IEC 60898-1

Edition 2.0 2019-12

INTERNATIONAL STANDARD

NORME INTERNATIONALE

AMENDMENT 1
AMENDEMENT 1

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

Petit appareillage électrique – Disjoncteurs pour la protection contre les surintensités pour installations domestiques et analogues – Partie 1: Disjoncteurs pour le fonctionnement en courant alternatif

IEC 60898-1:2015-03/AMD1:2019-12(en-fr)

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FOREWORD

This amendment 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 amendment is based on the following documents:

FDIS	Report on voting
23E/1156/FDIS	23E/1157/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- withdrawn,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.

FOREWORD

*Add the following paragraph after the sentence "*This publication has been drafted in accordance with the ISO/IEC Directives, Part 2*":*

The following differing practices of a less permanent nature exist in the countries indicated below.

– Annex J, Clause J.1: Upper limit of current for use of screwless terminals is 16 A (CZ, DK, NL and CH; upper limit of current for use of screwless terminals is 30 A (Japan).
– J.3.3: Only universal screwless-type terminals are accepted (AT, BE, CN, DK, DE, ES, FR, IT, PT, SE and CH).

1 Scope

*Replace in the third paragraph "*for not being maintained*" with "*do not require maintenance*".*

*Add, at the end of the fourth paragraph, after "*pollution degree 2*", the following text "*and overvoltage category III*".*

Add, after the second paragraph, the following note:

NOTE 1 Additional requirements are necessary for circuit-breakers used in locations having more severe overvoltage conditions.

Add, after the fourth paragraph, the following text:

For an environment with a higher pollution degree, enclosures giving the appropriate degree of protection are used.

Add, after the tenth paragraph, the following text:

This document does not apply to circuit-breakers for DC operation that are covered by IEC 60898-3.

*Delete paragraph 13: "*For an environment […] should be used.*".*

Renumber the existing note in paragraph 14 "NOTE 2".

2 Normative references

Add the following reference to Clause 2:

IEC 60664-3, *Insulation coordination for equipment within low-voltage systems – Part 3: Use of coating, potting or moulding for protection against pollution*

3 Terms and definitions

3.2.13

*Replace "*operation sequence*" by "*operating sequence*".*

Insert the following new terms and definitions:

3.2.15
type test
test of one or more devices made to a certain design to show that the design meets certain requirements

[SOURCE: IEC 60050-411:1996, 411-53-01, modified – "machines" and "specifications" have been replaced by "devices" and "requirements", respectively.]

3.2.16
routine test
test to which each individual device is subjected during or after manufacture to ascertain whether it complies with certain criteria

[SOURCE: IEC 60050-411:1996, 411-53-02, modified – "machine" has been replaced with "device".]

3.5.14.2

Replace the source text by the following:

[SOURCE: IEC 60947-2:2016, 2.17.1, modified – "in series" has been added.]

3.5.16

*Replace, in the definition, "*to trip*" by "*to operate*".*

5.1 List of characteristics

Replace list items:

– range of instantaneous tripping current (see 4.5 and 5.3.5);
– I^2t classification (see 4.6).

with the following:

– range of instantaneous tripping current (see 4.6 and 5.3.5);
– I^2t classification (see 4.7).

5.2.4 Rated short-circuit capacity (I_{cn})

*Replace the reference to "*Table 17*" in the note, by "*Table 18*".*

5.3.1 Preferred values of rated voltage

Table 1 – Preferred values of rated voltage

Delete NOTE 1 in Table 1 and renumber the other notes accordingly.

5.3.6 Standard values of rated impulse withstand voltage (U_{imp})

Replace Table 3 by the following new Table 3:

Table 3 – Rated impulse withstand voltage as a function of the nominal voltage of the installation

Rated impulse withstand voltage U_{imp} kV	Nominal voltage of the installation	
	Three-phase systems V	Single-phase system with mid-point earthed V
2,5[a]		120/240[b]
4[a]	230/400	120/240, 240[c]
NOTE 1 For test voltages to check the insulation, see Table 14. NOTE 2 For test voltages to check the isolation distance across open contacts, see Table 15.		
[a] The values 3 kV and 5 kV, respectively, are used for verifying the isolating distances across open contacts at the altitude of 2 000 m (see Table 15). [b] For installation practice in Japan. [c] For installation practice in North American countries.		

6 Marking and other product information

Add the following new paragraph after NOTE 3:

For rail-mounted circuit-breakers, appropriate rail(s) shall be indicated in the manufacturer's documentation.

8 Requirements for construction and operation

8.1.3 Clearances and creepage distances (see Annex B)

Replace 8.1.3 by the following new 8.1.3:

8.1.3 Clearances, creepage distances and solid insulation

The minimum required clearances and creepage distances are given in Table 4 which is based on the circuit-breaker being designed for operating in an environment with pollution degree 2.

Parts of PCBs connected to live parts and protected against pollution by the use of a type 2 protection according to IEC 60664-3 are exempted from this verification.

The insulating materials are classified into material groups on the basis of their comparative tracking index (CTI) according to IEC 60664-1.

NOTE 1 The comparative tracking index (CTI) is declared by the manufacturer on the basis of tests carried out on the insulating material.

NOTE 2 Information on the requirements for design of solid insulation is provided in IEC 60664-1.

For clearances on printed wiring material, footnote 3 in Table F.2 of IEC 60664-1:2007 applies. For creepage distances on printed wiring material, the distances from Table F.4 of IEC 60664-1:2007 for pollution degree 1 can be applied only if protected with a coating meeting IEC 60664-3 requirements and tests.

Table 4 – Minimum clearances and creepage distances

	Minimum clearances mm			**Minimum creepage distances** [e, f] mm											
				Group IIIa [h] **(175 V ≤ CTI < 400 V)**[d]				**Group II (400 V ≤ CTI < 600 V)**[d]				**Group I (600 V ≤ CTI)**[d]			
	Rated voltage V			**Working voltage**[e] V											
	U_{imp}														
	2,5 kV	**4 kV**	**4 kV**												
Description/item	120/240 120	120/240 240	230/400 230 400	> 25 ≤ 50[i]	120	250	400	> 25 ≤ 50[i]	120	250	400	> 25 ≤ 50[i]	120	250	400
1. Between live parts which are separated when the main contacts are in the open position[a, j]	2,0	4,0	4,0	1,2	2,0	4,0	4,0	0,9	2,0	4,0	4,0	0,6	2,0	4,0	4,0
2. Between live parts of different polarity[a]	1,5	3,0	3,0	1,2	1,5	3,0	4,0	0,9	1,5	3,0	3,0	0,6	1,5	3,0	3,0
3. Between circuits supplied from different sources, one of which being PELV or SELV[g]	3,0	6,0	8,0	3,0	6,0	8,0			3,0	6,0	8,0		3,0	6,0	8,0
	Rated voltage V														
				120/240		230/400		120/240		230/400		120/240		230/400	
4. Between live parts and – accessible surfaces of operating means – screws or other means for fixing covers which have to be removed when mounting the circuit-breaker – surface on which the circuit-breaker is mounted[b] – screws or other means for fixing the circuit-breaker – metal covers or boxes[b] – other accessible metal parts[c] – metal frames supporting flush-type circuit-breakers	1,5	3,0	3,0	1,5		4,0		1,5		3,0		1,5		3,0	

Care should be taken to provide adequate clearances and creepage distances between live parts of different polarity of circuit-breakers, for example of the plug-in type mounted close to one another. If the surfaces adjacent to the circuit-breaker do not meet the clearance and creepage distance requirements, appropriate information will be provided for installation purposes. NOTE 1 The values given for 400 V are also valid for 440 V. NOTE 2 The parts of the neutral path, if any, are considered to be live parts.
[a] For auxiliary and control contacts the values are given in the relevant standard. [b] The values are doubled if clearances and creepage distances between live parts of the device and the metallic screen or the surface on which the circuit-breaker is mounted are not dependent on the design of the circuit-breaker only, so that they can be reduced when the circuit-breaker is mounted in the most unfavourable condition. [c] Including a metal foil in contact with the surfaces of insulating material which are accessible after installation for normal use. The foil is pushed into corners, grooves, etc., by means of a straight unjointed test finger according to 9.6 (see Figure 8). [d] See IEC 60112. [e] Interpolation is allowed in determining creepage distances corresponding to voltage values intermediate to those listed as working voltage. When interpolating, linear interpolation shall be used and values shall be rounded to the same number of digits as the values taken from the tables. For determination of creepage distances, see Annex B. [f] Creepage distances cannot be less than the associated clearances. [g] To cover all different voltages including ELV in an auxiliary contact. [h] For material group IIIb (100 V ≤ CTI < 175 V) the values for material group IIIa multiplied by 1,6 apply. [i] For working voltages up to and including 25 V, reference may be made to IEC 60664-1. [j] The clearance and creepage distances between the metal parts within the arc chamber may be less than 1 mm, provided that the sum of distances is greater than specified in item 1 of Table 4.

8.1.3.1 Clearances

Compliance as regards item 1 in Table 4 is checked by measurement and by the tests of 9.7.5.4.

The test is carried out with samples not submitted to the humidity treatment described in 9.7.1.

Compliance as regards items 2 and 4 in Table 4 is checked by measurement and, if the clearances are reduced, by the tests of 9.7.5.2.

The clearances of items 2 and 4 (except for accessible surfaces after installation, see note) may be reduced provided that the measured clearances are not shorter than the minimum allowed in IEC 60664-1 for homogenous field conditions. In this case, compliance as regards items 2 and 4 is always checked by the test of 9.7.5.2.

NOTE An accessible surface after installation means any surface accessible by the user when the circuit-breaker is installed according to the manufacturer's instructions. The test finger can be applied to determine whether a surface is accessible or not.

Compliance as regards item 3 in Table 4 is checked by measurement.

8.1.3.2 Creepage distances

Compliance as regards items 1, 2, 3 and 4 of Table 4 is checked by measurement.

NOTE All measurements required in 8.1.3 are carried out in Test sequence A on one sample. Tests according to 9.7.2 to 9.7.5 are carried out in Test sequence B on three samples.

8.1.3.3 Solid insulation

Compliance is checked by the tests according to 9.7.2, 9.7.3, 9.7.4 and 9.7.5, as applicable.

8.1.4.4

Replace in the last paragraph "parts of electronic devices" *by* "electronic components, including printed circuit board".

Add at the end of the subclause "Compliance is checked by inspection in accordance with the manufacturer's declaration.".

8.1.5.1

Replace in the last paragraph "in the standard" by "in this document".

8.1.5.12

Replace "of the tapping screw type" *by* "the thread cutting type".

Add at the end of the subclause "Compliance is checked by inspection.".

8.1.7.1 General

Replace "the holding in position of which" *by* "the retention of which".

8.1.7.2 Plug-in type circuit-breakers, the holding in position of which does not depend solely on their plug-in connection(s)

Replace in the title "the holding in position of which" *by* "the retention of which".

8.1.7.3 Plug-in type circuit-breakers, the holding in position of which depends solely on their plug-in connection(s)

Replace in the title "the holding in position of which" *by* "the retention of which".

Add the following new subclauses:

8.14 Electromagnetic immunity

Circuit-breakers for overcurrent protection for household and similar installations are not sensitive to normal electromagnetic disturbances and therefore no immunity tests are required.

8.15 Electromagnetic emission

Electromagnetic disturbances can only be generated by circuit-breakers for overcurrent protection for household and similar installations during occasional switching or automatic breaking operations. The duration of the disturbances is of the order of milliseconds.

The frequency, the level and the consequences of these emissions are considered as part of the normal electromagnetic environment of low-voltage installations. Therefore the requirements for electromagnetic emissions are deemed to be satisfied and no verification is necessary.

9.2 Test conditions

Add, after the sixth paragraph, the following text:

"*The tightening torques to be applied to the terminal screws are two-thirds of those specified in Table 11.*"

and delete the same sentence before Table 10.

9.3 Test of indelibility of marking

Add after the first paragraph:

Alternately the following solvent could be used: n-hexane 95 % (Chemical Abstracts Service Registry Number CAS RN: 110-54-3).

NOTE n-hexane 95 % (Chemical Abstracts Service Registry Number CAS RN: 110-54-3) is available from a variety of chemical suppliers as a high-pressure liquid chromatography (HPLC) solvent.

Only the mandatory markings of Clause 6 are subjected to this test.

Add in the second paragraph the word "laser" after "moulding,".

9.4 Test of reliability of screws, current-carrying parts and connections

Delete the last two paragraphs of the subclause.

9.5.1

Replace in the second paragraph "These last tests" by "The tests of 9.4 and 9.5".

9.5.2

Replace in the second and third paragraphs "terminal" by "terminals".

9.5.3

Replace in the third paragraph "severed wires" by "severed strands".

Replace the existing 9.7 by the following new 9.7.

9.7 Test of dielectric properties

9.7.1 Resistance to humidity

9.7.1.1 Preparation of the circuit-breaker for test

Parts which can be removed without the aid of a tool are removed and subjected to the humidity treatment with the main part; spring lids are kept open during this treatment.

Inlet openings, if any, are left open; if knock-outs are provided, one of them is opened.

9.7.1.2 Test conditions

The humidity treatment is carried out in a humidity cabinet containing air with a relative humidity maintained between 91 % and 95 %.

The temperature of the air in which the sample is placed is maintained within ±1 °C of any convenient value *T* between 20 °C and 30 °C.

Before being placed in the humidity cabinet, the sample is brought to a temperature between *T* °C and *T* °C +4 °C.

9.7.1.3 Test procedure

The sample is kept in the cabinet for 48 h.

NOTE A relative humidity between 91 % and 95 % can be obtained by placing in the humidity cabinet a saturated solution of sodium sulphate (Na_2SO_4) or potassium nitrate (KNO_3) in water having a sufficiently large contact surface with the air.

In order to achieve the specified conditions within the cabinet, it is necessary to ensure constant circulation of the air within and, in general, to use a cabinet which is thermally insulated.

9.7.1.4 Condition of the circuit-breaker after the test

After this treatment, the sample shall show no damage within the meaning of this document and shall withstand the tests of 9.7.2, 9.7.3, 9.7.4, and 9.7.5.2.

9.7.2 Insulation resistance of the main circuit

The circuit-breaker having been treated as specified in 9.7.1 is then removed from the cabinet.

After an interval between 30 min and 60 min following this treatment, the insulation resistance is measured 5 s after application of a DC voltage of approximately 500^{+100}_{0} V, in the following order:

a) with the circuit-breaker in the open position, between each pair of the terminals which are electrically connected together when the circuit-breaker is in the closed position, in turn on each pole;

b) with the circuit-breaker in the closed position, in turn between each pole and the other poles connected together, electronic components connected between current paths being disconnected for the test;

c) with the circuit-breaker in the closed position, between all poles connected together and the frame, including a metal foil or part in contact with the outer surface of the housing of insulating material but with the terminal areas kept completely free to avoid flashover between terminals and the metal foil;

d) for circuit-breakers with a metal enclosure having an internal lining of insulating material, between the frame and a metal foil in contact with the inner surface of the lining of insulating material including bushings and similar devices.

The measurements in items a), b) and c) are carried out after having connected all auxiliary circuits to the frame.

The term "frame" includes:

– all accessible metal parts and a metal foil in contact with the surfaces of insulating material which are accessible after installation as for normal use;
– the surface on which the base of the circuit-breaker is mounted, covered, if necessary, with a metal foil;
– screws and other devices for fixing the base to its support;
– screws for fixing covers which have to be removed when mounting the circuit-breaker;
– metal parts of operating means referred to in 8.2.

If the circuit-breaker is provided with a terminal intended for the interconnection of protective conductors, this terminal is connected to the frame.

For the measurements according to items b), c) and d), the metal foil is applied in such a way that the sealing compound, if any, is effectively tested.

The insulation resistance shall be not less than

– 2 MΩ for the measurements according to items a) and b);

– 5 MΩ for the other measurements.

9.7.3 Dielectric strength of the main circuit

After the circuit-breaker has passed the tests of 9.7.2, the test voltage specified is applied for 1 min between the parts indicated in 9.7.2, with electronic components, if any, being disconnected for the test.

The test voltage shall have a practically sinusoidal waveform, and a frequency between 45 Hz and 65 Hz.

The source of the test voltage shall be capable of supplying a short-circuit current of at least 0,2 A.

No overcurrent tripping device of the transformer shall operate when the current in the output circuit is lower than 100 mA.

The values of the test voltage shall be as follows:

– 2 000 V for items a) to c) of 9.7.2;

– 2 500 V for item d) of 9.7.2.

Initially, not more than half the voltage specified in the list above is applied, then it is raised to the full value within 5 s.

No flashover or breakdown shall occur during the test.

Glow discharges without drop in the voltage are neglected.

9.7.4 Insulation resistance and dielectric strength of auxiliary circuits

Insulation resistance and dielectric strength shall be verified according to the following a), b) and c).

a) The measurement of the insulation resistance and the dielectric strength tests for the auxiliary circuits are carried out immediately after the measurement of the insulation resistance and the dielectric strength tests for the main circuit, under the conditions given in b) and c) below.

   Where electronic components connected to the main circuit in normal service are used, the temporary connections for test shall be made so that, during the tests, there is no voltage between the incoming and outgoing sides of the components.

b) The measurements of the insulation resistance are carried out:

   – between the auxiliary circuits connected to each other and to the frame;

   – between each part of an auxiliary circuit which can be separated from the other parts in normal service and all the other parts connected together.

   For both tests listed under b), a test voltage of 500^{+100}_{0} V is applied. After this voltage has been applied for 1 min the insulation resistance shall be not less than 2 MΩ.

c) A substantially sinusoidal voltage at rated frequency is applied for 1 min between the parts listed under b).

   The voltage values to be applied are specified in Table 13.

Table 13 – Test voltage of auxiliary circuits

Rated voltage of auxiliary circuits (AC or DC) V		Test voltage V
Greater than	Up to and including	
0	30	600
30	50	1 000
50	110	1 500
110	250	2 000
250	500	2 500

At the beginning of the test the voltage shall not exceed half the value specified. It is then increased steadily to the full value within 5 s.

During the test, there shall be no flashover or perforation.

NOTE 1 Discharges which do not correspond to a voltage drop are disregarded.

NOTE 2 In the case of circuit-breakers in which the auxiliary circuit is not accessible for verification of the requirements given in b), the tests can be made on samples specially prepared by the manufacturer or according to the manufacturer's instructions.

9.7.5 Verification of impulse withstand voltages (across clearances and across solid insulation) and of leakage current across open contacts

9.7.5.1 General testing procedure for the impulse withstand voltage tests

The impulses are given by a generator producing positive and negative impulses having a front time of 1,2 µs, and a time to half-value of 50 µs, the tolerances being as follows:

– ±5 % for the peak value;

– ±30 % for the front time;

– ±20 % for the time to half-value.

For each test, five positive impulses and five negative impulses are applied. The interval between consecutive impulses being at least 1 s for impulses of the same polarity and being at least 10 s for impulses of the opposite polarity.

When performing the impulse voltage test on a complete circuit-breaker, the attenuation or amplification of the test voltage shall be taken into account. It needs to be ensured that the required value of the test voltage is applied across the terminals of the equipment under test.

The surge impedance of the test apparatus shall have a nominal value of 500 Ω.

When carrying out tests on a circuit-breaker incorporating components across the parts under test (e.g. surge protective components), an impulse generator with a virtual impedance of 2 Ω shall be used.

The shape of the impulses is adjusted with the circuit-breaker under test connected to the impulse generator. For this purpose, appropriate voltage dividers and voltage sensors shall be used.

For a circuit-breaker incorporating components across the parts under test (e.g. surge protective components), the shape of the impulses is adjusted without connection of the circuit-breaker to the impulse generator.

Small oscillations in the impulses are allowed provided that their amplitude near the peak of the impulse is less than 5 % of the peak value.

For oscillations on the first half of the front, amplitudes up to 10 % of the peak value are allowed.

There shall be no disruptive discharge (sparkover, flashover or puncture) during the tests.

Partial discharges in clearances which do not result in breakdown are disregarded.

9.7.5.2 Verification of clearances with the impulse withstand voltage

If the measurement of clearances of items 2 and 4 of Table 4 does not show any reduced clearance, this test is not applied.

Where measurements of clearances within the device are not feasible this test may be used to replace measurements of clearances of items 2 and 4 of Table 4.

The test is carried out on a circuit-breaker fixed on a metal support and being in the closed position.

The test impulse voltage value shall be as specified in Table 14 in accordance with the rated impulse voltage of the circuit-breaker as given in Table 3. These values are corrected for barometric pressure and/or altitude at which the tests are carried out, according to Table 14.

Tests are made applying the impulse voltage:

a) in turn between each pole and the other poles connected together, electronic components connected between current paths being disconnected for the test.

b) between all poles connected together and the frame including a metal foil or part in contact with the outer surface of the housing of insulating material but with the terminal areas kept completely free to avoid flashover between terminals and the metal foil;

c) for circuit-breakers with a metal enclosure having an internal lining of insulating material, between the frame and a metal foil in contact with the inner surface of the lining of insulating material, including bushings and similar devices.

NOTE 1 The term "frame" is defined in 9.7.2.

Where applicable, the metal foil is applied in such a way that the sealing compound, if any, is effectively tested.

There shall be no disruptive discharge. If, however, only one such disruptive discharge occurs, ten additional impulses having the same polarity as that which caused the disruptive discharge are applied, the connections being the same as those with which the failure occurred.

No further disruptive discharge shall occur.

NOTE 2 The expression "disruptive discharge" is used to cover the phenomena associated with the failure of insulation under electric stress, which include a drop in the voltage and the flowing of current.