term “protection of persons against direct contact” is replaced by “basic protection”.

The requirements for the installation of such devices are specified in various sections of IEC 60364 series.

This annex includes definitions, additional requirements and tests for circuit-breakers incorporating residual current protection of type B to cover the use of new electronic technology in equipment which can result in particular residual currents not covered by the characteristics of type AC or type A.

NOTE 3 This annex complies with the relevant requirements of IEC 60755.

B.1.2 Scope and object

This annex applies to circuit-breakers providing residual current protection (CBRs). It covers the requirements for units that concurrently perform residual current detection, compare such measurements with a preset value and cause the protected circuit to be switched off when this value is exceeded.

This annex applies to:

- circuit-breakers in accordance with this document, which incorporate the residual current function as an integrated feature (hereinafter called integral CBRs);
- CBRs consisting of a combination of a residual current device (hereinafter referred to as r.c. units) and a circuit-breaker in accordance with this document; their combination both mechanically and electrically, may be carried out either at the factory or in the field by the user in accordance with the manufacturer's instructions.

This annex covers CBRs of type AC, type A and type B (see B.4.4).

This annex applies only to CBRs intended for use in a.c. circuits.

NOTE The neutral current sensing means, if any, can be external to the circuit-breaker or the combination, depending on the case.

The residual current function of CBRs covered by this annex may or may not be functionally dependent on line voltage. CBRs depending on an alternative supply source are not covered by this annex.

This annex does not apply to equipment where the current sensing means (except the neutral current sensing means) or the processing device are mounted separately from the circuit-breaker. The requirements for such devices are given in Annex M.

The object of this annex is to state:

a) the specific features of the residual current function;
b) the specific requirements that shall be complied with by the CBR
   – under normal circuit conditions;
   – under abnormal circuit conditions, whether of a residual current nature or not;
c) the tests that shall be performed to verify compliance with the requirements in b) above, together with the appropriate test procedures, including tests for electromagnetic compatibility;
d) the relevant product information.

B.2 Terms and definitions

As a complement to Clause 2 of this document, the following terms and definitions apply:

B.2.1 Terms and definitions relating to currents flowing from live parts to earth

B.2.1.1
earth fault current
current flowing to earth due to an insulation fault

[SOURCE: IEC 60050-442:1998, 442-01-23]

B.2.1.2
earth leakage current
current flowing from the live parts of the installation to earth in the absence of an insulation fault

[SOURCE: IEC 60050-442:1998, 442-01-24]

B.2.2 Terms and definitions relating to the energization of a CBR

B.2.2.1
energizing quantity
electrical energizing quantity that, alone or in combination with other such quantities, shall be applied to a CBR to enable it to accomplish its function under specified conditions

B.2.2.2
energizing input-quantity
energizing quantity by which the CBR is activated when it is applied under specified conditions

Note 1 to entry: These conditions can involve, e.g., the energizing of certain auxiliary elements.

[SOURCE: IEC 60050-442:1998, 442-05-58, modified – In the definition, "residual current device" has been replaced with "CBR".]

B.2.2.3
residual current
I_{Δ}
vectorial sum of the currents flowing in the main circuit of the CBR, expressed as an r.m.s. value

[SOURCE: IEC 60050-442:1998, 442-05-19, modified – The definition has been adapted to apply to CBRs.]

B.2.2.4
residual operating current
$I_{\Delta n}$
value of the residual current which causes the CBR to operate under specified conditions

[SOURCE: IEC 60050-442:1998, 442-05-20, modified – In the definition, "residual current device" has been replaced with "CBR".]

B.2.2.5
residual non-operating current
$I_{\Delta no}$
value of the residual current at which (and below which) the CBR does not operate under specified conditions

[SOURCE: IEC 60050-442:1998, 442-05-21, modified – Symbol introduced and, in the definition, "residual current device" has been replaced with "CBR".]

B.2.3 Terms and definitions relating to the operation and the functions of a CBR

B.2.3.1
circuit-breaker incorporating residual current protection
CBR
circuit-breaker (see 2.1) designed to cause the opening of the contacts when the residual current attains a given value under specified conditions

B.2.3.2
CBR functionally independent of line voltage
CBR for which the functions of detection and evaluation, and the actuating means of interruption (see B.2.3.6) do not depend on the line voltage

B.2.3.3
CBR functionally dependent on line voltage
CBR for which the functions of detection and/or evaluation, and/or the actuating means of interruption (see B.2.3.6) depend on the line voltage

Note 1 to entry: It is understood that the line voltage for detection, evaluation or interruption is applied to the CBR.

B.2.3.4
detection (of a residual current)
function consisting in sensing the presence of a residual current

Note 1 to entry: This function can be performed, for example, by a transformer integrating the vector sum of the currents.

[SOURCE: IEC 60050-442:1998, 442-05-24]

B.2.3.5
evaluation
function consisting in giving to the CBR the possibility to operate when the detected residual current exceeds a specified reference value

[SOURCE: IEC 60050-442:1998, 442-05-25, modified – In the term, "(for a residual current)" has been deleted and in the definition, "residual current device" has been replaced with "CBR".]

B.2.3.6
interruption
function consisting in bringing automatically the main contacts of the CBR from the closed position into the open position, thereby interrupting the current(s) flowing through them

[SOURCE: IEC 60050-442:1998, 442-05-26, modified – In the term, "(for a residual current device)" has been deleted and in the definition, "residual current device" has been replaced with "CBR".]

B.2.3.7
limiting non-actuating time
maximum delay during which a value of residual current higher than the rated residual non-operating current can be applied to the CBR without bringing it actually to operate

[SOURCE: IEC 60050-442:1998, 442-05-23, modified – In the definition, "residual current device" has been replaced with "CBR" and "rated" has been added.]

B.2.3.8
time-delay CBR
CBR specially designed to attain a predetermined value of limiting non-actuating time, corresponding to a given value of residual current

[SOURCE: IEC 60050-442:1998, 442-05-05, modified – In the definition and the term, "residual current device" has been replaced with "CBR".]

B.2.3.9
reset-CBR
CBR with an r.c. unit that shall be intentionally reset by a means different from the operating means of the CBR, following the occurrence of a residual current, before it can be reclosed

B.2.3.10
test device
device simulating a residual current for checking that the CBR operates

B.2.4 Terms and definitions relating to values and ranges of energizing quantities

B.2.4.1
limiting value of the non-operating over-current in the case of a single-phase load
maximum value of a single-phase over-current which, in the absence of a residual current, can flow through a CBR (whatever the number of poles) without causing it to operate

Note 1 to entry: See B.7.2.7.

B.2.4.2
residual short-circuit making and breaking capacity
value of the a.c. component of a residual prospective short-circuit current which a CBR can make, carry for its opening time and break under specified conditions of use and behaviour