



BSI Standards Publication

Electrical accessories — Circuit-breakers for overcurrent protection for household and similar installations

Part 1: Circuit-breakers for a.c. operation

National foreword

This British Standard is the UK implementation of EN 60898-1:2019+A11:2024 and EN 60898-1:2019+A1:2024. It is derived from IEC 60898-1:2015, incorporating amendment 1:2019. It supersedes BS EN 60898-1:2019, which will be withdrawn on 22 April 2027.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to IEC text carry the number of the IEC amendment. For example, text altered by IEC amendment 1 is indicated by **A1** **A1**.

The start and finish of text introduced or altered by amendment A11 is indicated in the text by tags. Tags indicating changes to text carry the number of the CENELEC amendment. For example, text altered by CENELEC amendment A11 is indicated by **A11** **A11**.

The CENELEC common modifications have been implemented at the appropriate places in the text. The start and finish of each common modification is indicated in the text by tags **C** **C**.

The UK participation in its preparation was entrusted to Technical Committee PEL/23/1, Circuit breakers and similar equipment for household use.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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UK Government is responsible for legislation. For information on legislation and policies relating to that legislation, consult the relevant pages of www.gov.uk.

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Date	Text affected
31 July 2024	Implementation of IEC amendment 1:2019 with CENELEC endorsement A1:2024 and CENELEC amendment A11:2024

English Version

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

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 , modifiée)

Elektrisches Installationsmaterial - Leitungsschutzschalter
für Hausinstallationen und ähnliche Zwecke - Teil 1:
Leitungsschutzschalter für Wechselstrom (AC)
(IEC 60898-1:2015 , modifiziert)

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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European foreword

This document (EN 60898-1:2018) consists of the text of IEC 60898-1:2015 prepared by SC 23E “Circuit-breakers and similar equipment for household use” of IEC/TC 23 “Electrical accessories”, together with the common modifications prepared by CLC/TC 23E “Circuit breakers and similar devices for household and similar applications”.

The following dates are fixed:

- latest date by which this document has to be (dop) 2019-07-18
implemented at national level by publication of an
identical national standard or by endorsement
- latest date by which the national standards (dow) 2024-05-28
conflicting with this document have to be withdrawn

This document supersedes EN 60898-1:2003, EN 60898-1:2003/A1:2004, and EN 60898-1:2003/A12:2008.

Clauses, subclauses, notes, tables, figures and annexes which are additional to those in IEC 60898-1:2015 are prefixed “Z”.

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For the relationship with EU Directive(s) see informative Annex ZZ, which is an integral part of this document.

Endorsement notice

The text of the International Standard IEC 60898-1:2015 was approved by CENELEC as a European Standard with agreed common modifications.

European foreword to Amendment 1

This document (EN 60898-1:2019/A1:2024) consists of the text of document IEC 60898-1:2015/AMD1:2019, prepared by IEC/SC 23E, "Circuitbreakers and similar equipment for household use", of IEC/TC 23 "Electrical accessories".

The following dates are fixed:

- latest date by which this document has to be (dop) 2025-04-22 implemented at national level by publication of an identical national standard or by endorsement
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This document has been prepared under a standardization request addressed to CENELEC by the European Commission. The Standing Committee of the EFTA States subsequently approves these requests for its Member States.

For the relationship with EU Legislation, see informative Annex ZZ, which is an integral part of EN 60898-1:2019/A11:2024.

Any feedback and questions on this document should be directed to the users' national committee. A complete listing of these bodies can be found on the CENELEC website

Endorsement notice

The text of the International Standard IEC 60898-1:2015/AMD1:2019 was approved by CENELEC as a European Standard without any modification.

European foreword to Amendment A11

This document (EN 60898-1:2019/A11:2024) has been prepared by CLC/TC 23E “Circuit breakers and similar devices for household and similar applications”.

The following dates are fixed:

- latest date by which this document has to be (dop) 2025-04-22
implemented at national level by publication of
an identical national standard or by
endorsement
- latest date by which the national standards (dow) 2027-04-22
conflicting with this document have to be
withdrawn

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This document is read in conjunction with EN 60898-1:2019 and EN 60898-1:2019/A1:2024.

This document has been prepared under a standardization request addressed to CENELEC by the European Commission. The Standing Committee of the EFTA States subsequently approves these requests for its Member States.

For relationship with EU Legislation, see informative Annex ZZ, which is an integral part of this document.

This amendment and EN 60898-1:2019/A1:2024 include the following significant technical changes with respect to EN 60898-1:2019:

- Clause 6, Marking and other product information: addition of two items dealing with the grid distance “a”; one for the value of “a”, the other for the installation information, when “a” is greater than 35 mm.
- Subclause 8.1.3, Clearances, creepage distances and solid insulation and 9.7, Test of dielectric properties: text is rearranged to be in line with the IEC 61008 and IEC 61009 series.
- Subclause 9.9, 28-day test: the reference temperature is measured during the first cycle (previously during the temperature-rise test).
- Subclause 9.12.9.2 (Short-circuit) Test in free air, addition of a maximum grid distance of 250 mm.
- Annex J: Upper limit of current for use of screwless terminals is increased up to 40 A.

This document has been prepared under a standardization request addressed to CENELEC by the European Commission. The Standing Committee of the EFTA States subsequently approves these requests for its Member States.

For relationship with EU Legislation, see informative Annex ZZ, which is an integral part of this document.

Any feedback and questions on this document should be directed to the users’ national committee. A complete listing of these bodies can be found on the CENELEC website.

Annex ZA (normative)

Classification of circuit-breakers Type B and C up to and including 63 A into energy limiting classes

Circuit-breakers of B-type and C-type up to and including 63 A, shall be classified into energy limiting classes 1 or 3 in accordance with Table ZA.1 or Table ZA.2, as applicable, and be marked with the number of the energy limiting class in a square adjoining the symbol given in f) of Clause 6.

This classification shall not be applied to circuit-breakers type D and to circuit-breakers with rated current higher than 63 A.

Table ZA.1 – Permissible I^2t (let-through) values for circuit-breakers type B with rated current up to and including 63 A

Rated shortcircuit capacity A	Type B				
	Class 1	Class 3			
	≤ 63 A	≤ 16 A	20 A, 25 A, 32 A	40 A	50 A, 63 A
3 000	No limits specified	15 000	18 000	21 600	28 000
4 500		25 000	32 000	38 400	48 000
6 000		35 000	45 000	54 000	65 000
10 000		70 000	90 000	108 000	135 000

Table ZA.2 – Permissible I^2t (let-through) values for circuit breakers type C with rated current up to and including 63 A

Rated shortcircuit capacity A	Type C				
	Class 1	Class 3			
	≤ 63 A	≤ 16 A	20 A, 25 A, 32 A	40 A	50 A, 63 A
3 000	No limits specified	17 000	20 000	24 000	30 000
4 500		28 000	37 000	45 000	55 000
6 000		40 000	52 000	63 000	75 000
10 000		80 000	100 000	120 000	145 000

The maximum I^2t values measured during the test sequence E1 or E2 as applicable serve as reference values for the classification

Compliance with the requirements of Tables ZA.1 and ZA.2 is checked on the circuit-breakers with the highest rated current available within the range covered by each of these tables.

If these current ratings are not included in the samples submitted to test sequence E₁ or E₂ of Annex C, the appropriate number of samples of these ratings shall be additionally submitted to that test sequence. None of the values measured shall exceed the permissible I^2t value of the proposed energy limiting class in accordance with Tables ZA.1 and ZA.2.

If circuit-breakers rated 40 A are submitted with the range of circuit-breakers with rating exceeding 16 A and their measured I^2t values are lower than those indicated in Table ZA.1 or Table ZA.2 for rating 32 A, no relevant test is necessary for the circuit-breakers rated 32 A.

EN 60898-1:2019+A11:2024 (E)

If circuit-breakers rated 50 A or 63 A are submitted with the range of circuit-breakers with rating exceeding 32 A and their measured I^2t values are lower than those indicated in Table ZA.1 or Table ZA.2 for rating 40 A, no relevant test is necessary for the circuit-breakers rated 40 A.

If circuit-breakers of D-type are submitted with the range of circuit-breakers of type B or type C and their measured I^2t values are lower than those indicated in Table ZA.1 or Table ZA.2 respectively, no relevant test is necessary for the circuit-breakers of type B or type C respectively.

If circuit-breakers of C-type are submitted with the range of circuit-breakers of type B and their measured I^2t values are lower than those indicated in Table ZA.1, no relevant test is necessary for the circuit-breakers of type B.

Annex ZB (normative)

Normative references to international publications with their corresponding European publications

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

Publication	Year	Title	EN / HD	Year
IEC 60051	Series	Direct acting indicating analogue electrical measuring instruments and their accessories -	EN 60051-1	2017
IEC 60112 +A1	2003 2009	Method for the determination of the proof and the comparative tracking indices of solid insulating materials	EN 60112 +A1	2003 2009
IEC 60228	2004	Conductors of insulated cables	EN 50525	Series
IEC 60364-1 (mod)	2005	Low-voltage electrical installations – Part 1: Fundamental principles, assessment of general characteristics, definitions	HD 60364-1 + 1	2008 2017
IEC 60364-4-41 (mod)	2005	Electrical installations of buildings – Part 4: Protection for safety – Chapter 41: Protection against electric shock	HD 60364-4-41 + 11	2017 2017
IEC 60364-4-43 (mod)	2008	Electrical installations of buildings – Part 4: Protection for safety – Chapter 47: Application of protective measures for safety – Section 473: Measures of protection against overcurrent	HD 60364-4-43	2010
IEC 60417	Datab ase	Graphical symbols for use on equipment. Available from: http://www.graphical-symbols.info/equipment	–	–
IEC 60529 + 1 + 2	1989 1999 2013	Degrees of protection provided by enclosures (IP Code)	EN 60529 + 1 + 2	1991 2000 2013
IEC 60664-1	2007	Insulation co-ordination for equipment within low voltage systems . Part 1: Principles, requirements and tests	EN 60664-1	2007
IEC 60664-3	-	Insulation coordination for equipment within low-voltage systems – Part 3: Use of coating, potting or moulding for protection against pollution	EN 60664-3	2017
IEC 60695-2-10	2013	Fire hazard testing - Part 2–10: Glowing/hot-wire based test methods - Glow-wire apparatus and common test procedure	EN 60695-2-10	2013

EN 60898-1:2019+A11:2024 (E)

IEC 60695-2-11	2014	Fire hazard testing - Part 2-11: Glowing/hot-wire based test methods – Glow- wire flammability test method for end products	EN 60695-2-11	2014
IEC 60898-2 +A1 (mod)	2000 2003	Circuit-breakers for overcurrent protection for household and similar installations – Part 2: Circuit-breakers for a.c. and d.c. operation	EN 60898-2	2006
IEC 60947-1	2007	Low-voltage switchgear and controlgear – Part 1 General rules	EN 60947-1	2007
IEC 60947-2	2016	Low-voltage switchgear and controlgear – Part 2 Circuit-breakers	EN 60947-2	2017
IEC 61009-1 +A1 +A2 (mod)	2010 2012 2013	Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBO's) – Part 1: General rules	EN 61009-1 +A1 +A2 +A11 +A12	2013 2014 2014 2015 2016
IEC 61009-2-1	1991	Residual current operated circuit-breakers with integral overcurrent protection for household and similar use (RCBO's) – Part 2-1: Applicability of the general rules to RCBO's functionally independent of line voltage	EN 61009-2-1 +A11	1994 1998
IEC 61009-2-2	1991	Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBO's) – Part 2-2: Applicability of the general rules to RCBO's functionally dependent on line voltage	–	–
IEC 61545	1996	Connecting devices – Devices for the connection of aluminium conductors in clamping units of any material and copper conductors in aluminium bodied clamping units	–	–
ISO 2039-2	1987	Plastics – Determination of hardness – Part 2: Rockwell hardness	EN ISO 2039-2	1999
ISO/IEC Guide 2	2004	Standardization and related activities - General vocabulary	–	–

Annex ZC (normative)

Special national conditions

Special national condition: National characteristic or practice that cannot be changed even over a long period, e.g. climatic conditions, electrical earthing conditions.

NOTE If it affects harmonization, it forms part of the European Standard or Harmonization Document.

For the countries in which the relevant special national conditions apply these provisions are normative, for other countries they are informative.

<u>Clause</u>	<u>Special national condition</u>
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J.1	Austria, Czech Republic, Netherlands, Norway and Switzerland
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The upper limit of current for use of screwless terminals is 16 A.

J.3.3	Austria, Belgium, Denmark, France, Germany, Italy, Portugal, Spain and Sweden
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Only universal screwless type terminals are accepted.

K.1	Belgium, Italy and Spain
-----	---------------------------------

The use of circuit-breakers with flat quick-connect terminations for rated currents up to and including 20 A is accepted.

K.8.2.2	Belgium, Italy and Spain
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The use for rated currents up to and including 20 A is accepted.

Annex ZD (informative)

List of clauses that require retesting

1) Application of EN 60898-1:2019

Based on EN 60898-1:2003, EN 60898-1:2003/A1:2004, EN 60898-1:2003/A11:2005, EN 60898-1:2003/A12:2008 and EN 60898-1:2003/A13:2012, the following tests and/or requirements have been technically modified and may require retesting or inspection as applicable:

- 9.5.2 in 9.5 Tests of reliability of screw-type terminals for external copper conductors;
- 9.7.4 Insulation resistance and dielectric strength of auxiliary circuits;
- 9.10.3 Test of instantaneous tripping of correct opening of the contacts and of the trip-free function;—
- 9.15 Test of resistance to abnormal heat.

2) Application of Amendment 1 of EN 60898-1:2019

Based on EN 60898-1:2019, tests and requirements have not been significantly modified from a technical point of view. Products already complying with EN 60898-1:2019 do not require retesting or inspection, Modified Annex J allows screwless terminals up to 40A when EN 60898-1:2019 allowed them only up to 20A. Technical changes in Annex J apply to products with rated current above 20A.

Annex ZZ (informative)

Relationship between this European standard and the safety objectives of Directive 2014/35/EU [2014 OJ L96] aimed to be covered

This European standard has been prepared under a Commission's standardisation request relating to harmonised standards in the field of the Low Voltage Directive, M/511, to provide one voluntary means of conforming to safety objectives of Directive 2014/35/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to the making available on the market of electrical equipment designed for use within certain voltage limits [2014 OJ L96].

Once this standard is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of this standard given in Table ZZ.1 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding safety objectives of that Directive, and associated EFTA regulations.

**Table ZZ.1 — Correspondence between this European standard and Annex I of
Directive 2014/35/EU [2014 OJ L96]**

Safety objectives of Directive 2014/35/EU	Clause(s) / sub-clause(s) of this EN	Remarks / Notes
(1)(a)	4, 5, 6 - 9.3	
(1)(b)	8.1 - 9.4 and 9.5 Annex J, Annex K	
(1)(c)	7 - 9.1 and 9.2, Annex I	
(2)(a)	8.2 – 9.6, 8.5 – 9.9, 8.6 – 9.10, 8.7 - 9.11, 8.8 - 9.12, Annex H, Annex C	
(2)(b)	8.4 – 9.8, 8.5 – 9.9, 8.6 – 9.10, 8.7 - 9.11, 8.8 – 9.12, Annex H, 8.13 – 9.8.5, Annex C	
(2)(c)	8.1.2 – 9.10.3	
(2)(d)	8.1.3 – 9.7, Annex B, 8.3 – 9.7	
(3)(a)	8.9 – 9.13, 8.12 – 9.16,	
(3)(b)	8.10 – 9.14, 8.11 – 9.15, 8.14, 8.15	
(3)(c)	8.6 – 9.10, 8.8 – 9.12, Annex H	

WARNING 1 — Presumption of conformity stays valid only as long as a reference to this European standard is maintained in the list published in the Official Journal of the European Union. Users of this standard should consult frequently the latest list published in the Official Journal of the European Union.

WARNING 2 — Other Union legislation may be applicable to the product(s) falling within the scope of this standard.”

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ELECTRICAL ACCESSORIES –
CIRCUIT-BREAKERS FOR OVERCURRENT PROTECTION
FOR HOUSEHOLD AND SIMILAR INSTALLATIONS –****Part 1: Circuit-breakers for a.c. operation****FOREWORD**

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This consolidated version of the official IEC Standard and its amendment has been prepared for user convenience.

IEC 60898-1 edition 2.1 contains the second edition (2015-03) [documents 23E/881/FDIS and 23E/894/RVD] and its corrigendum (2015-11), its amendment 1 (2019-12) [documents 23E/1156/FDIS and 23E/1157/RVD] and its corrigendum (2020-03). The contents of the corrigendum of the amendment only applies to the French version.

This Final version does not show where the technical content is modified by amendment 1. A separate Redline version with all changes highlighted is available in this publication.

International Standard IEC 60898-1 has been prepared by sub-committee 23E: Circuit-breakers and similar equipment for household use, of IEC technical committee 23: Electrical accessories.

This second edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) Revision of 9.5 Terminals
- b) Revision of the test of glow wire
- c) Simplification of the figures for short circuit tests.

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

A1 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). **A1**

In this standard, the following print types are used:

- Requirements proper: in roman type.
- *Test specifications: in italic type.*
- Explanatory matter: in smaller roman type.

A list of all parts in the IEC 60898 series, published under the general title *Electrical accessories – Circuit-breakers for overcurrent protection for household and similar installations*, can be found on the IEC website.

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

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

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

Part 1: Circuit-breakers for a.c. operation

1 Scope

This part of IEC 60898 applies to a.c. air-break circuit-breakers for operation at 50 Hz, 60 Hz or 50/60 Hz, having a rated voltage not exceeding 440 V (between phases), a rated current not exceeding 125 A and a rated short-circuit capacity not exceeding 25 000 A.

As far as possible, it is in line with the requirements contained in IEC 60947-2.

[A1] NOTE 1 Additional requirements are necessary for circuit-breakers used in locations having more severe overvoltage conditions. **[A1]**

These circuit-breakers are intended for the protection against overcurrents of wiring installations of buildings and similar applications; they are designed for use by uninstructed people and **[A1]** do not require maintenance. **[A1]**

They are intended for use in an environment with pollution degree 2 **[C]** and overvoltage category III. **[C]**

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

They are suitable for isolation.

[C] Circuit-breakers of this standard are suitable for use in IT systems provided that the requirements of HD 60364-4-43 are complied with. **[C]**

This standard also applies to circuit-breakers having more than one rated current, provided that the means for changing from one discrete rating to another is not accessible in normal service and that the rating cannot be changed without the use of a tool.

This standard does not apply to

- circuit-breakers intended to protect motors;
- circuit-breakers, the current setting of which is adjustable by means accessible to the user.

For circuit-breakers having a degree of protection higher than IP20 according to IEC 60529, for use in locations where arduous environmental conditions prevail (e.g. excessive humidity, heat or cold or deposition of dust) and in hazardous locations (e.g. where explosions are liable to occur), special constructions may be required.

[A1] This standard does not apply to circuit-breakers for a.c. and d.c. operation, which is covered by IEC 60898-2. **[A1]**

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

This standard does not apply to circuit-breakers which incorporate residual current tripping devices, which is covered by IEC 61009-1, IEC 61009-2-1, and IEC 61009-2-2.

ⓘ Supplementary requirements may be necessary for circuit-breakers of the screw-in types. ⓘ

A guide for coordination under short-circuit conditions between a circuit-breaker and another short-circuit protective device (SCPDs) is given in Annex D. For more severe overvoltage conditions, circuit-breakers complying with other standards (e.g. IEC 60947-2) should be used.

ⓘ NOTE 2 ⓘ Circuit-breakers within the scope of this standard can also be used for protection against electric shock in case of fault, depending on their tripping characteristics and on the characteristics of the installation. The criterion of application for such purposes is dealt with by installation rules.

ⓘ NOTE 3 Recommendations for the dimensional coordination between enclosures and circuit-breakers for mounting on rails according to EN 60715 or equivalent means are given in the CENELEC report PD CLC/TR 50473. ⓘ

This standard contains all requirements necessary to ensure compliance with the operational characteristics required for these devices by type tests.

It also contains the details relative to test requirements and methods of testing necessary to ensure reproducibility of test results.

This standard states

- a) the characteristics of circuit-breakers;
- b) the conditions with which circuit-breakers shall comply, with reference to:
 - 1) their operation and behaviour in normal service;
 - 2) their operation and behaviour in case of overload;
 - 3) their operation and behaviour in case of short-circuits up to their rated short-circuit capacity;
 - 4) their dielectric properties;
- c) the tests intended for confirming that these conditions have been met and the methods to be adopted for the tests;
- d) the data to be marked on the devices;
- e) the test sequences to be carried out and the number of samples (see Annex C);
- f) the co-ordination under short-circuit conditions with another short-circuit protective device (SCPD) associated in the same circuit (see Annex D);
- g) the routine tests to be carried out on each circuit-breaker to reveal unacceptable variations in material or manufacture, likely to affect safety (see Annex I).

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 60050 (all parts), *International Electrotechnical Vocabulary (IEV)*. Available from: <http://www.electropedia.org/>

ⓘ_{A11} Text deleted. ⓘ_{A11}

IEC 60364-4-41:2005, *Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock*

IEC 60417, *Graphical symbols for use on equipment*. Available from: <http://www.graphical-symbols.info/equipment>

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60664-1:2007, *Insulation co-ordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

Ⓐ¹ IEC 60664-3, *Insulation coordination for equipment within low-voltage systems – Part 3: Use of coating, potting or moulding for protection against pollution* Ⓐ¹

IEC 60695-2-10, *Fire hazard testing – Part 2-10: Glowing/hot-wire based test methods – Glow-wire apparatus and common test procedure*

IEC 60695-2-11:2000, *Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow- wire flammability test method for end-products*

IEC 60947-1:2007, *Low-voltage switchgear and controlgear – Part 1: General rules*

IEC 60947-2:2006, *Low-voltage switchgear and controlgear – Part 2: Circuit-breakers*

IEC 61545:1996, *Connecting devices – Devices for the connection of aluminium conductors in clamping units of any material and copper conductors in aluminium bodied clamping units*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050-441, as well as the following apply.

3.1 Devices

3.1.1

switching device

device designed to make or break the current in one or more electric circuits

[SOURCE: IEC 60050-441:1984, 441-14-01]

3.1.2

mechanical switching device

switching device designed to close and open one or more electric circuits by means of separable contacts

[SOURCE: IEC 60050-441:1984, 441-14-02]

3.1.3

fuse

device that, by the fusing of one or more of its specially designed and proportioned components, opens the circuit in which it is inserted and breaks the current when this exceeds a given value for a sufficient time

[SOURCE: IEC 60050-441:1984, 441-18-01, modified – "The fuse comprises all the parts that form the complete device" has been deleted.]

3.1.4

circuit-breaker

<mechanical> mechanical switching device, capable of making, carrying and breaking currents under normal circuit conditions and also making, carrying for a specified time, and automatically breaking currents under specified abnormal circuit conditions such as those of short-circuit

[SOURCE: IEC 60050-441:1984, 441-14-20]

3.1.5

plug-in circuit-breaker

circuit-breaker having one or more plug-in terminals (see 3.3.20) and designed for use with appropriate means for the plug-in connection

3.2 General terms

3.2.1

overcurrent

current exceeding the rated current

[SOURCE: IEC 60050-441:1984, 441-11-06]

3.2.2

overload current

overcurrent occurring in an electrically undamaged circuit

Note 1 to entry: An overload current may cause damage if sustained for a sufficient time.

3.2.3

short-circuit current

overcurrent resulting from a fault of negligible impedance between points intended to be at different potentials in normal service

Note 1 to entry: A short-circuit current may result from a fault or from an incorrect connection.

3.2.4

main circuit

<of a circuit-breaker> all the conductive parts of a circuit-breaker included in the circuit which it is designed to close and open

3.2.5

control circuit

<of a circuit-breaker> circuit (other than a path of the main circuit) intended for the closing operation or opening operation, or both, of the circuit-breaker

3.2.6

auxiliary circuit

<of a circuit-breaker> all the conductive parts of a circuit-breaker intended to be included in a circuit other than the main circuit and the control circuit of the circuit-breaker

3.2.7

pole

<of a circuit-breaker> that part of a circuit-breaker associated exclusively with one electrically separated conducting path of its main circuit provided with contacts intended to connect and disconnect the main circuit itself and excluding those portions which provide a means for mounting and operating the poles together

3.2.7.1

protected pole

pole provided with an overcurrent release (see 3.3.6)

3.2.7.2

unprotected pole

pole without overcurrent release (see 3.3.6), but otherwise generally capable of the same performance as a protected pole of the same circuit-breaker

Note 1 to entry: To ensure compliance with this requirement, the unprotected pole may be of the same construction as the protected pole(s), or of a particular construction.

Note 2 to entry: If the short-circuit capacity of the unprotected pole is different from that of the protected pole(s), this has to be indicated by the manufacturer.

3.2.7.3

switched neutral pole

pole only intended to switch the neutral, and not intended to have a short-circuit capacity

3.2.8

closed position

position in which the predetermined continuity of the main circuit of the circuit-breaker is secured

3.2.9

open position

position in which the predetermined clearance between open contacts in the main circuit of the circuit-breaker is secured

3.2.10

air temperature

3.2.10.1

ambient air temperature

temperature, determined under prescribed conditions, of the air surrounding the circuit-breaker

Note 1 to entry: For circuit breakers installed inside an enclosure, it is the temperature of air outside the enclosure

[SOURCE: IEC 60050-441:1984, 441-11-13, modified – "complete switching device or fuse" has been replaced by "circuit-breaker".]

3.2.10.2

reference ambient air temperature

ambient air temperature on which the time-current characteristics are based

3.2.11

operation

transfer of the moving contact(s) from the open position to the closed position or vice versa

Note 1 to entry: If distinction is necessary, an operation in the electrical sense (make or break) is referred to as a "switching operation" and an operation in the mechanical sense (close or open) is referred to as a "mechanical operation".

3.2.12

operating cycle

succession of operations from one position to another and back to the first position

3.2.13

A1 operating sequence A1

<of a mechanical switching device> succession of specified operations with specified time intervals

[SOURCE: IEC 60050-441:1984, 441-16-03]

3.2.14

uninterrupted duty

duty in which the main contacts of a circuit-breaker remain closed whilst carrying a steady current without interruption for long periods (which could be weeks, months, or even years)

A1 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.] A1

A1 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".] A1

3.3 Constructional elements

3.3.1

main contact

contact included in the main circuit of a circuit-breaker and intended to carry in the closed position the current of the main circuit

3.3.2

arcing contact

contact on which the arc is intended to be established

Note 1 to entry: An arcing contact may serve as a main contact. It may also be a separate contact so designed that it opens after and closes before another contact, which it is intended to protect from damage.

[SOURCE: IEC 60050-441:1984, 441-15-08]

3.3.3

control contact

contact included in a control circuit of a circuit-breaker and mechanically operated by the circuit-breaker

3.3.4

auxiliary contact

contact included in an auxiliary circuit and mechanically operated by the circuit-breaker (e.g. for indicating the position of the contacts)

3.3.5

release

device, mechanically connected to (or integrated into) a circuit-breaker, which releases the holding means and permits the automatic opening of the circuit-breaker

3.3.6

overcurrent release

release which causes a circuit-breaker to open, with or without time-delay, when the current in the release exceeds a pre-determined value

Note 1 to entry: In some cases this value can depend upon the rate of rise of current.

3.3.7

inverse time-delay overcurrent release

overcurrent release which operates after a time-delay inversely dependent upon the value of the overcurrent

Note 1 to entry: Such a release may be designed so that the time-delay approaches a definite minimum for high values of overcurrent.

3.3.8

direct overcurrent release

overcurrent release directly energized by the current in the main circuit of a circuit-breaker

3.3.9

overload release

overcurrent release intended for protection against overloads

3.3.10

conductive part

part which is capable of conducting current although it may not necessarily be used for carrying current in normal service

3.3.11

exposed conductive part

conductive part which can be readily touched and which normally is not live, but which may become live under fault conditions

Note 1 to entry: Typical exposed conductive parts are walls of metal enclosures, metal operating handles, etc.

3.3.12

terminal

conductive part of a device, provided for re-usable electrical connection to external circuits

3.3.12.1

screw-type terminal

terminal for the connection and subsequent disconnection of a conductor or the inter-connection of two or more conductors, capable of being dismantled, the connection being made, directly or indirectly, by means of screws or nuts of any kind

3.3.12.2

pillar terminal

screw-type terminal in which the conductor is inserted into a hole or cavity, where it is clamped under the shank of the screw(s).

Note 1 to entry: The clamping pressure may be applied directly by the shank of the screw or through an intermediate clamping element to which pressure is applied by the shank of the screw

Note 2 to entry: Examples of pillar terminals are shown in Annex F, Figure F.1.

[SOURCE: IEC 60050-442:1984, 442-06-22]

3.3.12.3

screw terminal

terminal in which the conductor is clamped under the head of the screw and where the clamping pressure can be applied directly by the head of the screw or through an intermediate part, such as a washer, a clamping plate or an anti-spread device

Note 1 to entry: Examples of screw terminals are shown in Annex F, Figure F.2.

[SOURCE: IEC 60050-442:1984, 442-06-08]

3.3.12.4

stud terminal

screw-type terminal in which the conductor is clamped under a nut.

Note 1 to entry: The clamping pressure may be applied directly by a suitably shaped nut or through an intermediate part, such as a washer, a clamping plate or an anti-spread device

Note 2 to entry: Examples of stud terminals are shown in Annex F, Figure F.2.

[SOURCE: IEC 60050-442:1984, 442-06-23]

3.3.12.5

saddle terminal

screw-type terminal in which the conductor is clamped under a saddle by means of two or more screws or nuts

Note 1 to entry: Examples of saddle terminals are shown in Annex F, Figure F.3.

[SOURCE: IEC 60050-442:1984, 442-06-09]

3.3.12.6

lug terminal

screw terminal or stud terminal, designed for clamping a cable lug or a bar directly or indirectly by means of a screw or nut

Note 1 to entry: Examples of lug terminals are shown in Annex F, Figure F.4.

[SOURCE: IEC 60050-442:1984, 442-06-16]

3.3.12.7

screwless terminal

connecting terminal for the connection and subsequent disconnection of one conductor or the interconnection of two or more conductors capable of being dismantled, the connection being made, directly or indirectly, by means of springs, wedges, eccentrics or cones, etc., without special preparation of the conductor other than removal of insulation

[SOURCE: IEC 60050-442:1984, 442-06-13 modified by adding the last part of the text]

3.3.12.8

plug-in terminal

terminal the electrical connection and disconnection of which can be effected without displacing the conductors of the corresponding circuit

Note 1 to entry: The connection is effected without the use of a tool and is provided by the resilience of the fixed and/or moving parts and/or by springs

3.3.13

tapping screw

screw manufactured from a material having a greater resistance to deformation when applied by rotary insertion to a hole in a material having a lesser resistance to deformation.

Note 1 to entry: The screw is made with a tapered thread, the taper being applied to the core diameter of the thread at the end section of the screw.

Note 2 to entry: The thread produced by application of the screw is formed securely only after sufficient revolutions have been made to exceed the number of threads on the tapered section

3.3.13.1

thread-forming tapping screw

tapping screw having an uninterrupted thread

Note 1 to entry: It is not a function of this thread to remove material from the hole

Note 2 to entry: An example of thread-forming tapping screw is shown in Figure 1.

3.3.13.2

thread-cutting tapping screw

tapping screw having an interrupted thread. The thread is intended to remove material from the hole.

Note 1 to entry: An example of thread-cutting tapping screw is shown in Figure 2.

3.4 Conditions of operation

3.4.1

closing operation

operation by which the circuit-breaker is brought from the open position to the closed position

3.4.2

opening operation

operation by which the circuit-breaker is brought from the closed position to the open position

3.4.3

dependent manual operation

operation solely by means of directly applied manual energy, such that the speed and force of the operation are dependent upon the action of the operator

[SOURCE: IEC 60050-441:1984, 441-16-13]

3.4.4

independent manual operation

stored energy operation where the energy originates from manual power, stored and released in one continuous operation, such that the speed and force of the operation are independent of the action of the operator

[SOURCE: IEC 60050-441:1984, 441-16-16]

3.4.5

trip-free circuit-breaker

circuit-breaker, the moving contacts of which return to and remain in the open position when the automatic opening operation is initiated after the initiation of the closing operation, even if the closing command is maintained

Note 1 to entry: To ensure proper breaking of the current which may have been established, it may be necessary that the contacts momentarily reach the closed position.

3.5 Characteristic quantities

NOTE Unless otherwise specified, all values of current and voltage are r.m.s. values.

3.5.1

rated value

stated value of any one of the characteristic quantities that serve to define the working conditions for which the circuit-breaker is designed and built

3.5.2

prospective current

current that would flow in the circuit if each pole of the circuit-breaker were replaced by a conductor of negligible impedance

Note 1 to entry: The prospective current may be qualified in the same manner as an actual current, for example prospective breaking current, prospective peak current.

[SOURCE: IEC 60050-441:1984, 441-17-01, modified – "complete switching device or fuse" has been replaced by "circuit-breaker".]

3.5.3

prospective peak current

peak value of a prospective current during the transient period following initiation

Note 1 to entry: The definition assumes that the current is established by an ideal circuit-breaker, that is, with instantaneous transition from infinite to zero impedance. For circuits where the current can follow several different paths, for example polyphase circuits, it further assumes that the current is established simultaneously in all poles, even if the current in only one pole is considered.

[SOURCE: IEC 60050-441:1984, 441-17-02]

3.5.4

maximum prospective peak current

prospective peak current when the initiation of the current takes place at the instant which leads to the highest possible value

Note 1 to entry: For a multipole circuit-breaker in a polyphase circuit, the maximum prospective peak current refers to a single pole only.

[SOURCE: IEC 60050-441:1984, 441-17-04]

3.5.5

short-circuit making and breaking capacity

alternating component of the prospective current, expressed by its r.m.s. value, which the circuit-breaker is designed to make, to carry for its opening time and to break under specified conditions

3.5.5.1

ultimate short-circuit breaking capacity

breaking capacity for which the prescribed conditions according to a specified test sequence do not include the capability of the circuit-breaker to carry 0,85 times its non-tripping current for the conventional time

3.5.5.2

service short-circuit breaking capacity

breaking capacity for which the prescribed conditions according to a specified test sequence include the capability of the circuit-breaker to carry 0,85 times its non-tripping current for the conventional time

3.5.6

breaking current

current in a pole of a circuit-breaker at the instant of initiation of the arc during a breaking operation

3.5.7

applied voltage

voltage which exists across the terminals of a pole of a circuit-breaker just before the making of the current

Note 1 to entry: This definition refers to a single-pole device. For a multipole device the applied voltage is the voltage across the supply terminals of the device.

3.5.8

recovery voltage

voltage which appears across the terminals of a pole of a circuit-breaker after the breaking of the current

Note 1 to entry: This voltage may be considered in two successive intervals of time, one during which a transient voltage exists, followed by a second one during which the power-frequency or the steady-state recovery voltage alone exists.

Note 2 to entry: This definition refers to a single-pole device. For a multipole device the recovery voltage is the voltage across the supply terminals of the device.

[SOURCE: IEC 60050-441:1984, 441-17-25, modified –Note 2 to entry has been added.]

3.5.8.1

transient recovery voltage

recovery voltage during the time in which it has a significant transient character

Note 1 to entry: The transient voltage may be oscillatory or non-oscillatory or a combination of these, depending on the characteristics of the circuit and of the circuit-breaker. It includes the voltage shift of the neutral of a polyphase circuit.

[SOURCE: IEC 60050-441:1984, 441-17-26, modified –Note 2 has been deleted.]

3.5.8.2

power-frequency recovery voltage

recovery voltage after the transient voltage phenomena have subsided

[SOURCE: IEC 60050-441:1984, 441-17-27]

3.5.9

opening time

time measured from the instant at which, the circuit-breaker being in the closed position, the current in the main circuit reaches the operating value of the overcurrent release to the instant when the arcing contacts have separated in all poles

Note 1 to entry: The opening time is commonly referred to as tripping time, although, strictly speaking, tripping time applies to the time between the instant of initiation of the opening time and the instant at which the opening command becomes irreversible.

3.5.10

arcing time

3.5.10.1

arcing time of a pole

interval of time between the instant of initiation of the arc in a pole and the instant of final arc extinction in that pole

[SOURCE: IEC 60050-441:1984, 441-17-37, modified – “or a fuse” and “or that fuse” have been deleted.]

3.5.10.2

arcing time of a multipole circuit-breaker

interval of time between the instant of first initiation of an arc and the instant of final extinction in all poles

[SOURCE: IEC 60050-441:1984, 441-17-38]

3.5.11

break time

interval of time between the beginning of the opening time of a circuit-breaker and the end of the arcing time

3.5.12

I^2t

Joule integral

integral of the square of the current over a given time interval

$$I^2t = \int_{t_0}^{t_1} i^2 dt$$

3.5.13

I^2t characteristic of a circuit-breaker

curve giving the maximum values of I^2t as a function of the prospective current under stated conditions of operation

3.5.14

co-ordination between overcurrent protective devices in series

3.5.14.1

overcurrent protective co-ordination of overcurrent protective devices

co-ordination of two or more overcurrent protective devices in series to ensure overcurrent selectivity) and/or back-up protection

[SOURCE: IEC 60947-1:2007, 2.5.22]

3.5.14.2

overcurrent selectivity

co-ordination of the operating characteristics of two or more overcurrent protective devices in series such that, on the incidence of overcurrents within stated limits, the device intended to operate within these limits does so, while the other(s) does (do) not

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

3.5.14.3

back-up protection

overcurrent co-ordination of two overcurrent protective devices in series, where the protective device, generally but not necessarily on the supply side, effects the overcurrent protection with or without the assistance of the other protective device and prevents excessive stress on the latter

[SOURCE: IEC 60947-1:2007, 2.5.24]

3.5.14.4

total selectivity

overcurrent selectivity where, in the presence of two overcurrent protective devices in series, the protective device on the load side effects the protection without causing the other protective device to operate

[SOURCE: IEC 60947-2:2006, 2.17.2]

3.5.14.5

partial selectivity

overcurrent selectivity where, in the presence of two overcurrent protective devices in series, the protective device on the load side effects the protection up to a given level of overcurrent, without causing the other protective device to operate

[SOURCE: IEC 60947-2:2006, 2.17.3]

3.5.14.6

selectivity limit current

I_s

current co-ordinate of the intersection between the total time-current characteristic of the protective device on the load side and the pre-arcing (for fuses), or tripping (for circuit-breakers) time-current characteristic of the other protective device

Note 1 to entry: The selectivity limit current (see Figure D.1) is a limiting value of current

- below which, in the presence of two overcurrent protective devices in series, the protective device on the load side completes its breaking operation in time to prevent the other protective device from starting its operation (i.e. selectivity is ensured);
- above which, in the presence of two overcurrent protective devices in series, the protective device on the load side may not complete its breaking operation in time to prevent the other protective device from starting its operation (i.e. selectivity is not ensured)

[SOURCE: IEC 60947-2:2006, 2.17.4]

3.5.14.7

take-over current

I_B

current co-ordinate of the intersection between the time-current characteristics of two overcurrent protective devices

Note 1 to entry: The take-over current is the current co-ordinate of the intersection between the maximum break-time / current characteristics of two overcurrent protective devices in series.

[SOURCE: IEC 60050-441:1984, 441-17-16]

3.5.14.8

conditional short-circuit current (of a circuit or a switching device)

prospective current that a circuit or a switching device, protected by a specified short-circuit protective device, can satisfactorily withstand for the total operating time of that device under specified conditions of use and behaviour

Note 1 to entry: For the purpose of this standard, the short-circuit protective device is generally a circuit-breaker or a fuse.

Note 2 to entry: This definition differs from IEC 60050-441:1984, 441-17-20 by broadening the concept of current limiting device into a short-circuit protective device, the function of which is not only to limit the current.

[SOURCE: IEC 60947-1:2007, 2.5.29]

3.5.14.9

rated conditional short-circuit current

I_{nc}

value of prospective current, stated by the manufacturer, which the equipment, protected by a short-circuit protective device specified by the manufacturer, can withstand satisfactorily for the operating time of this device under the test conditions in the relevant product standard

[SOURCE: IEC 60947-1:2007, 4.3.6.4]

3.5.15
conventional non-tripping current

I_{nt}

specified value of current which the circuit-breaker is capable of carrying for a specified time designated as conventional time, without tripping

[SOURCE: IEC 60050-442:1998, 442-05-54] 

3.5.16
conventional tripping current

I_t

specified value of current which causes the circuit-breaker  to operate  within a specified time (conventional time)

 [SOURCE: IEC 60050-441:1984, 442-05-55, modified] 

3.5.17
instantaneous tripping current

minimum value of current causing the circuit-breaker to operate automatically without intentional time-delay

3.6 Definitions related to insulation co-ordination

3.6.1
insulation coordination

mutual correlation of insulation characteristics of electrical equipment taking into account the expected micro-environment and the influencing stresses

[SOURCE: IEC 60664-1:2007, 3.1]

3.6.2
working voltage

highest r.m.s. value of the a.c. or d.c. voltage across any particular insulation which can occur when the equipment is supplied at rated voltage

Note 1 to entry: Transients are disregarded.

Note 2 to entry: Both open-circuit conditions and normal operating conditions are taken into account.

[SOURCE: IEC 60664-1:2007, 3.5]

3.6.3
overvoltage

any voltage having a peak value exceeding the corresponding peak value of maximum steady-state voltage at normal operating conditions

[SOURCE: IEC 60664-1:2007, 3.7]

3.6.4
impulse withstand voltage

highest peak value of impulse voltage of prescribed form and polarity, which does not cause breakdown of the insulation under specific conditions

[SOURCE: IEC 60664-1:2007, 3.8.1]

3.6.5
overvoltage category

numeral defining a transient overvoltage condition

[SOURCE: IEC 60664-1:2007, 3.10, modified – The notes have been deleted.]



3.6.6

macro-environment

environment of the room or other location, in which the equipment is installed or used

[SOURCE: IEC 60664-1:2007, 3.12.1]

3.6.7

micro-environment

immediate environment of the insulation which particularly influences the dimensioning of the creepage distances

[SOURCE: IEC 60664-1:2007, 3.12.2]

3.6.8

pollution

any addition of foreign matter, solid, liquid or gaseous that can result in a reduction of electric strength or surface resistivity of the insulation

[SOURCE: IEC 60664-1:2007, 3.11]

3.6.9

pollution degree

numeral characterising the expected pollution of the micro-environment

Note 1 to entry: The pollution degree to which equipment is exposed may be different from that of the macro-environment where the equipment is located because of protection offered by means such as an enclosure or internal heating to prevent absorption or condensation of moisture.

[SOURCE: IEC 60664-1:2007, 3.13, modified – Note 1 to entry has been added.]

3.6.10

isolation

isolating function

function intended to cut off the supply from all or a discrete section of the installation by separating the installation from every source of electrical energy for reasons of safety

[SOURCE: IEC 60947-1:2007, 2.1.19,]

3.6.11

isolating distance

<of a pole of a mechanical switching device> clearance between open contacts, meeting the safety requirements specified for isolation purposes

[SOURCE: IEC 60050-441:1984, 441-17-35] , modified 

3.6.12

clearance

shortest distance in air between two conductive parts along a string stretched the shortest way between these conductive parts (see Annex B)

Note 1 to entry: For the purpose of determining a clearance to accessible parts, the accessible surface of an insulating enclosure is considered conductive as if it was covered by a metal foil wherever it can be touched by a hand or a standard test finger according to Figure 8.

[SOURCE: IEC 60050-441:1984, 441-17-31, modified – Note 1 to entry has been added.]

3.6.13

creepage distance

shortest distance along the surface of an insulating material between two conductive parts

Note 1 to entry: See Annex B.

Note 2 to entry: For the purpose of determining a creepage distance to accessible parts, the accessible surface of an insulating enclosure is considered conductive as if it was covered by a metal foil wherever it can be touched by a hand or a standard test finger according to Figure 8.

[SOURCE: IEC 60050-151:1984, 151-15-50 modified – Notes 1 and 2 to entry have been added.]

4 Classification

4.1 General

Circuit-breakers are classified according to several criteria.

4.2 According to the number of poles:

- single-pole circuit-breakers;
- two-pole-circuit-breakers with one protected pole;
- two-pole circuit-breakers with two protected poles;
- three-pole circuit-breakers with three protected poles;
- four-pole circuit-breakers with three protected poles;
- four-pole circuit-breakers with four protected poles.

NOTE The pole which is not a protected pole can be

- "unprotected" (see 3.2.7.2), or
- "switched neutral" (see 3.2.7.3).

4.3 According to the protection against external influences:

- enclosed-type (not requiring an appropriate enclosure);
- unenclosed-type (for use with an appropriate enclosure).

4.4 According to the method of mounting:

- surface-type;
- flush-type;
- panel board type, also referred to as distribution board type.

NOTE These types may be intended to be rail mounted.

4.5 According to the methods of connection

4.5.1 According to the fixation system:

- circuit-breakers, the electrical connections of which are not associated with the mechanical mounting;
- circuit-breakers, the electrical connections of which are associated with the mechanical mounting.

NOTE Examples of this type are:

- plug-in type;
- bolt-on type;
- screw-in type.

Some circuit-breakers can be of the plug-in type or bolt-on type on the line side only, the load terminals being usually suitable for wiring connection.

4.5.2 According to the type of terminals:

- circuit-breakers with screw-type terminals for external copper conductors;
 - circuit-breakers with screwless type terminals for external copper conductors;
- NOTE 1 The requirements for circuit-breakers equipped with this type of terminals are given in Annex J.
- circuit-breakers with flat quick-connect terminals for external copper conductors;
- NOTE 2 The requirements for circuit-breakers equipped with this type of terminals are given in Annex K.

A11 Text deleted. **A11**

4.6 According to the instantaneous tripping current (see 3.5.17)

- B-type;
- C-type;
- D-type.

NOTE The selection of a particular type can depend on the installation rules.

4.7 According to the I^2t characteristic

C Circuit-breakers of B-type and C-type, having rated current up to and including 63 A and having short-circuit breaking capacity of 3 000 A, 4 500 A, 6 000 A and 10 000 A, are classified according to the limits within which their I^2t characteristics lie, measured according to 9.12.6 (see Annex ZA). **C**

5 Characteristics of circuit-breakers**5.1 List of characteristics**

The characteristics of a circuit-breaker shall be stated in the following terms:

- number of poles (see 4.2);
- protection against external influences (see 4.3);
- method of mounting (see 4.4);
- method of connection (see 4.5);
- value of rated operational voltage (see 5.3.1);
- value of rated current (see 5.3.2);
- value of rated frequency (see 5.3.3);
- **A1** range of instantaneous tripping current (see 4.6 and 5.3.5); **A1**
- value of rated short-circuit capacity (see 5.3.4);
- I^2t characteristic (see 3.5.13);
- **A1** I^2t classification (see 4.7). **A1**

5.2 Rated quantities**5.2.1 Rated voltages****5.2.1.1 Rated operational voltage (U_e)**

The rated operational voltage (hereinafter referred to as rated voltage) of a circuit-breaker is the value of voltage, assigned by the manufacturer, to which its performance (particularly the short-circuit performance) is referred.

NOTE The same circuit-breaker can be assigned a number of rated voltages and associated rated short-circuit capacities.

5.2.1.2 Rated insulation voltage (U_i)

The rated insulation voltage of a circuit-breaker is the value of voltage, assigned by the manufacturer, to which dielectric test voltages and creepage distances are referred.

Unless otherwise stated, the rated insulation voltage is the value of the maximum rated voltage of the circuit-breaker. In no case shall the maximum rated voltage exceed the rated insulation voltage.

5.2.1.3 Rated impulse withstand voltage (U_{imp})

☐ The rated impulse withstand voltage (U_{imp}) of a circuit-breaker is the value of voltage, assigned by the manufacturer, to which impulse test voltages and clearances are referred.

The rated impulse withstand voltage of a circuit-breaker shall be equal to or higher than the standard value of rated impulse withstand voltage given in 5.3.6.

NOTE For dimensioning of clearances, for rated impulse withstand voltages higher than the standard value of rated impulse withstand voltage given in 5.3.6, see EN 60664 series. ☐

5.2.2 Rated current (I_n)

A current assigned by the manufacturer as the current which the circuit-breaker is designed to carry in uninterrupted duty (see 3.2.14), at a specified reference ambient air temperature.

The standard reference ambient air temperature is 30 °C. If a different reference ambient air temperature for the circuit-breaker is used, the effect on the overload protection of cables shall be taken into account, since this is also based on a reference ambient air temperature of 30 °C according to installation rules.

☐ Text deleted. ☐

5.2.3 Rated frequency

The rated frequency of a circuit-breaker is the power frequency for which the circuit-breaker is designed and to which the values of the other characteristics correspond.

The same circuit-breaker may be assigned a number of rated frequencies.

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

The rated short-circuit capacity of a circuit-breaker is the value of the ultimate short-circuit breaking capacity (see 3.5.5.1) assigned to that circuit-breaker by the manufacturer.

NOTE A circuit-breaker having a given rated short-circuit capacity has a corresponding service short-circuit capacity (I_{cs}) (see ☐ Table 18 ☐).

Rated making and breaking capacity of an individual pole (I_{cn1})

The value of the limiting short-circuit making and breaking capacity on each individual protected pole of multipole circuit breakers.

NOTE The corresponding rated quantity of RCBOs is the rated residual making and breaking capacity $I_{\Delta m}$ (see 5.2.7 of IEC 61009-1:2010).

The standard values are those given in 5.3.4.1.

5.3 Standard and preferred values

5.3.1 ☐ Standard values of rated voltage

Standard values of rated voltage are given in Table 1. ☐

Table 1 — Standard values of rated voltage

Circuit-breakers	Circuit supplying the circuit-breaker	Rated voltage of circuit-breakers for use in systems 230 V, 230/400 V, 400 V
Single pole	Single phase (phase to neutral or phase to phase)	230 V
	Three-phase 4-wire	230 V
	Single phase (phase to neutral) or three-phase, using 3 single-pole circuit-breakers (3-wire or 4-wire)	230/400 V
Two-pole	Single phase (phase to neutral or phase to phase)	230 V
	Single phase (phase to phase)	400 V
	Three phase (4-wire)	230 V
Three-pole	Three phase (3-wire or 4-wire)	400 V
Four-pole	Three phase (4-wire)	400 V
NOTE Wherever in this standard there is a reference to 230 V or 400 V, they may be read as 220 V or 240 V, 380 V or 415 V, respectively.		

Two-pole circuit breakers rated 230 V may have one or two protected poles.

Two-pole circuit breakers rated 400 V shall have two protected poles.

Three-pole circuit breakers shall have three protected poles.

Four-pole circuit breakers may have three or four protected poles. 

5.3.2 Preferred values of rated current

Preferred values of rated current are:

6 A, 8 A, 10 A, 13 A, 16 A, 20 A, 25 A, 32 A, 40 A, 50 A, 63 A, 80 A, 100 A and 125 A.

5.3.3 Standard values of rated frequency

Standard values of rated frequency are 50 Hz and 60 Hz.

5.3.4 Values of rated short-circuit capacity

5.3.4.1 Standard values up to and including 10 000 A

Standard values of rated short-circuit capacities up to and including 10 000 A are:

 1 500 A* , 3 000 A, 4 500 A, 6 000 A, 10 000 A.

 (*) Only for circuit-breakers incorporated or associated with and in the immediate vicinity of socket-outlets or switches for household and similar applications. 

The corresponding power factor ranges are given in 9.12.5.

5.3.4.2 Values above 10 000 A up to and including 25 000 A

For values above 10 000 A up to and including 25 000 A the standard values are:

15 000 A, 20 000 A and 25 000 A.

The corresponding power factor range is given in 9.12.5.

5.3.5 Standard ranges of instantaneous tripping

Standard ranges of instantaneous tripping are given in Table 2.

Table 2 – Ranges of instantaneous tripping

Type	Range
B	Above $3 I_n$ up to and including $5 I_n$
C	Above $5 I_n$ up to and including $10 I_n$
D	Above $10 I_n$ up to and including $20 I_n$
Text deleted	

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

The standard value of the rated impulse withstand voltage (U_{imp}) is 4 kV.

Table 3 (void)

Text deleted

6 Marking and other product information

6.1 Standard marking

Each circuit-breaker shall be marked in a durable manner with the following:

- manufacturer's name or trade mark;
- type designation, catalogue number or serial number;
- rated voltage(s);
- rated current without symbol "A", preceded by the symbol of instantaneous tripping (B, C or D), for example B 16;
- rated frequency if the circuit-breaker is designed only for one frequency (see 5.3.3);
- rated short-circuit capacity, in A, within a rectangle, without symbol "A";
- wiring diagram, unless the correct mode of connection is evident;
- reference calibration temperature, if different from 30 °C;
- degree of protection (only if different from IP20);
- void;
- void;
- making and breaking capacity on an individual protected pole of multipole circuit-breakers (I_{cn1}), if different from I_{cn} ;
- energy limiting class in a square in accordance with Annex ZA, if applied. I_{cn} and the energy limiting class, when applied, shall be both on the device and combined;
- Indication of grid distance "a" according to 9.12.9.2, if different from 35 mm;
- Circuit-breaker installation information related to the grid distance "a" if different from 35 mm or if requiring additional barrier(s) to achieve the grid distance "a".

Marking d) shall be readily visible when the circuit-breaker is installed. If, for small devices, the available space is insufficient, markings a), b), c), f), g), l) and m) may be put on the side or on the back of the circuit-breaker. Marking g) alternatively may be on the inside of any cover which has to be removed in order to connect the supply wires but shall not be on a label loosely attached to the circuit-breaker. Any other information not marked shall be given in the manufacturer's documentation.

The suitability for isolation, which is provided by all circuit-breakers of this standard, may be indicated by the symbol  (IEC 60417-6169-1) on the device. When affixed, this marking may be included in a wiring diagram, where it may be combined with symbols of other functions, e.g. overload protection, or other symbols of IEC 60417. When the symbol is used on its own (i.e. not in a wiring diagram), combination with symbols of other functions is not allowed.

Irrespective of type (B, C or D), the manufacturer shall publish in his literature the I^2t characteristic (see 3.5.13).

The manufacturer may indicate the I^2t classification (see 4.7) and mark the circuit-breakers accordingly.

For circuit-breakers other than those operated by means of push-buttons the open position shall be indicated by the symbol O (a circle) IEC 60417-5008 and the closed position by the symbol I (a short vertical straight line) IEC 60417-5007. Additional national symbols for this indication are allowed. Provisionally the use of this national indication alone is allowed. These indications shall be readily visible when the circuit-breaker is installed.

For circuit-breakers operated by means of two push-buttons, only the push-button designed for the opening operation shall be red and/or be marked with the symbol O (IEC 60417-5008).

Red shall not be used for any other push-button of the circuit-breaker.

If a push-button is used for closing the contacts and is clearly identified as such, its depressed position is sufficient to indicate the closed position.

If a single push-button is used for closing and opening the contacts and is identified as such, the button remaining in its depressed position is sufficient to indicate the closed position. On the other hand, if the button does not remain depressed, an additional means indicating the position of the contacts shall be provided.

For circuit-breakers with multiple current ratings, the maximum value shall be marked in accordance with marking d), and in addition the value for which the circuit-breaker is adjusted shall be indicated without ambiguity.

If it is necessary to distinguish between the supply and the load terminals, the former shall be indicated by arrows pointing towards the circuit-breaker and the latter by arrows pointing away from the circuit-breaker.

Terminals intended exclusively for the neutral shall be indicated by the letter N.

Terminals intended for the protective conductor, if any, shall be indicated by the symbol  (IEC 60417-5019).

NOTE The symbol , (IEC 60417-5017), previously recommended, will be progressively superseded by the preferred symbol IEC 60417-5019 given above.

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

Marking shall be indelible and easily legible, and shall not be placed on screws, washers or other removable parts.

Compliance is checked by inspection and by the test of 9.3.

6.2 Additional marking

Additional marking to other standards (EN or IEC or other) is allowed under the following conditions:

- the circuit-breaker shall comply with all the requirements of the additional standard;
- the relevant standard to which the additional marking refers shall be indicated adjacent to this marking and shall be clearly differentiated or separated from the standard marking according to 6.1.

Compliance is checked by inspection and by carrying out all the test sequences required by the relevant standard. Equivalent or less severe test sequences need not be repeated.

6.3 Guidance table for marking

Marking and other product information Each MCB shall be marked in a durable manner with all or, for small apparatus, part of the following data:		Markings may be on the MCB itself			Product information in catalogue
		If, for small devices the space available does not allow all the above data to be marked, at least this information shall be marked and visible when the device is installed.	This information 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 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 catalogues .
a)	manufacturer's name or trademark		X		
b)	type designation, catalogue number or serial number		X		
c)	rated voltage, with the symbol ~		X		
d)	rated current without symbol "A" preceded by the symbol of overcurrent instantaneous tripping (B, C or D), for example B 16	X			
e)	rated frequency if the circuit-breaker is designed only for one frequency (see 5.3.3)				X
f)	rated short-circuit capacity in a rectangle, in amperes, without symbol "A"		X(*)		
g)	wiring diagram, unless the correct mode of connection is evident		X	X	
h)	reference calibration temperature, if different from 30 °C				X
i)	the degree of protection (only if different from IP20)				X
j)	Void				
k)	Void				
l)	breaking capacity on one pole of multipole MCBs in case of short-circuit to earth I_{cn1}		X		
m)	energy limiting class (e.g. 3) in a square in accordance with Annex ZA, as applicable		X(*)		X(**)
	the position of use (symbol according to EN 60051), if necessary;		X		
	indication of the terminal for the neutral with "N"		X		
	additional marking of performance to other standards		X		
n)	Indication of grid distance "a" according to 9.12.9.2, if different from 35 mm				X

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o)	Circuit-breaker installation information related to the grid distance "a" if different from 35 mm or if requiring additional barrier(s) to achieve the grid distance "a"				X
(*) I_{cn} and the energy limiting class, as applicable, shall be both on the device and combined together. (**) The manufacturer shall publish in his literature the I^2t characteristic. 					



7 Standard conditions for operation in service and for installation

7.1 Standard conditions

Circuit-breakers complying with this standard shall be capable of operating under the standard conditions shown in Table Z.1.

Table Z.1 – Standard conditions for operation in service

Influencing quantity	Standard range of application	Reference value	Test tolerances ^f
Ambient temperature ^{a g}	–5 °C to +40 °C ^b	see 9.2	
Altitude	Not exceeding 2 000 m		
Relative humidity maximum value 40 °C	50 % ^c		
External magnetic field	Not exceeding 5 times the earth's magnetic field in any direction	Earth's magnetic field	^d
Position	As stated by the manufacturer, with a tolerance of 2° in any direction ^e	As stated by the manufacturer	2° in any direction
Frequency	Reference value ± 5 % ^f	Rated value	± 5 %
Sinusoidal wave distortion	Not exceeding 5 %	Zero	Zero
^a The maximum value of the mean daily temperature is +35 °C. ^b Values outside the range are admissible where more severe climatic conditions prevail, subject to agreement between manufacturer and user. ^c Higher relative humidities are admitted at lower temperature (for example 90 % at 20 °C). ^d When a circuit-breaker is installed in proximity of a strong magnetic field, supplementary requirements may be necessary. ^e The device shall be fixed without causing deformation liable to impair its functions. ^f The tolerances given apply unless otherwise specified in the relevant test. ^g Extreme limits of –20 °C and +60 °C are admissible during storage and transportation, and should be taken into account in the design of the device.			

7.2 Conditions of installation

Circuit-breakers shall be installed in accordance with the manufacturer's instructions. 

8 Requirements for construction and operation

8.1 Mechanical design

8.1.1 General

Circuit-breakers shall be so designed and constructed that, in normal use, their performance is reliable and without danger to the user or surroundings.

In general, compliance is checked by carrying out all the relevant tests specified.