

Electrical accessories – Circuit breakers for overcurrent protection for household and similar installations –

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

ICS 29.120.50

National foreword

This British Standard is the UK implementation of EN 60898-1:2003+A13:2012, incorporating amendments A11:2005, A12:2008 and A13:2012, and corrigendum February 2004. It is derived from IEC 60898-1:2002, incorporating amendment 1:2002. It supersedes BS EN 60898-1:2003+A1:2004 which will be withdrawn on 21 May 2015.

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 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**.

Where a common modification to an IEC amendment has been introduced, the tags carry the number of the amendment. For example, the common modifications introduced by CENELEC to IEC amendment 1 are indicated by **C1** **C1**.

Where a common modification has been introduced by CENELEC amendment, the tags carry the number of the amendment. For example, the common modifications introduced by CENELEC amendment A11 are indicated by **C11** **C11**.

National Annex NA (informative) reproduces CENELEC Interpretation Sheets 1–4, August 2007.

Corrigendum February 2004 made changes to **5.2**, **5.2.5**, **5.3.1**, **6.3**, **8.1.3**, **9.12.1**, **9.12.11**, **9.12.11.4**, **C.2**, Annex E and Annex ZA.

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

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

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	30 April 2009	Implementation of CENELEC amendment A12:2008
	31 October 2012	Implementation of CENELEC amendment A13:2012

English version

**Electrical accessories –
Circuit breakers for overcurrent protection
for household and similar installations
Part 1: Circuit-breakers for a.c. operation
(IEC 60898-1:2002, 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
(CEI 60898-1:2002, modifiée)

Elektrisches Installationsmaterial –
Leitungsschutzschalter für Hausinstallationen
und ähnliche Zwecke
Teil 1: Leitungsschutzschalter für
Wechselstrom (AC)
(IEC 60898-1:2002, modifiziert)

This European Standard was approved by CENELEC on 2002-09-24. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

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

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The text of document 23E/470/FDIS, future edition 1 of IEC 60898-1, prepared by SC 23E, Circuit-breakers and similar equipment for household use, of IEC TC 23, Electrical accessories, together with common modifications prepared by the Technical Committee CENELEC TC 23E, Circuit breakers and similar devices for household and similar applications, was submitted to the Unique Acceptance Procedure and was approved by CENELEC as EN 60898-1 on 2002-09-24.

This European Standard supersedes EN 60898:1991 + corrigendum October 1991 + A1:1991 + A11:1994 + A12:1995 + A13:1995 + A14:1995 + A15:1995 + A16:1996 + A17:1998 + A18:1998 + A19:2000.

The following dates were fixed:

- latest date by which the EN has to be implemented
at national level by publication of an identical
national standard or by endorsement (dop) 2003-10-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2008-10-01

Annexes designated "normative" are part of the body of the standard.

Annexes designated "informative" are given for information only.

In this standard, annexes B, C, E, H, I, ZA and ZB are normative and annexes A, D and F are informative.

Annexes ZA and ZB have been added by CENELEC.

In this standard, the following print types are used:

- requirements: roman type;
- *test specifications: italic type;*
- notes: smaller roman type.

Endorsement notice

The text of the International Standard IEC 60898-1:2002 was approved by CENELEC as a European Standard with agreed common modifications.

Foreword to amendment A1

The text of amendment 1:2002 to the International Standard IEC 60898-1:2002, prepared by SC 23E, Circuit-breakers and similar equipment for household use, of IEC TC 23, Electrical accessories, together with common modifications prepared by the Technical Committee CENELEC TC 23E, Circuit breakers and similar devices for household and similar applications, was submitted to the Unique Acceptance Procedure and was approved by CENELEC as amendment A1 to EN 60898-1:2003 on 2004-03-16.

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with the amendment have to be withdrawn (dow) 2008-10-01

Annex ZC has been added by CENELEC.

Endorsement notice

The text of amendment 1:2002 to the International Standard IEC 60898-1:2002 was approved by CENELEC as an amendment to the European Standard with agreed common modifications as given below.

Foreword to amendment A11

This amendment, aiming to improve the interpretation of some requirements/testing specifications of EN 60898-1:2003, has been prepared by the Technical Committee CENELEC TC 23E, Circuit breakers and similar devices for household and similar applications.

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with the amendment have to be withdrawn (dow) 2010-05-01

Tables which are additional to those in IEC 60898-1 are prefixed “Z”.

Foreword to amendment A12

At the request of the German electrotechnical committee a draft for an amendment to the European Standard EN 60898-1:2003 was submitted to the CENELEC members for acceptance in May 2008.

The text of the draft was accepted by CENELEC as amendment A12 to EN 60898-1:2003 on 2008-08-01.

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Foreword to amendment 13

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national standard or by endorsement (dop) 2013-05-21
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document have to be withdrawn (dow) 2015-05-21

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

Clauses, subclauses, notes, tables, figures and annexes which are additional to those in IEC 60898-1:2003 are prefixed “Z”.

This standard covers the Principle Elements of the Safety Objectives for Electrical Equipment Designed for Use within Certain Voltage Limits (LVD - 2006/95/EC).

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

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

1 Scope and object

This part of IEC 60898 applies to a.c. air-break circuit-breakers for operation at 50 Hz or 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.

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 for not being maintained.

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

They are suitable for isolation.

 Circuit-breakers of this standard are suitable for use in IT systems provided that the requirements of HD 384.4.473 are complied with. 

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  EN 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.

Requirements for circuit-breakers for a.c. and d.c. operation are given in  EN 60898-2 .

 Requirements for circuit-breakers which incorporate residual current tripping devices are to be found in EN 61009-1 and EN 61009-2-1.

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

A guide for co-ordination under short-circuit conditions between a circuit-breaker and another short-circuit protective device (SCPDs) is given in annex D.

NOTE 1 For more severe overvoltage conditions, circuit-breakers complying with additional requirements or other standards should be used.

NOTE 2 For an environment with a higher pollution degree, enclosures giving the appropriate degree of protection should be used.

NOTE 3 Circuit-breakers within the scope of this standard may 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 4 Recommendations for the dimensional coordination between enclosures and circuit breakers for mounting on rail according to EN 60715 or equivalent means are given in the CENELEC report R023-001.

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 to be submitted for certification purposes (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

NOTE Normative references to international standards are given in annex ZB.

3 Definitions

For the purpose of this part of IEC 60898, the definitions given in IEC 60050(441) and the following apply.

3.1 Devices

3.1.1

switching device

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

[IEV 441-14-01]

3.1.2

mechanical switching device

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

[IEV 441-14-02 , modified 

3.1.3

fuse

a switching device that, by the melting 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

[IEV 441-18-01, modified]

3.1.4

circuit-breaker (mechanical)

a 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

[IEV 441-14-20, modified]

3.1.5

plug-in circuit-breaker

a 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

a current exceeding the rated current

[IEV 441-11-06]

3.2.2

overload current

overcurrent occurring in an electrically undamaged circuit

NOTE 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 A short-circuit current may result from a fault or from an incorrect connection.

[IEV 441-11-07, modified]

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 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 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

 NOTE The switched neutral pole may remain closed when the circuit-breaker opens. 

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

the temperature, determined under prescribed conditions, of the air surrounding the circuit-breaker (for an enclosed circuit-breaker, it is the air outside the enclosure)

[IEV 441-11-13, modified]

3.2.10.2

reference ambient air temperature

the 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 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

operation sequence (of a mechanical switching device)

a succession of specified operations with specified time intervals

[IEV 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)

3.2.15

routine test

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

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 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.

[IEV 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 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 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 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

3.3.13**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

3.3.14**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). 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 Examples of pillar terminals are shown in annex F, figure F.1.

3.3.15**screw terminal**

screw-type terminal in which the conductor is clamped under the head of the screw. The clamping pressure may 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 Examples of screw terminals are shown in annex F, figure F.2.

3.3.16**stud terminal**

screw-type terminal in which the conductor is clamped under a nut. 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 Examples of stud terminals are shown in annex F, figure F.2.

3.3.17

saddle terminal

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

NOTE Examples of saddle terminals are shown in annex F, figure F.3.

3.3.18

lug terminal

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

NOTE Examples of lug terminals are shown in annex F, figure F.4.

3.3.19

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

3.3.20

plug-in terminal

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

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

3.3.21

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.

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.

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

3.3.22

thread-forming tapping screw

tapping screw having an uninterrupted thread. It is not a function of this thread to remove material from the hole

NOTE An example of thread-forming tapping screw is shown in figure 1.

3.3.23

thread-cutting tapping screw

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

NOTE 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

an 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

[IEV 441-16-13]

3.4.4

independent manual operation

a 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

[IEV 441-16-16]

3.4.5

trip-free circuit-breaker

a 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 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

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 (of a circuit, and with respect to a circuit-breaker)

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

NOTE The prospective current may be qualified in the same manner as an actual current, for example prospective breaking current, prospective peak current.

[IEV 441-17-01, modified]

3.5.3

prospective peak current

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

NOTE 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.

[IEV 441-17-02]

3.5.4

maximum prospective peak current (of an a.c. circuit)

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

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

[IEV 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

the 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

the 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

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

NOTE 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

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

NOTE 1 This voltage may be considered as comprising two successive intervals of time, one during which a transient voltage exists, followed by a second one during which power-frequency voltage alone exists.

NOTE 2 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.

[IEV 441-17-25, modified]

3.5.8.1

transient recovery voltage

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

NOTE 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.

 Text deleted 

3.5.8.2**power-frequency recovery voltage**

recovery voltage after the transient voltage phenomena have subsided

[IEV 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 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

[IEV 441-17-37, modified]

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

[IEV 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 discrimination (selectivity) and/or back-up protection

[IEC 60947-1, definition 2.5.22]

3.5.14.2

overcurrent discrimination

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

[IEV 441-17-15 , modified 

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

[IEC 60947-1, definition 2.5.24]

3.5.14.4

total discrimination (total selectivity)

overcurrent discrimination 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

[IEC 60947-2, definition 2.17.2]

3.5.14.5

partial discrimination (partial selectivity)

overcurrent discrimination 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

[IEC 60947-2, definition 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

The selectivity limit current (see figure D.1 of this standard) 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)

[IEC 60947-2, definition 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 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.

[IEV 441-17-16 , modified 

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 For the purpose of this standard, the short-circuit protective device is generally a circuit-breaker or a fuse.

NOTE 2 This definition differs from IEC 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.

[IEC 60947-1, definition 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

[IEC 60947-1, definition 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 (conventional time) without tripping

Ⓒ11 (IEV 442-05-54, modified) Ⓒ11

3.5.16**conventional tripping current**

I_t

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

Ⓒ11 (IEV 442-05-55, modified) Ⓒ11

3.5.17**instantaneous tripping current**

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

Ⓒ11 (IEV 442-05-47, modified) Ⓒ11

3.6 Definitions related to insulation co-ordination**3.6.1****insulation co-ordination**

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

[IEC 60664-1, definition 1.3.1]

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

[IEC 60664-1, definition 1.3.5]

NOTE 1 Transients are disregarded.

NOTE 2 Both open-circuit conditions and normal operating conditions are taken into account.

3.6.3

overvoltage

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

[IEC 60664-1, definition 1.3.7]

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

[IEC 60664-1, definition 1.3.8.1]

3.6.5

overvoltage category

numeral defining a transient overvoltage condition

[IEC 60664-1, definition 1.3.10]

3.6.6

macro-environment

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

[IEC 60664-1, definition 1.3.12.1]

3.6.7

micro-environment

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

[IEC 60664-1, definition 1.3.12.2]

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

[IEC 60664-1, definition 1.3.11]

3.6.9

pollution degree

numeral characterising the expected pollution of the micro-environment

NOTE 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.

[IEC 60664-1, definition 1.3.13]

3.6.10

isolation (isolating function)

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

[IEC 60947-1, definition 2.1.19, modified]

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

[IEV 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 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 9.

[IEV 441-17-31, modified]

3.6.13**creepage distance**

shortest distance along the surface of an insulating material between two conductive parts (see annex B)

NOTE 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 9.

4 Classification

Circuit-breakers are classified according to several criteria.

4.1 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 may be

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

4.2 According to the protection against external influences:

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

4.3 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.

** 4.4 According to the methods of connection****4.4.1 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. 

A1 NOTE Examples of this type are:

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

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

4.4.2 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.

- circuit-breakers with screw-type terminals for external aluminium conductors;

NOTE 3 The requirements for circuit-breakers equipped with this type of terminals are under consideration. **A1**

4.5 According to the instantaneous tripping current (see 3.5.17)

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

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

C13 4.6 According to the I^2t characteristic

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). **C13**

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 4.1);
- protection against external influences (see 4.2);
- method of mounting (see 4.3);
- method of connection (see 4.4);
- 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);
- range of instantaneous tripping current (see 4.5 and 5.3.5);
- value of rated short-circuit capacity (see 5.3.4);
- I^2t characteristic (see 3.5.13);
- I^2t classification (see 4.6).

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

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.

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).

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

The RMS 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 EN 61009-1).

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

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

NOTE2 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 **Standard 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 **Standard 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 ranges are 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 values of rated impulse withstand voltage (U_{imp})**

Table 3 gives the standard values of rated impulse withstand voltages as a function of the nominal voltage of the installation.

Table 3 ± (void)

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

6 Marking and other product information

6.1 Standard marking

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

- a) manufacturer's name or trade mark;
- b) type designation, catalogue number or serial number;
- c) rated voltage(s);
- d) rated current without symbol "A", preceded by the symbol of instantaneous tripping (B, C or D), for example B 16;
- e) rated frequency if the circuit-breaker is designed only for one frequency (see 5.3.3);
- f) I_{cn} rated short-circuit capacity, in A, within a rectangle, without symbol "A"; I_{cn}
- g) wiring diagram, unless the correct mode of connection is evident;
- h) reference I_{cn} calibration I_{cn} temperature, if different from 30 °C;
- i) degree of protection (only if different from IP20);
- j) 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. I_{cn}
- k) I_{cn} making and breaking capacity on an individual protected pole of multipole circuit breakers (I_{cn1}), if different from I_{cn} . I_{cn}

I_{cn} 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) and j) 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. I_{cn}

The suitability for isolation, which is provided by all circuit-breakers of this standard, may be indicated by the symbol  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 technical committee 3 of IEC 1. When the symbol is used on its own (i.e. not in a wiring diagram), combination with symbols of other functions is not allowed.

I_{cn} Text deleted I_{cn}

I_{cn} Text deleted I_{cn}

If a degree of protection higher than IP20 according to IEC 60529 is marked on the device, it shall comply with it, whichever the method of installation. If the higher degree of protection is obtained only by a specific method of installation and/or with the use of specific accessories (e.g. terminal covers, enclosures, etc.), this shall be specified in the manufacturer's literature.

I_{cn} The manufacturer shall publish in his literature the I^2t characteristic (see 3.5.13). I_{cn}

¹ IEC technical committee 3: Documentation and graphical symbols.

For circuit-breakers other than those operated by means of push-buttons the open position shall be indicated by the symbol O (a circle) and the closed position by the symbol I (a short vertical straight line). 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.

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

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 circuit breaker shall be marked in a durable manner with all or, for small apparatus, part of the following data:		Markings may be on the circuit breaker 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.	
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)	energy limiting class (e.g. 3) in a square in accordance with annex ZA, [C13] as applicable** [C13]		X(*)		
k)	breaking capacity on one pole of multipole circuit breakers in case of short-circuit to earth I_{cn1}				X
	the position of use (symbol according to IEC 60051), if necessary;		X		
	indication of the terminal for the neutral with "N"		X		
	additional marking of performance to other standards		X		
I_{cn} and the energy limiting class, [C13] as applicable [C13], shall be both on the device and combined together. [C13] (**) If Annex ZA is not applicable to the device, I^2t characteristics shall be available on request. [C13]					





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 Z1.

Table Z1 ± 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	20 °C	± 5 °C
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	± 2 %
Sinusoidal wave distortion	Not exceeding 5 %	Zero	5 %
^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.

8.1.2 Mechanism

The moving contacts of all poles of multipole circuit-breakers shall be so mechanically coupled that all poles, except the switched neutral, if any, make and break substantially together, whether operated manually or automatically, even if an overload occurs on one protected pole only.

The switched neutral pole (see 3.2.7.3) of four-pole circuit-breakers shall not close after and shall not open before the protected poles.

Compliance is checked by inspection and by manual test, using any appropriate means (e.g. indicator lights, oscilloscope, etc.).

If a pole having an appropriate short-circuit making and breaking capacity is used as a neutral pole and the circuit-breaker has an independent manual operation (see 3.4.4), then all poles, including the neutral pole, may operate substantially together.

Circuit-breakers shall have a trip-free mechanism.

It shall be possible to switch the circuit-breaker on and off by hand. For plug-in type circuit-breakers C11 *Text deleted* C11, this requirement is not considered met by the fact that the circuit-breaker can be removed from its base.

Circuit-breakers shall be so constructed that the moving contacts can come to rest only in the closed position (see 3.2.8) or in the open position (see 3.2.9), even when the operating means is released in an intermediate position.

Circuit-breakers shall provide in the open position (see 3.2.9) an isolation distance in accordance with the requirements necessary to satisfy the isolating function (see 8.3). Indication of the open and closed position of the main contacts shall be provided by one or both of the following means:

- the position of the actuator (this being preferred), or
- a separate mechanical indicator.

If a separate mechanical indicator is used to indicate the position of the main contacts, this shall show the colour red for the closed position (ON) and the colour green for the open position (OFF).

The means of indication of the contact position shall be reliable.

Compliance is checked by inspection and by the tests of 9.10.2.

Circuit-breakers shall be designed so that the actuator, front plate or cover can only be correctly fitted in a manner which ensures correct indication of the contact position.

Compliance is checked by inspection and by the tests of 9.12.12.1 and 9.12.12.2.

Where the operating means is used to indicate the position of the contacts, the operating means, when released, shall automatically take up the position corresponding to that of the moving contact(s); in this case, the operating means shall have two distinct rest positions corresponding to the position of the contacts but, for automatic opening, a third distinct position of the operating means may be provided.

The action of the mechanism shall not be influenced by the position of enclosures or covers and shall be independent of any removable part.

A cover sealed in position by the manufacturer is considered to be a non-removable part.

If the cover is used as a guiding means for push-buttons, it shall not be possible to remove the buttons from the outside of the circuit-breaker.

Operating means shall be securely fixed on their shafts and it shall not be possible to remove them without the aid of a tool. Operating means directly fixed to covers are allowed.

If the operating means has an "up-down" movement, when the circuit-breaker is mounted as in normal use, the contacts shall be closed by the up movement.

 Text deleted .

Compliance is checked by inspection and by manual test.

When means are provided or specified by the manufacturer to lock the operating means in the open position, locking in that position shall only be possible when the main contacts are in the open position.

 NOTE Locking of the operating means in the closed position is permitted for particular applications. 

Compliance is checked by inspection, taking into account the instructions of the manufacturer.

8.1.3 Clearances and creepage distances (see annex B)

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 degree of pollution 2. However, the clearances of items 2, 4 and 5 may be reduced provided that the tests at rated impulse voltage are withstood.

The insulating materials are classified into material groups on the basis of their comparative tracking index (CTI) according to 2.7.1.1 and 2.7.1.3 of IEC 60664-1.

Table 4 ± Minimum clearances and creepage distances

Description	Minimum clearances mm	Minimum creepage distances ^{e, f} mm												
		Group IIIa ^h (175V ≤ CTI < 400 V) ^d				Group II (400V ≤ CTI < 600V) ^d				Group I (600V ≤ CTI) ^d				
		Working voltage ^e V												
		>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 C11 C11	230/400V 230V 400 V	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	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	8,0	8,0		3,0	6,0	8,0		3,0	6,0	8,0		3,0	6,0	8,0
		Rated voltage V												
		230 / 400				230 / 400				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 ^b - metal covers or boxes ^b - other accessible metal parts ^c - metal frames supporting flush-type circuit-breakers	3,0	4,0				3,0				3,0				
C11 Text deleted C11														
NOTE The values given for 400 V are also valid for 440 V. NOTE 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 9).
- d See IEC 60112.
- e Interpolation is allowed in determining creepage distances corresponding to voltage values intermediate to those listed as working voltage. 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 ($100 \text{ V} \leq \text{CTI} < 175 \text{ V}$) 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.
- C11 j This applies also to clearance and creepage distances between live parts of different polarity of circuit breakers mounted close to one another. C11



8.1.4 Screws, current-carrying parts and connections

8.1.4.1 Connections, whether electrical or mechanical, shall withstand the mechanical stresses occurring in normal use.

Screws operated when mounting the circuit-breaker during installation shall not be of the thread-cutting type.

NOTE 1 Screws (or nuts) which are operated when mounting the circuit-breaker include screws for fixing covers or cover-plates, but not connecting means for screwed conduits and for fixing the base of a circuit-breaker.

Compliance is checked by inspection and by the test of 9.4.

NOTE 2 Screwed connections are considered as checked by the tests of 9.8, 9.9, 9.12, 9.13 and 9.14.

8.1.4.2 For screws in engagement with a thread of insulating material and which are operated when mounting the circuit-breaker during installation, correct introduction of the screw into the screw hole or nut shall be ensured.

Compliance is checked by inspection and by manual test.

NOTE The requirement with regard to correct introduction is met, if introduction of the screw in a slanting manner is prevented, for example by guiding the screw by the part to be fixed by a recess in the female thread, or by the use of a screw with the leading thread removed.

8.1.4.3 Electrical connections shall be so designed that contact pressure is not transmitted through insulating material other than ceramic, pure mica or other material with characteristics no less suitable, unless there is sufficient resilience in the metallic parts to compensate for any possible shrinkage or yielding of the insulating material.

Compliance is checked by inspection.

NOTE The suitability of the material is considered in respect of the stability of the dimensions.

8.1.4.4 Current-carrying parts and connections including parts intended for protective conductors, if any, shall be of

- copper;
- an alloy containing at least 58 % copper for parts worked cold, or at least 50 % copper for other parts;
- other metal or suitably coated metal, no less resistant to corrosion than copper and having mechanical properties no less suitable.

NOTE New requirements and appropriate tests for determining the resistance to corrosion are under consideration. These requirements should permit other materials to be used if suitably coated.

The requirements of this subclause do not apply to contacts, magnetic circuits, heater elements, bimetals, current-limiting materials, shunts, C11 electronic parts, including circuit boards, C11 nor to screws, nuts, washers, clamping plates and similar parts of terminals.

C11 Compliance is checked by inspection in accordance with manufacturer's declaration. C11

8.1.5 Terminals for external conductors

8.1.5.1 Terminals for external conductors shall be such that the conductors may be connected so as to ensure that the necessary contact pressure is maintained permanently.

A1 Text deleted A1

Connection arrangements intended for busbar connection are admissible, provided they are not used for the connection of cables.

Such arrangements may be either of the plug-in or of the bolt-on type.

The terminals shall be readily accessible under the intended conditions of use.

A1 Compliance is checked by inspection, by the tests of 9.5 for screw-type terminals, by specific tests for plug-in or bolt-on circuit-breakers included in the standard, or by the tests of annex J or K, as relevant for the type of connection. A1

8.1.5.2 Circuit-breakers shall be provided with terminals which shall allow the connection of copper conductors having nominal cross-sectional areas as shown in table 5.

A1 NOTE 1 Examples of possible designs of screw-type terminals are given in annex F. A1

Compliance is checked by inspection, by measurement and by fitting in turn one conductor of the smallest and one of the largest cross-sectional area as specified.

Table 5 ± Connectable cross-sections of copper conductors for screw-type terminals

Rated current ^a A	Range of nominal cross-sections to be clamped mm ²
Up to and including 13	1 to 2,5
above 13 up to and including 16	1 to 4
above 16 up to and including 25	1,5 to 6
above 25 up to and including 32	2,5 to 10
above 32 up to and including 50	4 to 16
above 50 up to and including 80	10 to 25
above 80 up to and including 100	16 to 35
above 100 up to and including 125	25 to 50
^a It is required that, for current ratings up to and including 50 A, terminals be designed to clamp solid conductors as well as rigid stranded conductors; the use of flexible conductors is permitted. Nevertheless, it is permitted that terminals for conductors having cross-sections from 1 mm ² up to 6 mm ² be designed to clamp solid conductors only.	

 Text deleted 

8.1.5.3 The means for clamping the conductors in the terminals shall not serve to fix any other component, although they may hold the terminals in place or prevent them from turning.

Compliance is checked by inspection and by the tests of 9.5.

8.1.5.4 Terminals for rated currents up to and including 32 A shall allow the conductors to be connected without special preparation.

Compliance is checked by inspection.

NOTE The term "special preparation" covers soldering of the wire of the conductor, use of cable lugs, formation of eyelets, etc., but not the reshaping of the conductor before its introduction into the terminal or the twisting of a flexible conductor to consolidate the end.

8.1.5.5 Terminals shall have adequate mechanical strength. Screws and nuts for clamping the conductors shall have a metric ISO thread or a thread comparable in pitch and mechanical strength.

Compliance is checked by inspection and by the tests of 9.4 and 9.5.1.

NOTE Provisionally, SI, BA and UN threads may be used as they are virtually equivalent in pitch and mechanical strength to metric ISO threads.

8.1.5.6 Terminals shall be so designed that they clamp the conductor without undue damage to the conductor.

Compliance is checked by inspection and by the test of 9.5.2.

8.1.5.7 Terminals shall be so designed that they clamp the conductor reliably and between metal surfaces.

Compliance is checked by inspection and by the tests of 9.4 and 9.5.1.

8.1.5.8 Terminals shall be so designed or positioned that neither a rigid solid conductor nor a wire of a stranded conductor can slip out while the clamping screws or nuts are tightened.

This requirement does not apply to lug terminals.

Compliance is checked by the test of 9.5.3.

8.1.5.9 Terminals shall be so fixed or located that, when the clamping screws or nuts are tightened or loosened, the terminals shall not work loose from their fixings to circuit-breakers.

NOTE 1 These requirements do not imply that the terminals shall be so designed that their rotation or displacement is prevented, but any movement must be sufficiently limited so as to prevent non-compliance with the requirements of this standard.

NOTE 2 The use of sealing compound or resin is considered to be sufficient for preventing a terminal from working loose, provided that

- the sealing compound or resin is not subject to stress during normal use, and
- the effectiveness of the sealing compound or resin is not impaired by temperatures attained by the terminal under the most unfavourable conditions specified in this standard.

Compliance is checked by inspection, by measurement and by the test of 9.4.

8.1.5.10 Clamping screws or nuts of terminals intended for the connection of protective conductors shall be adequately secured against accidental loosening.

Compliance is checked by manual test.

NOTE In general, the designs of terminals (examples of which are shown in annex F) provide sufficient resilience to comply with this requirement; for other designs, special provisions, such as the use of an adequately resilient part which is not likely to be removed inadvertently, may be necessary.

8.1.5.11  Void 

8.1.5.12 Screws and nuts of terminals intended for the connection of external conductors shall be in engagement with a metal thread and the screws shall not be of the tapping screw type.

 *Compliance is checked by inspection.* 

8.1.6 Non-interchangeability

For circuit-breakers intended to be mounted on bases forming a unit therewith (plug-in type or screw-in type) it shall not be possible, without the aid of a tool, to replace a circuit-breaker when mounted and wired as for normal use by another of the same make having a higher rated current.

Compliance is checked by inspection.

NOTE The expression "as for normal use" implies that the circuit-breaker is installed according to the manufacturer's instructions.

8.1.7 Mechanical mounting of plug-in type circuit-breakers

The mechanical mounting of plug-in type circuit-breakers C11 *Text deleted* C11 shall be reliable and have adequate stability.

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

Compliance of the mechanical mounting is checked by the relevant tests of 9.13.

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

Compliance of the mechanical mounting is checked by the relevant tests of 9.13.

8.2 Protection against electric shock

Circuit-breakers shall be so designed that, when they are mounted and wired as for normal use (see note to 8.1.6), live parts are not accessible.

A part is considered to be "accessible" if it can be touched by the test finger (see 9.6).

For circuit-breakers other than those of the plug-in type, external parts, other than screws or other means for fixing covers and labels, which are accessible when the circuit-breakers are mounted and wired as for normal use, shall either be of insulating material or be lined throughout with insulating material, unless the live parts are within an internal enclosure of insulating material.

Linings shall be fixed in such a way that they are not likely to be lost during installation of the circuit-breakers. They shall have adequate thickness and mechanical strength and shall provide adequate protection at places where sharp edges occur.

Inlet openings for cables or conduits shall either be of insulating material or be provided with bushings or similar devices of insulating material. Such devices shall be reliably fixed and shall have adequate mechanical strength.

For plug-in circuit-breakers, external parts other than screws or other means for fixing covers, which are accessible in normal conditions of use, shall be of insulating material.

Metallic operating means shall be insulated from live parts and their exposed conductive parts shall be covered by insulating material. This requirement does not apply to means for coupling insulated operating means of several poles. Metal parts of the mechanism shall not be accessible. In addition, they shall be insulated from accessible metal parts, from metal frames supporting the base of flush-type circuit-breakers, from screws or other means for fixing the base to its support and from a metal plate, if any, used as support.

It shall be possible to replace plug-in circuit-breakers easily without touching live parts.

Lacquer or enamel are not considered to provide adequate insulation for the purpose of this subclause.

Compliance is checked by inspection and by the test of 9.6.

8.3 Dielectric properties and isolating capability

Circuit-breakers shall have adequate dielectric properties and shall ensure isolation.

8.3.1 Dielectric strength at power frequency

Circuit-breakers shall have adequate dielectric properties at power frequency.

Compliance is checked by the tests of 9.7.1, 9.7.2 and 9.7.3 on the circuit-breaker in new condition.

Moreover, after the endurance tests of 9.11 and after the short-circuit tests of 9.12, the circuit-breakers shall withstand the test of 9.7.3 but at the reduced test voltage specified in 9.11.3 and 9.12.12.2 respectively and without the previous humidity treatment of 9.7.1.

8.3.2 Isolating capability

Circuit-breakers shall be suitable for isolation.

Compliance is checked by the verification of compliance with the minimum clearances and creepage distances of item 1 of table 4 and by the tests of 9.7.6.1 and 9.7.6.3.

8.3.3 Dielectric strength at rated impulse withstand voltage (U_{imp})

Circuit-breakers shall adequately withstand impulse voltages.

Compliance is checked by the tests of 9.7.6.2.

8.4 Temperature-rise

8.4.1 Temperature-rise limits

The temperature rises of the parts of a circuit-breaker specified in table 6, measured under the conditions specified in 9.8.2, shall not exceed the limiting values stated in that table.

The circuit-breaker shall not suffer damage impairing its functions and its safe use.

Table 6 ± Temperature-rise values

Parts ^{a b}	Temperature-rise K
Terminals for external connections ^c	60
External parts liable to be touched during manual operation of the circuit-breaker, including operating means of insulating material and metallic means for coupling insulated operating means of several poles	40
External metallic parts of operating means	25
Other external parts, including that face of the circuit-breaker in direct contact with the mounting surface	60
^a No value is specified for the contacts, since the design of most circuit-breakers is such that a direct measurement of the temperature of those parts cannot be made without the risk of causing alterations or displacements of parts likely to affect the reproducibility of the tests. The 28-day test (see 9.9) is considered to be sufficient for checking indirectly the behaviour of the contacts with respect to undue overheating in service. ^b No value is specified for parts other than those listed, but no damage shall be caused to adjacent parts of insulating materials, and the operation of the circuit-breaker shall not be impaired. ^c For plug-in type circuit-breakers, the terminals of the base on which they are installed.	

8.4.2 Ambient air temperature

The temperature-rise limits given in table 6 are applicable only if the ambient air temperatures remain between the limits given in 7.1.

8.5 Uninterrupted duty

Circuit-breakers shall operate reliably even after long service.

Compliance is checked by the test of 9.9.

8.6 Automatic operation

8.6.1 Standard time-current zone

The tripping characteristic of circuit-breakers shall be such that they ensure adequate protection of the circuit, without premature operation.

The zone of the time-current characteristic (tripping characteristic) of a circuit-breaker is defined by the conditions and the values stated in table 7.

This table refers to a circuit-breaker mounted in accordance with the reference conditions (see 9.2) operating at the reference calibration temperature of 30 °C, with a tolerance of $^{+5}_{0}$ °C.

Compliance is checked by the tests specified in 9.10.

The test may be made at any convenient temperature, the results being referred to 30 °C, using the information given by the manufacturer.

In any case the variation from the test current of table 7 shall not exceed 1,2 %/ per K of calibration temperature variation.

If the circuit-breakers are marked for a calibration temperature different from 30 °C, they are tested for that different temperature.

The manufacturer shall be prepared to give information on the variation of the tripping characteristic for calibration temperatures differing from the reference value.

Table 7 ± Time-current operating characteristics

Test	Type	Test current	Initial condition	Limits of tripping or non-tripping time	Result to be obtained	Remarks
a	B, C, D	$1,13 I_n$	Cold ^a	$t \leq 1 \text{ h}$ (for $I_n \leq 63 \text{ A}$) $t \leq 2 \text{ h}$ (for $I_n > 63 \text{ A}$)	No tripping	
b	B, C, D	$1,45 I_n$	Immediately following test a	$t < 1 \text{ h}$ (for $I_n \leq 63 \text{ A}$) $t < 2 \text{ h}$ (for $I_n > 63 \text{ A}$)	Tripping	Current steadily increased within 5 s
c	B, C, D	$2,55 I_n$	Cold ^a	$1 \text{ s} < t < 60 \text{ s}$ (for $I_n \leq 32 \text{ A}$) $1 \text{ s} < t < 120 \text{ s}$ (for $I_n > 32 \text{ A}$)	Tripping	
d	B C D	$3 I_n$ $5 I_n$ $10 I_n$	Cold ^a	$0,1 \text{ s} < t < 45 \text{ s}$ (for $I_n \leq 32 \text{ A}$) $0,1 \text{ s} < t < 90 \text{ s}$ (for $I_n > 32 \text{ A}$) $0,1 \text{ s} < t < 15 \text{ s}$ (for $I_n \leq 32 \text{ A}$) $0,1 \text{ s} < t < 30 \text{ s}$ (for $I_n > 32 \text{ A}$) $0,1 \text{ s} < t < 4 \text{ s}^b$ (for $I_n \leq 32 \text{ A}$) $0,1 \text{ s} < t < 8 \text{ s}$ (for $I_n > 32 \text{ A}$)	Tripping	Current established by closing an auxiliary switch
e	B C D	$5 I_n$ $10 I_n$ $20 I_n$	Cold ^a	$t < 0,1 \text{ s}$	Tripping	Current established by closing an auxiliary switch
Note deleted ^a The term "cold" means without previous loading, at the reference calibration temperature. ^b For $I_n \leq 10 \text{ A}$, $t < 8 \text{ s}$ is permissible.						



8.6.2 Conventional quantities

8.6.2.1 Conventional time

The conventional time is 1 h for circuit-breakers of rated current up to and including 63 A, and 2 h for circuit-breakers of rated current above 63 A.

8.6.2.2 Conventional non-tripping current (I_{nt})

The conventional non-tripping current of a circuit-breaker is 1,13 times its rated current.

8.6.2.3 Conventional tripping current (I_t)

The conventional tripping current of a circuit-breaker is 1,45 times its rated current.

8.6.3 Tripping characteristic

The tripping characteristic of circuit-breakers shall be contained within the zone defined in 8.6.1.

NOTE 1 Conditions of temperature and mounting different from those specified in 9.2 (e.g. mounting in a special enclosure, grouping of several circuit-breakers in the same enclosure) may affect the tripping characteristic of circuit-breakers.

NOTE 2 The manufacturer should be prepared to give information on the variation of the tripping characteristic for ambient temperatures differing from the reference value, within the limits of 7.1.

8.6.3.1 Effect of single-pole loading of multipole circuit-breakers on the tripping characteristic

When circuit-breakers having more than one protected pole are loaded on only one of the protected poles, starting from cold, with a current equal to

- 1,1 times the conventional tripping current, for two-pole circuit-breakers with two protected poles,
- 1,2 times the conventional tripping current, for three-pole and four-pole circuit-breakers,

the circuit-breakers shall trip within the conventional time specified in 8.6.2.1.

Compliance is checked by the test of 9.10.3.

8.6.3.2 Effect of the ambient air temperature on the tripping characteristic

Ⓒ Ambient air temperatures other than the reference temperature, within the limits of $-5\text{ }^{\circ}\text{C}$ and $+40\text{ }^{\circ}\text{C}$, shall not unacceptably affect the tripping characteristic of circuit-breakers. Ⓒ

Compliance is checked by the tests of 9.10.4.

8.7 Mechanical and electrical endurance

Circuit-breakers shall be capable of performing an adequate number of cycles with rated current.

Compliance is checked by the test of 9.11.

8.8 Performance at short-circuit currents

Circuit-breakers shall be capable of performing a specified number of short-circuit operations, during which they shall neither endanger the operator nor initiate a flashover between live conductive parts or between live conductive parts and earth.

Compliance is checked by the tests of 9.12.

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

8.9 Resistance to mechanical shock and impact

Circuit-breakers shall have adequate mechanical behaviour so as to withstand the stresses imposed during installation and use.

Compliance is checked by the tests of 9.13.