

Specification for

Circuit-breakers for overcurrent protection for household and similar installations

The European Standard EN 60898:1991 has the status of a
British Standard

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Cooperating organizations

The European Committee for Electrotechnical Standardization (CENELEC), under whose supervision this European Standard was prepared, comprises the National Committees of the following countries

Austria	Italy
Belgium	Luxembourg
Denmark	Netherlands
Finland	Norway
France	Portugal
Germany	Spain
Greece	Sweden
Iceland	Switzerland
Ireland	United Kingdom

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National foreword

This British Standard has been prepared under the direction of the Power Electrical Engineering Standards Policy Committee and is the English language version of EN 60898 “*Circuit-breakers for overcurrent protection for household and similar installations*” including amendments A11 to A19 inclusive, published by the European Committee for Electrotechnical Standardization (CENELEC). EN 60898 was derived by CENELEC from IEC 60898:1987, including corrigendum May 1988 and its amendments 2:1989 and 3:1990 and corrigendum August 1990, which has the same title as the European Standard. The CENELEC common modifications have been implemented at the appropriate places in the text of IEC 60898 and are indicated by a single vertical line in the margin. Amendment A1 to EN 60898:1991, which endorses the text of Amendment 1:1989 to IEC 60898:1987 without common modifications, was ratified by CENELEC on 25 June 1991 and is incorporated into this British Standard. The corrigendum to EN 60898 published October 1991 has been incorporated into this British Standard.

An error has been noted in EN 60898:1991, which forms the basis of this British Standard. This error, which is listed below, has been brought to the attention of the Secretariat of the relevant CENELEC Technical Committee:

Table II The range for D should read “above $10I_n$ and up to and including $20I_n$ ”

The following dates were fixed:

- latest date of publication of an identical national standard (dop) 1992-07-01
- latest date of withdrawal of conflicting national standards (dow) 1994-07-01

This standard supersedes BS 3871-1:1965 which will be withdrawn on 1 July 1994.

The foreword and preface of IEC 60898 and the deleted parts of the original IEC text, which do not form part of the text of EN 60898, have been quoted in National appendix NA.

From 1 January 1997, all IEC publications have the number 60000 added to the old number. For instance, IEC 27-1 has been renumbered as IEC 60027-1. For a period of time during the change over from one numbering system to the other, publications may contain identifiers from both systems.

Annexes designated “normative” are part of the body of the standard. Annexes designated “informative” are given for information only. National appendices are designated “informative”.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled “International Standards Correspondence Index”, or by using the “Find” facility of the BSI Standards Electronic Catalogue.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 93 and a back cover.

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EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN 60898

July 1991

+ A1: November 1991

+ A11: September 1994

+ A12: August 1995

+ A13: August 1995

+ A14: August 1995

+ A15: October 1995

+ A16: April 1996

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English version

Circuit-breakers for overcurrent protection for household and similar installations

(Includes Amendments A1:1991, A11:1994, A12:1995, A13:1995, A14:1995, A15:1995, A16:1996, A17:1998 A18:1998 and A19:2000)

(IEC 60898:1987, modified + corrigendum May 1988 + Amendment 2 1989 + Amendment 3:1990 + corrigendum August 1990)

Disjoncteurs pour installations domestiques et analogues pour la protection contre les surintensités

(Inclut les amendements A1:1991, A11:1994, A12:1995, A13:1995, A14:1995, A15:1995, A16:1996, A17:1998, A18:1998 et A19:2000)
(CEI 60898:1987, modifiée + corrigendum mai 1988 + Modification 2 1989 + Modification 3:1990 + corrigendum août 1990)

Leitungsschutzschalter für den Haushalt und ähnliche Anwendungen

(Enthält Änderungen A1:1991, A11:1994, A12:1995, A13:1995, A14:1995, A15:1995, A16:1996, A17:1998, A18:1998 und A19:2000)
(IEC 60898, modifiziert: 1987 + Corrigendum Mai 1988 + Änderung 2 1989 + Änderung 3:1990 + Corrigendum August 1990)

This European Standard was approved by CENELEC on 3 March 1990. 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, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

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

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Foreword

The CENELEC questionnaire procedure, performed for finding out whether or not the International Standard IEC 898:1987 + corrigendum May 1988 and its amendments 2:1989 and 3:1990 + corrigendum August 1990, could be accepted without textual changes, has shown that some CENELEC common modifications were necessary for the acceptance as European Standard.

The reference document, together with the common modifications prepared by the CENELEC Technical Committee TC 23E, was submitted to the CENELEC members for formal vote.

The text of the draft was approved by CENELEC as EN 60898 on 5th March 1990.

The following dates were fixed:

- latest date of publication of an identical national standard (dop) 1992-04-01
- latest date of withdrawal of conflicting national standards (dow) 1994-07-01

For products which have complied with the relevant national standard before 1994-07-01, as shown by the manufacturer or by a certification body, this previous standard may continue to apply for production until 1999-07-01.

Additional annexes, have been called Annex ZA, Annex ZB and Annex ZC. The annex designated “normative” is part of the body of the standard. The annex designated “informative” is given only for information. In this standard, Annex ZC is informative.

NOTE 1 The technical content of amendment 2 and 3 to IEC was submitted to the voting procedure as prAM1, prAM2, prAM3 and prAM4 to prEN 60898 and has been incorporated in EN 60898 as common modifications.

NOTE 2 Where the term “explanation” is used it covers all explanatory matter shown in smaller roman type in IEC 898.

Foreword to amendment A11

A draft for an amendment to EN 60898, prepared by CENELEC Technical Committee TC 23E, Circuit-breakers and similar devices for household and similar applications, was submitted to the CENELEC Unique Acceptance Procedure (UAP) in November 1993 and was approved by CENELEC as amendment A11 to EN 60898 on 5 July 1994.

The following dates were fixed:

- latest date of publication of an identical national standard (dop) 1995-07-15
- latest date of withdrawal of conflicting national standards (dow) 1995-07-15

For products which have complied with EN 60898:1991 and its amendment A1:1991 before 1995-07-15, as shown by the manufacturer or by a certification body, this previous standard may continue to apply for production until 2000-07-15.

Foreword to amendment A12

In view of the application of Directive 89/336/EEC on electromagnetic compatibility (compulsory in the EU starting from 1996-01-01), the Technical Committee CENELEC TC 23E, Circuit-breakers and similar devices for household and similar applications, at their meeting on November 8th and 9th, 1994, decided that an appropriate amendment to EN 60898 should be introduced, applying the philosophy of the recently published EN 60947-1:1991/A11:1994, taking into account that circuit-breakers for overcurrent protection for household and similar installations in EN 60898 do not incorporate electronic circuits.

The text of the draft was submitted to the formal vote and was approved by CENELEC as amendment A12 to EN 60898:1991 on 1995-07-04.

The following dates were fixed:

- latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1995-12-31
- latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 1995-12-31

For products which have complied with EN 60898:1991 + A11:1994 before 1995-12-31, as shown by the manufacturer or by a certification body, this previous standard may continue to apply for production until 2000-12-31.

Foreword to amendment A13

The text of document 23E(CO)141, future amendment to IEC 898:1987, prepared by SC 23E, Circuit-breakers and similar equipment for household use, of IEC TC 23, Electrical accessories, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A13 to EN 60898:1991 on 1994-09-01.

NOTE The text of document 23E(CO)141 has been included in IEC 898:1995.

The following dates were fixed:

- latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1996-08-15
- latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 1996-08-15

For products which have complied with EN 60898:1991 + A11:1994 + A12:1995 before 1996-08-15, as shown by the manufacturer or by a certification body, this previous standard may continue to apply for production until 2001-08-15.

Foreword to amendment A14

The text of document 23E(CO)140, future amendment to IEC 898:1987, prepared by SC 23E, Circuit-breakers and similar equipment for household use, of IEC TC 23, Electrical accessories, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A14 to EN 60898:1991 on 1995-07-04.

NOTE The text of document 23E(CO)140 has been included in IEC 898:1995.

The following dates were fixed:

- latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1996-07-01
- latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 1997-02-01

For products which have complied with EN 60898:1991 + A11:1994 + A12:1995 before 1996-08-15, as shown by the manufacturer or by a certification body, this previous standard may continue to apply for production until 2001-08-15.

Foreword to amendment A15

The text of document 23E(CO)124, future amendment to IEC 898:1987, prepared by SC 23E, Circuit-breakers and similar equipment for household use, of IEC TC 23, Electrical accessories, was submitted to the CENELEC formal vote and was approved by CENELEC as amendment A15 to EN 60898:1991 on 1995-09-20.

NOTE The text of document 23E(CO)124 has been included in IEC 898:1995.

The following dates were fixed:

- latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1996-07-01
- latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 1997-02-01

For products which have complied with EN 60898:1991, A11:1994, A12:1995, A13:1995 and A14:1995 before 1997-02-01, as shown by the manufacturer or by a certification body, this previous standard may continue to apply for production until 1999-02-01.

Foreword to amendment A16

This amendment was prepared by the Technical Committee CENELEC TC 23E, Circuit-breakers and similar devices for household and similar applications.

The text of the draft was submitted to the Unique Acceptance Procedure and was approved by CENELEC as amendment A16 to EN 60898:1991 on 1996-03-05.

The following dates were fixed:

- latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1997-03-01
- latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 1997-09-01

For products which have complied with EN 60898:1991 and its amendments A1:1991, A11:1994, A12:1995, A13:1995, A14:1995 and A15:1995 before 1997-09-01, as shown by the manufacturer or by a certification body, this previous standard may continue to apply for production until 1999-09-01.

Foreword to amendment A17

This amendment was prepared by the Technical Committee CENELEC TC 23E, Circuit-breakers and similar devices for household and similar applications.

The text of the draft was submitted to the formal vote and was approved by CENELEC as amendment A17 to EN 60898:1991 on 1997-10-01.

The following dates were fixed:

- latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1998-07-01
- latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 2001-01-01

Foreword to amendment A18

This amendment was prepared by the Technical Committee CENELEC TC 23E, Circuit-breakers and similar devices for household and similar applications.

It comprises the text of two draft amendments, prAA and prAB, which were submitted to the Unique Acceptance Procedure and were approved together as amendment A18 to EN 60898:1991 on 1998-04-01.

The following dates were fixed:

- latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1998-11-01
- latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 2003-03-01

Foreword to amendment A19

At the request of the Swedish electrotechnical committee, a draft for an amendment to EN 60898:1991 was submitted to the CENELEC members for acceptance in December 1999.

The text draft was accepted by CENELEC as amendment A19 to EN 60898:1991 on 2000-02-03.

The following dates were fixed:

- latest date by which the existence of the amendment has to be announced at national level (doa) 2000-05-03
- latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dow) 2003-08-03

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1. General

1.1 Scope

This standard 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 Publication 157-1.

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.

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 specifically 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, 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.

Supplementary requirements are necessary for circuit-breakers which incorporate residual current tripping devices.

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

A guide for coordination of circuit-breakers with fuses is given in Annex D.

Recommendations for the dimensional coordination between enclosures and circuit-breakers for mounting on rail according to EN 50022 or equivalent means are under consideration.

- 1) Circuit-breakers within the scope of this standard are considered as suitable for isolation (see sub-clause 7.1.3).
Special precautions (e.g. use of lightning arresters) may be necessary when excessive overvoltages are likely to occur on the supply side (e.g. in the case of supply through overhead lines).
- 2) Circuit-breakers within the scope of this standard may also be used for protection against electric shock, in case of a 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.

1.2 Object

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:

- 1) the characteristics of circuit-breakers;
- 2) the conditions with which circuit-breakers shall comply, with reference to:
 - a) their operation and behaviour in normal service;
 - b) their operation and behaviour in case of overload;
 - c) their operation and behaviour in case of short-circuits up to their rated short-circuit capacity;
 - d) their dielectric properties;
- 3) the tests intended for confirming that these conditions have been met and the methods to be adopted for the tests;
- 4) the data to be marked on the devices;
- 5) the test sequences to be carried out and the number of samples to be submitted for certification purposes (see Annex C);
- 6) the coordination with separate fuses associated in the same circuit (see Annex I)

2 Definitions

2.1 Devices

2.1.1

switching device

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

2.1.2

mechanical switching device

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

2.1.3

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

2.1.4

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

2.1.5

plug-in circuit-breaker

circuit-breaker having one or more plug-in terminals (see 2.3.20) and designed for use with appropriate means for the plug-in connection

2.2 General terms

2.2.1

overcurrent

any current exceeding the rated current

2.2.2

overload current

an overcurrent occurring in an electrically undamaged circuit

An overload current may cause damage if sustained for a sufficient time.

2.2.3

short-circuit current

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

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

2.2.4

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

2.2.5

control circuit (of a circuit-breaker)

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

2.2.6

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

2.2.7**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

2.2.7.1**protected pole**

a pole provided with an overcurrent release (see sub-clause 2.3.6)

2.2.7.2**unprotected pole**

a pole without overcurrent release (see sub-clause 2.3.6), but otherwise generally capable of the same performance as a protected pole of the same circuit-breaker

- 1) To ensure this requirement, the unprotected pole may be of the same construction as the protected pole(s), or of a particular construction.
- 2) If the short-circuit capacity of the unprotected pole is different from that of the protected pole(s), this shall be indicated by the manufacturer.

2.2.7.3**switched neutral pole**

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

2.2.8**closed position**

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

2.2.9**open position**

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

2.2.10 Air temperature**2.2.10.1****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)

2.2.10.2**reference ambient air temperature**

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

2.2.11**operation**

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

If distinction is necessary, an operation in the electrical sense (e.g. make or break) is referred to as a switching operation and an operation in the mechanical sense (e.g. close or open) is referred to as a mechanical operation.

2.2.12**operating cycle**

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

2.2.13**sequence of operation**

a succession of specified operations with specified time intervals

2.2.14**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)

2.2.15

routine test

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

2.3 Constructional elements

2.3.1

main contact

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

2.3.2

arcing contact

a contact on which the arc is intended to be initiated

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.

2.3.3

control contact

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

2.3.4

auxiliary contact

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

2.3.5

release

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

2.3.6

overcurrent release

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

In some cases this value can depend upon the rate of rise of current.

2.3.7

inverse time-delay overcurrent release

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

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

2.3.8

direct overcurrent release

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

2.3.9

overload release

an overcurrent release intended for protection against overloads

2.3.10

conductive part

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

2.3.11

exposed conductive part

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

2.3.12**terminal**

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

2.3.13**screw-type terminal**

a terminal for the connection and subsequent disconnection of a conductor or the interconnection 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

2.3.14**pillar terminal**

a 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

Examples of pillar terminals are shown in Annex F, Figure F1, page 72.

2.3.15**screw terminal**

a 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

Examples of screw terminals are shown in Annex F, Figure F2, page 73.

2.3.16**stud terminal**

a 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

Examples of stud terminals are shown in Annex F, Figure F2, page 73.

2.3.17**saddle terminal**

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

Examples of saddle terminals are shown in Annex F, Figure F3, page 74.

2.3.18**lug terminal**

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

Examples of lug terminals, are shown in Annex F, Figure F4, page 74.

2.3.19**screwless terminal**

a connecting terminal for the connection and subsequent disconnection of one conductor or the dismantlable 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

2.3.20**plug-in terminal**

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

The connection is effected without the use of the tool and is provided by the resilience of the fixed and/or moving parts and/or by springs

2.3.21

tapping screw

a 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.

2.3.22

thread-forming tapping screw

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

An example of thread-forming tapping screw is shown in Figure 1, page 51.

2.3.23

thread-cutting tapping screw

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

An example of thread-cutting tapping screw is shown in Figure 2, page 51.

2.4 Conditions of operation

2.4.1

closing operation

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

2.4.2

opening operation

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

2.4.3

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

2.4.4

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

2.4.5

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

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

2.5 Characteristic quantities

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

2.5.1

rated value

a 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

2.5.2**prospective current (of a circuit, and with respect to a circuit-breaker)**

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

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

For the purpose of this standard, the prospective current of an a.c. circuit is expressed by the r.m.s. value of the alternating current.

2.5.3**prospective peak current**

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

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.

2.5.4**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

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

2.5.5**short-circuit (making and breaking) capacity**

the 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

2.5.5.1**ultimate short-circuit breaking capacity**

a 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

2.5.5.2**service short-circuit breaking capacity**

a 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

2.5.6**breaking current**

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

For a.c., reference is made to the r.m.s. value.

2.5.7**applied voltage**

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

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.

2.5.8 Recovery voltage

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

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.

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.

2.5.8.1**transient recovery voltage**

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

NOTE 1 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.

2.5.8.2**power frequency recovery voltage**

the recovery voltage after the transient voltage phenomena have subsided

2.5.9**opening time**

the 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

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.

2.5.10 Arcing time**2.5.10.1****arcing time of a pole**

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

2.5.10.2**arcing time of a multipole circuit-breaker**

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

2.5.11**break time**

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

2.5.12 **I^2t (Joule integral)**

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

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

2.5.13 **I^2t characteristic of a circuit-breaker**

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

2.5.14 Coordination between overcurrent protective devices in series**2.5.14.1****selectivity-limit current (I_s)**

the current coordinate of the intersection between the maximum break 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

1) The selectivity-limit current 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).

2) I^2t current characteristics may be used instead of time-current characteristics. In the case of breaking of short-circuit currents the time-current characteristics do not give adequate information.

2.5.14.2**take-over current (I_B)**

the current coordinate of the intersection between the maximum break time-current characteristics of two overcurrent protective devices

- 1) The take-over current is a limiting value of current above which in the presence of two overcurrent protective devices in series the protective device generally, but not necessarily on the supply side, provides back-up protection for the other protective device.
- 2) I^2t current characteristics may be used instead of time-current characteristics. In the case of breaking of short-circuit currents the time-current characteristics do not give adequate information.

2.5.15**conventional non-tripping current (I_{nt})**

a specified value of current which the circuit-breaker is capable of carrying for a specified time (conventional time) without tripping

2.5.16**conventional tripping current (I_t)**

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

2.5.17**instantaneous tripping current**

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

2.5.18**clearance (see Annex B)**

the shortest distance in air between two conductive parts

For the purpose of determining a clearance to accessible parts, the accessible surface of an insulating enclosure shall be 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, page 57.

2.5.19**creepage distance (see Annex B)**

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

For the purpose of determining a creepage distance to accessible parts, the accessible surface of an insulating enclosure shall be 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.

3 Classification

Circuit-breakers are classified:

3.1 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.

The pole which is not a protected pole may be:

- “unprotected” (see sub-clause 2.2.7.2), or
- “switched neutral” (see sub-clause 2.2.7.3).

3.2 According to the protection against external influences:

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

3.3 According to the method of mounting:

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

These types may be intended to be mounted on a rail.

3.4 According to the method of electrical connection:

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

3.5 According to the instantaneous tripping current (see sub-clause 2.5.17)

- B-type,
- C-type,
- D-type.

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

3.6 According to the I^2t characteristic:

Circuit-breakers of B-type and C-type, having rated current up to and including 32 A and having short-circuit breaking capacity of 3 000 A, 6 000 A and 10 000 A, may be classified according to the limits within which their I^2t characteristics lie, measured according to 8.12.6, in accordance with Annex ZA.

4 Characteristics of circuit-breakers

4.1 List of characteristics

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

- number of poles (sub-clause 3.1),
- protection against external influences (sub-clause 3.2),
- method of mounting (sub-clause 3.3),
- method of connection (sub-clause 3.4),
- value of rated operational voltage (sub-clause 4.3.1),
- value of rated current (sub-clause 4.3.2),
- value of rated frequency (sub-clause 4.3.3),
- range of instantaneous tripping current (sub-clauses 3.5 and 4.3.5),
- value of rated short-circuit capacity (sub-clause 4.3.4),
- I^2t characteristic (sub-clause 2.5.13),
- I^2t classification (under consideration — see sub-clause 3.6).

4.2 Rated quantities

4.2.1 Rated voltages

4.2.1.1 Rated operational voltage (U_e)

The rated operational voltage (hereafter 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.

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

4.2.1.2 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.

4.2.2 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 sub-clause 2.2.14), 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.

4.2.3 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.

4.2.4 Rated short-circuit capacity (I_{en})

The rated short-circuit capacity of a circuit-breaker is the value of the ultimate short-circuit breaking capacity (see sub-clause 2.5.5.1) assigned to that circuit-breaker by the manufacturer.

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

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

The r.m.s. value of the limiting short-circuit making and breaking capacity on an individual pole of multi-pole 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 Table I.

4.3 Standard and preferred values

4.3.1 Standard values of rated voltage

Standard values of rated voltage are:

230 V, for single-pole and two-pole circuit-breakers, 230/400 V, for single-pole circuit-breakers, 400 V, for two-pole, three-pole and four-pole circuit-breakers.

For the time being the values 240 V, 240/415 V and 415 V respectively are also standard values.

NOTE 1 Wherever in this standard there is a reference to 230 V, 230/400 V or 400 V they may be read as 240 V, 240/415 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.

NOTE 2 In IEC Publication 38 the voltage values of 230 and 230/400 V have been standardized. These values should progressively replace the values of 220 V, 240 V, 220/380 V and 240/415 V.

NOTE 3 Circuit-breakers complying with the requirements of this standard may be used in IT systems, as described in HD 384-3.

NOTE 4 In Annex ZB information is given on the selection of circuit-breakers with reference to their rated voltage and to the circuits in which they may be installed.

4.3.2 Preferred values of rated current

Preferred values of rated current are:

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

4.3.3 Standard values of rated frequency

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

4.3.4 Values of rated short-circuit capacity

4.3.4.1 Standard values up to and including 10 000 A

Standard values of rated short-circuit capacities up to and including 10 000 A are given in Table I.

Table I — Standard values of rated short-circuit capacity

1 500 A ^a
3 000 A
4 500 A
6 000 A
10 000 A
^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 ranges of power factor are given in sub-clause 8.12.5.

4.3.4.2 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, 20 000 and 25 000 A.

The corresponding ranges of power factor are given in sub-clause 8.12.5.

4.3.5 Standard ranges of instantaneous tripping

Standard ranges of instantaneous tripping are given in Table II.

Table II — 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 $10 I_n$ and including $20 I_n$

5 Marking and other product information

5.1 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 other identification;
 - rated voltage with the symbol ~;
 - 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 sub-clause 4.3.3);
 - rated short-circuit capacity, in amperes, within a rectangle, without indicating the unit symbol;
 - wiring diagram, unless the correct mode of connection is evident;
 - reference calibration temperature, if different from 30 °C;
 - 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.
- making and breaking capacity on an individual pole of multi-pole circuit-breakers (I_{cnl}), if different from I_{cn} .

d) shall be readily visible when the circuit-breaker is installed. If, for small apparatus, the available space is insufficient, a), b), c), f), g) and i) may be put on the side or on the back of the circuit-breaker. Alternatively g) may be on the inside of any cover which has to be removed in order to connect the supply wires. This diagram shall not be on a label loosely attached to the circuit-breaker

The manufacturer shall publish in his literature the I^2t characteristic (see sub-clause 2.5.13). In addition, if circuit-breakers are classified according to sub-clause 3.6, they shall be marked accordingly.

If the degree of protection IP is marked on the device itself, all parts shall comply with the relevant IP requirements (EN 60529). The IP indications in the catalogue or instruction sheets may take into account various methods of installation (e.g. additional covers, terminal covers, enclosures...).

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

Additional national symbols are allowed. Provisionally the use of national indications only is allowed. These indications shall be readily visible when the circuit-breaker is installed.

For circuit-breakers operated by means of two push-buttons, the push-button designed for the opening operation only 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 contact 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 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 417-5019).

The symbol  (IEC 417-5017), previously recommended, will be progressively superseded by the preferred symbol IEC 417-5019 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 sub-clause 8.3.

5.2 Additional marking

Additional marking to other standards (European or International Standards 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 5.1.

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

5.3 Guidance table for marking

See page 22.

6 Standard conditions for operation in service

Circuit-breakers complying with this standard shall be capable of operating under the following standard conditions:

6.1 Ambient air temperature range

The ambient air temperature does not exceed +40 °C and its average over a period of 24 h does not exceed +35 °C.

The lower limit of the ambient air temperature is – 5 °C.

Circuit-breakers intended to be used in ambient air temperatures above +40 °C (particularly in tropical countries) or below –5 °C shall either be specially designed or be used according to the information given in the manufacturer's catalogue.

6.2 Altitude

The altitude of the site of installation does not exceed 2 000 m.

For installations at higher altitudes, it is necessary to take into account the reduction of the dielectric strength and of the cooling effect of the air.

Circuit-breakers intended to be so used shall be designed specially or used in accordance with the information given by the manufacturer, e.g. in his catalogue.

6.3 Atmospheric conditions

The air is clean and its relative humidity does not exceed 50 % at a maximum temperature of +40 °C.

Higher relative humidities may be permitted at lower temperatures, for example 90 % at +20 °C.

Care should be taken by appropriate means (for example drainage holes) of moderate condensation which may occasionally occur due to variations in temperature.

6.4 Conditions of installation

The circuit-breaker shall be installed in accordance with the manufacturer's instructions.

7 Requirements for construction and operation

7.1 Mechanical design

7.1.1 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.

7.1.2 Mechanism

The moving contacts 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. A switched neutral pole (see sub-clause 2.2.7.3) shall open after and close before the protected pole(s).

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 sub-clause 2.4.4) 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 circuit-breakers without an operating handle, 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 sub-clause 2.2.8) or in the open position (see sub-clause 2.2.9), even when the operating means is released in an intermediate position.

Circuit-breakers shall be provided with means for indicating their closed and open positions, which shall be easily discernible from the front of the circuit-breaker when fitted with its cover(s) or cover plate(s), if any (see Clause 5).

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 contacts; 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.

Compliance is checked by inspection and by manual test.

5.3 Guidance table for marking

5	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:	Marking on the circuit-breaker itself			Marking in the catalogue
		Marking <u>visible</u> when the device is installed, in the case of small devices, where the space available does not allow all the data to be marked.	Marking allowed on the <u>side</u> or on the <u>back</u> of the device, visible before the device is installed.	Alternatively the information may be on the inside of any <u>cover</u> which has to be removed in order to connect the supply wires.	Remaining information to be given in the manufacturer's <u>catalogues</u> , if not marked on the device
a)	the 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 4.3.3)				X
f)	rated short-circuit capacity in a rectangle, in amperes, without symbol "A"		X ^a		
g)	wiring diagram, unless the correct mode of connection is evident,		X	X	
h)	reference calibration temperature, if different from 30 °C.				X
i)	Energy limiting class (e.g 3) in a square in accordance with Annex ZA if applied		X ^a		
	the degree of protection (only if different from IP20);				X
	the position of use (symbol according to IEC 51), if necessary;		X		
	Breaking capacity on one pole of multipole MCBs in case of short-circuit to earth I _{cn} l.				X
	Indication of the terminal for the neutral with "N".		X		
	Additional marking of performances to other standards.				
^a I _{cn} and the energy limiting class, if applied, shall be both on the device and combined together.					

7.1.3 Clearances and creepage distances (see Annex B)

Clearances and creepage distances shall be not less than the values shown in Table III, when the circuit-breaker is mounted as for normal use.

Table III — Clearances and creepage distances

Description	Distance mm
<i>Clearances:</i>	
1. between live parts which are separated when the circuit-breaker is in the open position ^a ...	3
2. between live parts of different polarity.....	3
3. between live parts and:	
— accessible surfaces of operating means.....	3
— screws or other means for fixing covers which have to be removed when mounting the circuit-breaker.....	3
— surface on which the base is mounted ^b	6 (3)
— screws or other means for fixing the circuit-breaker ^b	6 (3)
— metal covers or boxes ^b	6 (3)
— other accessible metal parts ^c	3
— metal frames supporting flush-type circuit-breakers.....	3
4. between metal parts of the mechanism and:	
— accessible metal parts ^c	3
— screws or other means for fixing the circuit-breaker.....	3
— metal frames supporting flush-type circuit-breakers.....	3
<i>Creepage distances:</i>	
1. between live parts which are separated when the circuit-breaker is in the open position ^a	3
2. between live parts of different polarity:	
— for circuit-breakers having a rated voltage not exceeding 250 V.....	3
— for other circuit-breakers.....	4
3. between live parts and:	
— accessible surfaces of operating means.....	3
— screws or other means for fixing covers which have to be removed when mounting the circuit-breaker.....	3
— screws or other means for fixing the circuit-breaker ^b	6 (3)
— accessible metal parts ^c	3
^a Not applicable to auxiliary and control contacts. ^b 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 dependent on the design of the circuit-breaker only, so that they cannot be reduced when the circuit-breaker is mounted in the most unfavourable condition (even in a metallic enclosure), the values in brackets are sufficient. ^c Including a metal foil in contact with the surfaces of insulating material which are accessible after installation as for normal use. The foil is pushed into corners, grooves, etc., by means of a straight unjointed test finger according to sub-clause 8.6 (see Figure 9, page 57).	

1) Void

2) Void

3) A revision of the values of Table III is under consideration.

4) For auxiliary circuits of safety extra-low voltage see Annex E.

7.1.4 Screws, current-carrying parts and connections

7.1.4.1 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.

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 sub-clause 8.4.

Screwed connections are considered as checked by the tests of sub-clauses 8.8, 8.9, 8.12, 8.13 and 8.14.

7.1.4.2 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.

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.

7.1.4.3 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.

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

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

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

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 sub-clause do not apply to contacts, magnetic circuits, heater elements, bimetals, current-limiting materials, shunts, parts of electronic devices nor to screws, nuts, washers, clamping plates and similar parts of terminals.

7.1.5 Terminals for external conductors

7.1.5.1 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.

In this standard only screw-type terminals for external copper conductors are considered.

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.

Compliance is checked by inspection and by the tests of sub-clause 8.5.

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

Examples of possible shapes and designs of terminals are given in Annex F.

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 IV — 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 mm² up to 6 mm² be designed to clamp solid conductors only.

7.1.5.3 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 sub-clause 8.5.

7.1.5.4 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.

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.

7.1.5.5 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 sub-clauses 8.4 and 8.5.1.

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

7.1.5.6 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 sub-clause 8.5.2.

7.1.5.7 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 sub-clauses 8.4 and 8.5.1.

7.1.5.8 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 sub-clause 8.5.3.

7.1.5.9 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.

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

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 sub-clause 8.4.

7.1.5.10 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.

In general, the designs of terminals (of which examples 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.

7.1.5.11 Void

7.1.5.12 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.

7.1.6 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.

The expression “as for normal use” implies that the circuit-breaker is installed according to the manufacturer’s instructions.

7.1.7 Mechanical mounting of plug-in circuit-breakers

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

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

Requirements for circuit-breakers of this type are under consideration.

7.2 Protection against electric-shock

Circuit-breakers shall be so designed that, when they are mounted and wired as for normal use (see Note to sub-clause 7.1.6), live parts are not accessible.

A part is considered to be “accessible” if it can be touched by the test finger (see sub-clause 8.6).

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 the live parts and their accessible conductive parts, which otherwise would become exposed conductive parts, shall be covered by insulating material: this does not apply to means for coupling insulated operating means of several poles.

Other 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 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 sub-clause.

Compliance is checked by inspection and by the test of sub-clause 8.6.