भारतीय मानक IS/IEC 60898-2 : 2016

Indian Standard

विद्युत सहायक उपकरण — घरेलू और समान संस्थापनों के लिए ओवरकरंट से सुरक्षा हेतु परिपथ वियोजक

भाग 2 प्रत्यावर्ती धारा और दिष्ट धारा के प्रचालन के लिए परिपथ वियोजक

(पहला पुनरीक्षण)

Electrical Accessories — Circuit-Breakers for Overcurrent Protection for Household and Similar Installations

Part 2 Circuit-Breakers for a.c. and d.c. Operation

(First Revision)

ICS 29.120.50

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NATIONAL FOREWORD

This Indian Standard (Part 2) (First Revision) which is identical with IEC 60898-2 : 2016 'Electrical accessories — Circuit-breakers for overcurrent protection for household and similar installations — Part 2: Circuit-breakers for a.c. and d.c. operation' issued by the International Electrotechnical Commission (IEC) was adopted by the Bureau of Indian Standards on the recommendation of the Low Voltage Switchgear and Controlgear Sectional Committee and approval of the Electrotechnical Division Council.

Requirements for 'Circuit Breakers for over current protection for household and similar installations' were earlier covered under IS 8828 : 1996. IS 8828 was superseded by IS/IEC 60898-2 : 2003 in the year 2007. This revision of IS/IEC 60898-2 : 2003 has been undertaken to align this standard with the latest international practices.

The significant technical changes in this revision are as follows:

a) alignment with IS/IEC 60898-1 : 2015; and
b) introduction of test I_{cn1}.

The text of the IEC standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appears referring to this standard, they should be read as 'Indian Standard'; and
b) Comma (,) has been used as a decimal marker, while in Indian Standards the current practice is to use a point (.) as the decimal marker.

In this adopted standard, reference appears to International Standards for which Indian Standards also exists. The corresponding Indian Standards, which are to be substituted, are listed below along with their degree of equivalence for the editions indicated:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
IEC 60898-1 : 2015 Electrical accessories — Circuit-breakers for overcurrent protection for household and similar installations — Part 1: Circuit-breakers for a.c. operation	IS/IEC 60898-1 : 2015 Electrical accessories — Circuit-breakers for overcurrent protection for household and similar installations: Part 1 Circuit-breakers for a.c. operation (*first revision*)	Identical

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated expressing the result of a test, shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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Indian Standard

ELECTRICAL ACCESSORIES — CIRCUIT-BREAKERS FOR OVERCURRENT PROTECTION FOR HOUSEHOLD AND SIMILAR INSTALLATIONS

PART 2 CIRCUIT-BREAKERS FOR a.c. AND d.c. OPERATION

(First Revision)

1 Scope

Clause 1 of IEC 60898-1:2015 is applicable except as follows:

Addition at the end of the first paragraph:

This standard gives additional requirements for single- and two-pole circuit-breakers which, in addition to the above characteristics, are suitable for operation with direct current, and have a rated DC voltage not exceeding 220 V for single-pole and 440 V for two-pole circuit-breakers, a rated current not exceeding 125 A and a rated DC short-circuit capacity not exceeding 10 000 A.

NOTE This standard applies to circuit-breakers able to make and break both alternating current and direct current.

Delete the last two paragraphs.

2 Normative references

Clause 2 of IEC 60898-1:2015 is applicable except as follows:

Addition:

IEC 60898-1:2015, *Electrical accessories – Circuit-breakers for overcurrent protection for household and similar installations – Part 1: Circuit-breakers for a.c. operation*

3 Terms and definitions

Clause 3 of IEC 60898-1:2015 is applicable except as follows:

Addition:

3.5.10.3
time constant
T
rise time of a prospective direct current to reach a value of 0,63 times the maximum peak current

$T = L/R$ (ms)

4 Classification

Clause 4 of IEC 60898-1:2015 is applicable except as follows:

4.2 According to the number of poles:

Replacement:

– single-pole circuit-breakers;
– two-pole circuit-breakers with two protected poles.

4.6 According to the instantaneous tripping current (see 3.5.17)

Delete D-Type.

Addition:

4.8 According to the time constant

– circuit-breakers suitable for DC circuits with a time constant of $T \leq 4$ ms;
– circuit-breakers suitable for DC circuits with a time constant of $T \leq 15$ ms.

NOTE It is assumed that short-circuit currents of 1 500 A are not exceeded in installations in which, due to the loads connected, time constants in normal service up to 15 ms can occur. Where higher short-circuit currents can occur, the time constant of $T = 4$ ms is considered sufficient.

5 Characteristics of circuit-breakers

Clause 5 of IEC 60898-1:2015 is applicable except as follows:

5.3.1 Preferred values of rated voltage

Replacement:

The preferred values of rated voltage are given in Table 1.

Examples of connections of circuit-breakers in DC systems are given in Figure 18.

Table 1 – Preferred values of rated voltage

Circuit-breakers	AC		DC [b]		
	AC circuit supplying the circuit-breaker	Rated AC voltage	DC circuit supplying the circuit-breaker	Rated DC voltage	DC wiring examples
Single-pole	Single-phase (phase to neutral)	230 V	Two wires (unearthed system)	125 V or 220 V	Figure 18a
	Single-phase (phase to earthed middle conductor, or phase to neutral)	120 V	–	–	
	Single-phase (phase to neutral) or three-phase (3 single-pole circuit-breakers) (3-wire or 4-wire)	230/400 V	–	–	
Two-pole	Single-phase (phase-to-phase)	400 V	Two wires (earthed system)	220/440 V	Figures 18b, 18c, 18d
	Single phase (phase-to-phase, 3-wire)	120/240 V [a]	Two wires (earthed system)	125/250 V [a]	

Applicable for DC voltages:

[a] Also for single-pole circuit-breakers to be used in pairs at 250 V DC (respectively 240 V AC) and individually at 125 V DC (respectively 120 V AC).

[b] The rated voltage per pole does not exceed 220 V DC.

Applicable for AC voltages:

NOTE 1 In IEC 60038 the network voltage value of 230/400 V has been standardized. This value progressively supersedes the values of 220/380 V and 240/415 V.

NOTE 2 Wherever in this standard there is a reference to 230 V or 400 V, it can be read as 220 V or 240 V, and 380 V or 415 V, respectively.

NOTE 3 Circuit-breakers complying with this standard can be used in IT systems.

The manufacturer shall declare in his literature the minimum voltage for which the circuit-breaker is designed.

Relevant tests are under consideration.

5.3.5 Standard ranges of instantaneous tripping

Replacement:

Table 2 – Ranges of instantaneous tripping

Type	Ranges for alternating current	Ranges for direct current
B	Above 3 I_n up to and including 5 I_n	Above 4 I_n up to and including 7 I_n
C	Above 5 I_n up to and including 10 I_n	Above 7 I_n up to and including 15 I_n

6 Marking and other product information

Clause 6 of IEC 60898-1:2015 is applicable except as follows:

Replacement:

c) rated AC voltage with the symbol ~ (IEC 60417-5032:2002-10) and rated DC voltage with the symbol ⎓ (IEC 60417-5031:2002-10).

d) rated current without symbol "A", preceded by the symbol of instantaneous tripping (B or C), for example B 16;

f) rated short-circuit capacity for AC and DC in amperes in one rectangle, without the symbol A, if valid for both AC and DC (see Example 1 below). If the rated short-circuit capacity is different for AC and DC this shall be indicated in two adjacent rectangles, without the symbol A, with the symbol ~ (IEC 60417-5032:2002-10) near the rectangle containing the AC value and with the symbol ⎓ (IEC 60417-5031:2002-10) near the rectangle containing the DC value (see Example 2 below).

Delete j).

Addition:

m) time constant *T*15 within a rectangle, if applicable, associated with the marking for the short-circuit capacity at the time constant of 15 ms (see Example 3 below).

Replacement of the first paragraph following l):

If, for small devices, the space available does not allow all the above data to be marked, at least the information under c) and d) shall be marked and visible when the circuit-breaker is installed.

The information under a), b), e), f), g), h), i), l) and m) may be marked on the side or on the back of the device and be visible only before the device is installed.

Alternatively, the information under g) may be on the inside of any cover which has to be removed in order to connect the supply wires. Any remaining information not marked shall be given in the manufacturer’s literature.

EXAMPLE 1 6 000

EXAMPLE 2 10 000 ~

6 000 ⎓

EXAMPLE 3 | 1 500 | *T*15 |

The terminals shall be marked with + or – if necessary. Additionally, arrows indicating the direction of the current are allowed.

Indications on the possible connection diagrams according to Figure 18 shall be given in the manufacturer's documentation

7 Standard conditions for operation in service

Clause 7 of IEC 60898-1:2015 applies.

8 Requirements for construction and operation

Clause 8 of IEC 60898-1:2015 is applicable except as follows:

8.6.1 Standard time-current

zone *Replacement:*

Table 7 – Time-current operating characteristics

Test	Type	Test current AC	Test current DC	Initial condition	Limits of tripping or non-tripping time	Result to be obtained	Remarks
a	B, C	1,13 I_n		Cold [a]	$t \geq 1$ h ($I_n \leq 63$ A) $t \geq 2$ h ($I_n > 63$ A)	No tripping	
b	B, C	1,45 I_n		Immediately following test a	$t < 1$ h ($I_n \leq 63$ A) $t < 2$ h ($I_n > 63$ A)	Tripping	Current steadily increased within 5 s
c	B, C	2,55 I_n		Cold [a]	1 s < t < 60 s ($I_n \leq 32$ A) 1 s < t < 120 s ($I_n > 32$ A)	Tripping	
d	B C	3 I_n 5 I_n	4 I_n 7 I_n	Cold [a]	0,1 < t < 45 s ($I_n \leq 32$ A) 0,1 < t < 90 s ($I_n > 32$ A) 0,1 < t < 15 s ($I_n \leq 32$ A) 0,1 < t < 30 s ($I_n > 32$ A)	Tripping	Current established by closing an auxiliary switch
e	B C	5 I_n 10 I_n	7 I_n 15 I_n	Cold [a]	t < 0,1 s	Tripping	Current established by closing an auxiliary switch
[a] The term "cold" means without previous loading, at the reference calibration temperature.							

8.8 Performance at short-circuit currents

Replacement of the third paragraph:

It is required that circuit-breakers be able to make and to break any value of current up to and including the value corresponding to the rated short-circuit capacity at rated frequency, at a power-frequency recovery voltage equal to 105 % (±5 %) of the rated operational voltage and at any power factor not less or any time constant not greater than the appropriate limit of the range stated in 9.12.5. It is also required that the corresponding values of I^2t lie below the I^2t characteristic (see 3.5.13).

9 Tests

Clause 9 of IEC 60898-1:2015 is applicable except as follows:

9.2 Test conditions

Addition after the fourth paragraph:

For direct current, the test voltage (current) shall have a ripple of ω ≤ 5 % or have the minimum instantaneous value of the voltage (current) no lower than the required test voltage (current) −5 %

9.10.3.1 General test conditions

Replacement of second paragraph:

For the upper values of the test current, the test is made on each protected pole:

– *for alternating current, at rated voltage between phase to neutral with a power factor between 0,95 and 1;*

– *for direct current, a time constant of T = 4 ms or, for circuit-breakers marked with T15, a time constant of T = 15 ms.*

9.10.3.2 For circuit-breakers of the B-type

Replacement:

An alternating current equal to 3 I_n is passed through all poles connected in series, starting from cold. The opening time shall comply with Table 7.

An alternating current equal to 5 I_n is then passed through each pole separately, starting from cold. The opening time shall comply with Table 7.

A direct current equal to 4 I_n is passed through all poles connected in series, starting from cold. The opening time shall comply with Table 7.

A direct current equal to 7 I_n is then passed through each pole separately, starting from cold. The opening time shall comply with Table 7.

9.10.3.3 For circuit-breakers of the C-type

Replacement:

An alternating current equal to 5 I_n is passed through all poles connected in series, starting from cold. The opening time shall comply with Table 7.

An alternating current equal to 10 I_n is then passed through each pole separately, starting from cold. The opening time shall comply with Table 7.

A direct current equal to 7 I_n is passed through all poles connected in series, starting from cold. The opening time shall comply with Table 7.

A direct current equal to 15 I_n is then passed through each pole separately, starting from cold. The opening time shall comply with Table 7.

9.11.1 General test conditions

Addition after the fourth paragraph:

The direct current shall have a ripple of $\omega \leq 5$ % and a time constant of T = 4 ms (with a tolerance of $^{0}_{-10}$ %) or, for circuit-breakers marked with T15, a time constant of T = 15 ms (with a tolerance of $^{0}_{-10}$ %).

9.11.2 Test procedure

Replacement of the first paragraph:

One set of circuit-breakers is submitted to 4 000 operating cycles at alternating current, and another set to 1 000 operating cycles at direct current, both at their rated current.

9.12.3 Tolerances and test quantities

Addition:

– *ripple* ≤ 5 *%*

– *time constant* $^{0}_{-10}$ *%.*

9.12.5 Power factor of the test circuits

Replacement:

9.12.5 Power factor and time constant of the test circuits

Addition:

For DC test currents up to and including 1 500 A, one of the following time constants shall be used:

T = L / R = 4 ms *for devices not marked T15*

T = L / R = 15 ms *for devices marked T15.*

For DC tests currents above 1 500 A and less than or equal to 10 000 A, the tests for all samples are made at the time constant of T = 4 ms.

NOTE It is assumed that short-circuit currents of 1 500 A are not exceeded in installations in which, due to the loads connected, time constants in normal service up to 15 ms can occur. Where higher short-circuit currents can occur, the time constant of T = 4 ms is considered sufficient.

9.12.8 Interpretation of records

Replacement:

9.12.8.1 Interpretation of records in case of AC voltage

a) Determination of the applied and power frequency recovery voltages.

The applied and power frequency recovery voltages are determined from the record corresponding to the opening operation O, (see 9.12.11.1) made with the apparatus under test and estimated as indicated in Figure 6a. The voltage on the supply side shall be measured during the first cycle after arc extinction in all poles and after high frequency phenomena have subsided.

b) Determination of the prospective short-circuit current.

The AC component of the prospective current is taken as being equal to the r.m.s. value of the AC component of the calibration current (values corresponding to A_2 of Figure 6a). Where applicable, the prospective short-circuit current shall be the average of the prospective currents in all the phases.

9.12.8.2 Interpretation of records in case of DC voltage

a) Determination of the applied voltage and the recovery voltage.

The applied voltage and the recovery voltage are determined from the record taken during the break test. The voltage on the supply side shall be measured after arc extinction and after high frequency phenomena have subsided.

b) Determination of the prospective short-circuit current.

NOTE The value of the prospective current is taken as being equal to the maximum value A_2 as determined from the calibration curve because circuit-breakers according to this standard break the current before it has reached its maximum value.

The maximum value of the prospective current is indicated as A_2 in Figure 6b.

Replacement:

9.12.11.2 Tests at reduced short-circuit currents

by

9.12.11.2 Tests at reduced short-circuit currents and at small direct currents

Additional subclauses:

9.12.11.2.3 Tests at reduced DC short-circuit currents

At direct currents the test circuit is adjusted so as to obtain a current of 500 A or 10 × I_n whichever is the higher, at a time constant corresponding to the assigned time constant.

Each of the protected poles of the circuit-breaker is subjected separately to a test in a circuit, the connections of which are shown in Figure 3.

The circuit-breaker is caused to open automatically three times, the circuit being closed once by the auxiliary switch A and twice by the circuit-breaker itself.

The sequence of operations shall be:

$$O - t - CO - t - CO$$

After arc extinction, the recovery voltage shall be maintained for a duration not less than 0,1 s.

9.12.11.2.4 Test at small direct currents up to and including 150 A

The circuit-breaker shall be closed three times on to each of the test currents listed below; during the tests, the operating means is actuated as in normal use. If the circuit-breaker does not trip, it shall be switched off manually.

Test currents: 1 A, 2 A, 4 A, 8 A, 16 A, 32 A, 63 A, 150 A

The time between each operating cycle CO shall be at least 10 s, the closing time shall not be longer than 2 s. The time between the various test currents shall be at least 2 min.

The time of the arc extinction during the test shall not exceed 1 s.

9.12.11.3 Test at 1 500 A

Replacement of the first two paragraphs by the following paragraphs:

For circuit-breakers having rated short-circuit capacity of 1 500 A, the test circuit is calibrated according to 9.12.7.1 and 9.12.7.2, to obtain a current of 1 500 A at a power factor corresponding to this current according to Table 17.

For direct current the time constant is calibrated corresponding to the assigned time constant.

For circuit-breakers having rated short-circuit capacity exceeding 1 500 A, the test circuit is calibrated according to 9.12.7.1 and 9.12.7.3, at a power factor corresponding to 1 500 A, according to Table 17.

For direct current the time constant is calibrated corresponding to the assigned time constant.

Replacement of the eighth paragraph:

The sequence of operations shall be as specified in 9.12.11.2.1 and 9.12.11.2.3.

For single-pole circuit-breakers of rated voltage 230/400 V, the operations for alternating current are as follows:

Subsequent to the six O operations only two CO operations are performed. In addition, these circuit-breakers are then tested by performing simultaneously one O operation, with one circuit-breaker being inserted in each phase of the test circuit for three-pole circuit-breakers. For this test the auxiliary switch establishing the short-circuit is not synchronized.

9.12.11.4.2 Test at service short-circuit capacity (I_{cs})

Replacement of the first paragraph of a):

a) The test circuit is calibrated according to 9.12.7.1 and 9.12.7.3, on alternating current with a power factor according to Table 17, or on direct current with a time constant according to 9.12.5.

Addition:

e) In the case of direct current, the test sequence for single- and two-pole circuit-breakers is:

$$O - t - CO - t - CO$$

Three operations are made, the circuit being closed once by the auxiliary switch A and twice by the circuit-breaker.

9.12.11.4.3 Test at rated short-circuit capacity (I_{cn})

Replacement of the first paragraph:

a) The test circuit is calibrated according to 9.12.7.1 and 9.12.7.2, on alternating current with a power factor according to Table 17, or on direct current with a time constant according to 9.12.5.

Addition:

c) In the case of direct current, the test sequence for single- and two-pole circuit-breakers is:

$$O - t - CO$$

Two operations are made, the circuit being closed once by the auxiliary switch A and once by the circuit-breaker.

9.12.11.4.4 Test at the making and breaking capacity on an individual pole (I_{cn1}) of multipole circuit-breakers

Replacement:

9.12.11.4.4 Performance at rated making and breaking capacity (I_{cn1}) on individual poles of two-pole circuit-breakers

For alternating currents (AC), 9.12.11.4.4 of IEC 60898-1:2015 applies.

Additional tests for direct currents (DC):

The test circuit is calibrated according to 9.12.7.1 and 9.12.7.2 for DC currents with a time constant according to 9.12.5.

The test is carried out on each pole according to Figure 3 at a DC voltage equal to 0,5 times the rated voltage.

The pole which does not carry the short-circuit current during this test shall be connected to its supply voltage at the corresponding terminals.

The test sequence shall be:

$$O - t - CO$$

The two operations shall be carried out first by closing the auxiliary switch T and second by closing the circuit breaker.

9.12.12 Verification of the circuit-breaker after short-circuit tests

Addition at the end of 9.12.12.2:

The test of 9.12.11.2.4 is repeated but the test currents 63 A and 150 A are omitted.

Figure 6 – Example of short-circuit making or breaking test record in the case of a single-pole device on single phase a.c.

Renumber Figure 6 as Figure 6a.

Addition:

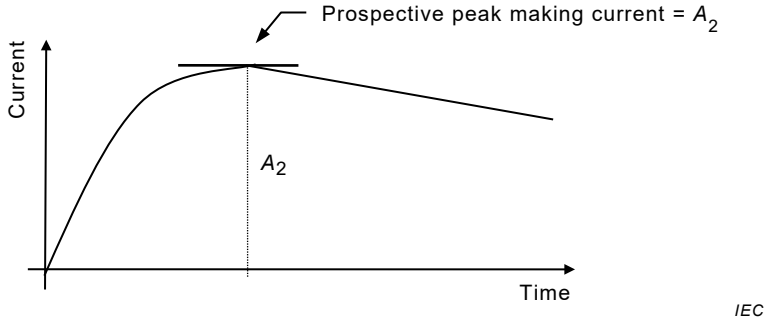
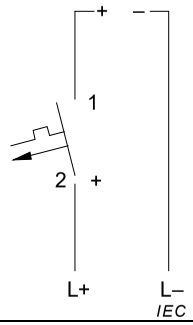
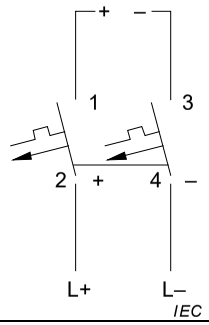
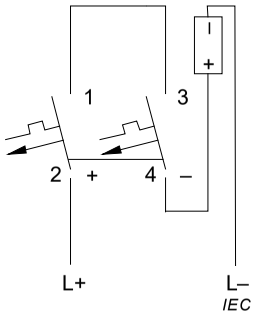
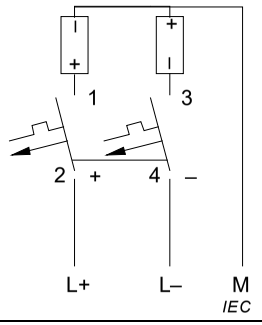


Figure 6b – Calibration of the test circuit in case of direct currents

Figure 6 – Calibration of the test circuit

Addition:

	a			b			c			d		
Circuit-breaker rated voltage	220 V	125 V		220/440 V		125/250 V	220/440 V		125/250 V	220/440 V		125/250 V
Maximum voltage between the conductors	220 V	125 V		440 V		250 V	440 V		250 V	440 V		250 V
Maximum voltage between conductor and earth							440 V [a]		250 V [a]	220 V		125 V
Circuit-breaker	Single-pole			Two-pole			Two-pole			Two-pole		
Distribution system connected to earth	No			No			Yes			Yes		
Circuit												

[a] For applications with an earthed negative pole, where the voltage to earth is higher than the rated voltage of a single-pole circuit-breaker.

Figure 18 – Methods of connection of the circuit-breakers in different DC systems

Annexes

The annexes of IEC 60898-1:2015 are applicable, except as follows:

Annex C
(normative)

Test sequences and number of samples

Annex C of IEC 60898-1:2015 applies with the following modifications:

Replacement:

Table C.1 – Test sequences

Test sequence	Clause or subclause	Test (or inspection)
A_1	6	Marking
	8.1.1	General
	8.1.2	Mechanism
	9.3	Indelibility of marking
	8.1.3	Clearances and creepage distances (external parts only)
	8.1.6	Non-interchangeability
	9.4	Reliability of screws, current-carrying parts and connections
	9.5	Reliability of screw-type terminals for external copper conductors
	9.6	Protection against electric shock
	8.1.3	Clearances and creepage distances (internal parts only)
	9.14	Resistance to heat
	9.16	Resistance to rusting
A_2	9.15	Resistance to abnormal heat and to fire
B	9.7.5.4	Verification of resistance of the insulation of open contacts and basic insulation against an impulse voltage in normal conditions
	9.7.1	Resistance to humidity
	9.7.2	Insulation resistance of the main circuit
	9.7.3	Dielectric strength of the main circuit
	9.7.4	Insulation resistance and dielectric strength of auxiliary circuit
	9.7.5.2	Verification of clearances with the impulse withstand voltage
	9.8	Temperature rise and power loss
	9.9	28-day test

Test sequence		Clause or subclause	Test (or inspection)		
			Test performed at		
C	C_1	9.11			Mechanical and electrical endurance
		9.12.11.2.1	AC		Test at reduced AC short-circuit currents
		9.12.12			Verification of circuit-breaker after short-circuit tests
		9.11			Mechanical and electrical endurance
		9.12.11.2.3		DC	Test at reduced DC short-circuit currents
		9.12.12			Verification of circuit-breaker after short-circuit tests
	C_2	9.12.11.2.2	AC		Short-circuit test for verifying the suitability of circuit-breakers for use in IT systems
		9.12.12			Verification of circuit-breaker after short-circuit tests
	C_3	9.12.11.2.4		DC	Test at small direct currents up to and including 150 A
		9.12.12			Verification of circuit-breaker after short-circuit tests
D	D_0	9.10	AC	DC	Tripping characteristic
	D_1	9.13	AC	DC	Mechanical stresses
		9.12.11.3			Short-circuit performance at 1 500 A
		9.12.12			Verification of circuit-breaker after short-circuit tests
E	E_1	9.12.11.4.2	AC	DC	Service short-circuit capacity (I_{cs})
		9.12.12			Verification of circuit-breaker after short-circuit tests
	E_2	9.12.11.4.3	AC	DC	Performance at rated short-circuit capacity (I_{cn})
		9.12.12			Verification of circuit-breaker after short-circuit tests
	E_3	9.12.11.4.4	AC	DC	Performance at rated making and breaking capacity (I_{cn1}) on individual poles of two-pole circuit-breaker
		9.12.12			Verification of circuit-breaker after short-circuit tests
NOTE With the agreement of the manufacturer, the same samples can be used for more than one sequence.					

Replacement:

Table C.2 – Number of samples for full test procedure

Test sequence		Number of samples		Minimum number of samples which shall pass the tests [a] [b]		Number of samples for repeated tests [c]	
		AC	DC	AC	DC	AC	DC
A_1		1		1			
A_2		3		2		3	
B		3		2		3	
C	C_1	3	3	2 [e]	2 [e]	3	3
	C_2	3		2 [e]		3	
	C_3		3		2		2
D		3	3	2 [e]	2 [e]	3	3
E_1		3 + 3 [d]	3	2 [e] + 2 [d e]	2 [e]	3 + 3 [d]	3
E_2		3 + 4 [d]	3	2 [e] + 3 [d e]	2 [e]	3 + 4 [d]	3
E_3		3	3	2 [e]	2 [e]	3	3

[a] In total, a maximum of two test sequences may be repeated.

[b] It is assumed that a sample which has not passed a test has not met the requirements due to workmanship or assembly defects which are not representative of the design.

[c] In the case of repeated tests, all results shall be acceptable.

[d] Supplementary samples in the case of single-pole circuit-breakers of rated voltage 230/400 V.

[e] All samples shall meet the test requirements of 9.12.10, 9.12.11.2, 9.12.11.3 and 9.12.11.4 as appropriate.

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