

Specification for

Circuit-breakers for equipment (CBE)

The European Standard EN 60934 : 1994 has the status of a
British Standard

Disjoncteurs pour équipement (DPE)

Geräteschutzschalter (CBE)

UDC 621.316.57 : 614.8

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

This British Standard, having been prepared under the direction of the Power Electrical Engineering Standards Policy Committee, was published under the authority of the Standards Board and comes into effect on 15 July 1994

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Amendment No. 1
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to BS EN 60934 : 1994

Specification for circuit-breakers for equipment (CBE)

NOTE. This amendment implements amendment A1 to EN 60934.

This amendment together with the European Standard EN 60934 : 1994 has the status of a British Standard.

Revised text

National foreword

In line 3 of paragraph 1 after '(CBE)' insert 'including Amendment A1 : 1994'.

AMD 8614/May 1995

EN title page and foreword

Insert the attached title page and foreword after the existing EN title page.

AMD 8614/May 1995

Text of EN 60934

Amend the text of European Standard EN 60934 in accordance with the following details.

Annex C

Insert in table C3 in the boxes of test sequence A the reference to the additional note 'h'.

Insert the following note:

'h) When multiple circuit breakers are submitted, a maximum of four screw-type terminals for external conductors are subjected to the tests of 8.5, i.e. two supply and two load terminals.'

AMD 8614/May 1995

UDC 621.316.57 : 614.8
ICS 29.120.40 29.120.60

Descriptors: Household accessory, low voltage equipment, circuit-breaker, automatic switching device, characteristic, test

Amendment A1 to the English version EN 60934

Circuit-breakers for equipment (CBE)

(IEC 934 : 1993/A1 : 1994)

Disjoncteurs pour équipement (DPE)
(CEI 934 : 1993/A1 : 1994)

Geräteschutzschalter (GS)
(IEC 934 : 1993/A1 : 1994)

This amendment A1 modifies the European Standard EN 60934 : 1994. It was approved by CENELEC on 1994-09-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this amendment 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 amendment 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

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

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Ref. No. EN 60934 : 1994/A1 : 1994 E

 **Documents**
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Foreword

The text of document 23E(CO)142, as prepared by Subcommittee 23E, Circuit-breakers and similar equipment for household use, of IEC Technical Committee 23, Electrical accessories, was submitted to the IEC-CENELEC parallel vote in February 1994.

The reference document was approved by CENELEC as amendment A1 to EN 60934 on 1 September 1994 with an editorial modification as indicated by a vertical line in the left margin of the text.

The following dates were fixed:

- latest date of publication of
an identical national standard (dop) 1995-10-01
- latest date of withdrawal of
conflicting national standards (dow) 1995-10-01

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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 60934 : 1994 *Circuit-breakers for equipment (CBE)*, published by the European Committee for Electrotechnical Standardization (CENELEC). It was derived by CENELEC from IEC 934 : 1993 published by the International Electrotechnical Commission (IEC).

The CENELEC common modification has been implemented at the appropriate place in the text and is indicated by a side line in the margin.

This standard supersedes BS 7395 : 1991 which is withdrawn. The foreword of the EN makes reference to the 'date of withdrawal', *dow*, of the relevant national standard. In this case the relevant national standard is BS 7395 which will be withdrawn on 1 September 1994. Certificates and Marks will not be awarded after this date with respect to the withdrawn British Standard. However such Certificates and Marks, already awarded, may continue to apply to production until 1 September 1999.

In the UK, devices covered by this standard are normally described as 'thermal switches' and are not considered to be 'circuit-breakers'. They are not to be confused with circuit-breakers intended for protection of installations, for which BS 3871 *Specification for miniature and moulded case circuit-breakers* applies.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

UDC 621.316.57 : 614.8

Descriptors: Household accessory, low voltage equipment, circuit-breaker, automatic switching device, characteristic, test

English version

Circuit-breakers for equipment (CBE)

(IEC 934 : 1993, modified)

Disjoncteurs pour équipement (DPE)
(CEI 934: 1993, modifiée)

Geräteschutzschalter (CBE)
(IEC 934 : 1993, modifiziert)

This European Standard was approved by CENELEC on 1993-12-08. 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.

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CENELEC

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

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Ref. No. EN 60934 : 1994 E

Foreword

The text of document 23E(CO)136, as prepared by Sub-Committee 23E of IEC Technical Committee 23, Electrical accessories, was submitted to the IEC-CENELEC parallel vote in July 1992.

At the request of the CENELEC Technical Committee TC 23E, Circuit breakers and similar devices for household and similar applications, the text of amendment 2 : 1992 to IEC 934 : 1988 was submitted to the CENELEC Unique Acceptance Procedure (UAP) in December 1992.

Both documents were approved by CENELEC as amendments to EN 60934: 1990, with the decision to await publication of a new edition of IEC 934.

Upon confirmation by the secretary of CLC/TC 23E that the new edition of IEC 934, published in July 1993, was indeed equivalent with the first edition + A1 + A2 + A3, the CENELEC Technical Board approved the text of IEC 934 : 1993 with the common modifications agreed for the first edition, as EN 60934 on 1993-08-12.

The following dates were fixed:

- latest date of publication
of an identical national
standard (dop) 1994-09-01
- latest date of withdrawal
of conflicting national
standards (dow) 1994-09-01

For products which have complied with EN 60934 : 1990 and its amendment A1 : 1992 before 1994-09-01, as shown by the manufacturer or by a certification body, this previous standard may continue to apply for production until 1999-09-01.

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CIRCUIT-BREAKERS FOR EQUIPMENT (CBE)

1 General

1.1 Scope

This standard is applicable to mechanical switching devices designed as "circuit-breakers for equipment" (CBE) intended to provide protection to circuits within electrical equipment.

CBEs may have a rated short-circuit capacity higher than that required for overload conditions and may in addition have a conditional short-circuit current rating in association with a specified short-circuit protective device (SCPD).

This standard is also applicable for protection of electrical equipment in case of undervoltage and/or overvoltage.

It is applicable for a.c. not exceeding 440 V and/or d.c. not exceeding 250 V, and a rated current not exceeding 125 A.

This standard may be used as a guiding document for voltages up to 630 V a.c.

This standard covers CBEs which are either intended for automatic interruption and non-automatic resetting only, or intended also for performing manual switching operations.

The term "equipment" includes appliances.

The protected components are usually motors, transformers, internal wiring, etc.

This standard does not cover CBEs for isolating purposes, for which more stringent requirements are under consideration.

1.2 Object

This standard contains all the 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.

1.3 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 50(441): 1984, *International Electrotechnical Vocabulary (IEV), Chapter 441: Switchgear, controlgear and fuses*

IEC 112: 1979, *Method for determining the comparative and the proof tracking indices of solid insulating materials under moist conditions*

IEC 227, *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V*

IEC 269, *Low-voltage fuses*

IEC 529: 1989, *Degrees of protection provided by enclosures (IP Code)*

IEC 664, *Insulation co-ordination for equipment within low-voltage systems*

IEC 695-2-1: 1991, *Fire hazard testing – Part 2: Test methods – Section 1: Glow-wire test and guidance*

IEC 898: 1987, *Circuit-breakers for overcurrent protection for household and similar installations*

2 Definitions

2.1 Devices

2.1.1 switching device: A device designed to make or 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 for equipment (CBE): A mechanical switching device, specifically designed for the protection of equipment, capable of making, carrying and breaking currents under normal conditions and also making, carrying for a specified time and automatically breaking currents under specified abnormal circuit conditions.

Abnormal circuit conditions may be an overcurrent, an undervoltage or an overvoltage.

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 CBE): All the conductive parts of a CBE included in the circuit which it is designed to close and open.

2.2.5 control circuit (of a CBE): A circuit (other than a path of the main circuit) intended for the closing operation or opening operation, or both, of the CBE.

2.2.6 auxiliary circuit (of a CBE): All the conductive parts of a CBE intended to be included in a circuit other than the main circuit and the control circuit of the CBE.

2.2.7 pole (of a CBE): That part of a CBE 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 2.3.6).

2.2.7.2 unprotected pole: A pole without overcurrent release (see 2.3.6) but otherwise generally capable of the same performance as a protected pole of the same CBE.

2.2.7.3 switched neutral pole: A pole, only intended to switch the neutral, and not intended to have a conditional short-circuit capacity.

2.2.8 closed position: The position in which the predetermined continuity of the main circuit of the CBE is secured.

2.2.9 open position: The position in which the predetermined clearance between open contacts in the main circuit of the CBE is secured.

2.2.10 ambient air temperature: The temperature, determined under prescribed conditions, of the air surrounding the complete CBE (e.g. for an enclosed CBE, it is the air outside the enclosure).

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 operations: A succession of specified operations with specified time intervals.

2.2.14 uninterrupted duty: Duty in which the main contacts of a CBE remain closed whilst carrying a steady current without interruption for long periods (which could be weeks, months, or even years).

2.3 Constructional elements

2.3.1 main contact: A contact included in the main circuit of a CBE, intended to carry, in the closed position, the current of the main circuit.

2.3.2 control contact: A contact included in a control circuit of a CBE and mechanically operated by the CBE.

2.3.3 auxiliary contact: A contact included in an auxiliary circuit and mechanically operated by the CBE.

2.3.4 a-contact (make contact): A control or auxiliary contact which is closed when the main contacts of the CBE are closed and open when they are open.

2.3.5 b-contact (break contact): A control or auxiliary contact which is open when the main contacts of the CBE are closed and closed when they are open.

2.3.6 release: A device, mechanically connected to (or integrated into) a CBE, which releases the holding means and permits the automatic opening of the CBE.

2.3.7 overcurrent release: A release which causes a CBE to open, with or without delay, when the current in the release exceeds a predetermined value.

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

2.3.8 inverse time-delay overcurrent release: An overcurrent release which causes a CBE to open 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.

2.3.9 direct overcurrent release: An overcurrent release directly energized by the current in the main circuit of a CBE.

2.3.10 overload release: An overcurrent release intended for protection against overloads.

2.3.11 under-voltage release: A release which causes a CBE to open, with or without delay, when the voltage across the terminals of the release falls below a predetermined value.

2.3.12 over-voltage release: A release which causes a CBE to open, with or without delay, when the voltage across the terminals of the release rises above a predetermined value.

2.3.13 conductive part: A part which is capable of conducting current although it may not necessarily be used for carrying service current.

2.3.14 exposed conductive part: A conductive part which can be readily touched and which is not normally live, but which may become live under fault conditions.

Typical exposed conductive parts are walls of metal enclosures, metal operating handles, etc.

2.3.15 terminal: A conductive part of a device, provided for re-usable electrical connection.

Definitions for flat quick connect terminations are under consideration.

2.3.16 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.

2.3.17 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 E.

2.3.18 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 E.

2.3.19 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 E.

2.3.20 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 E.

2.3.21 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 E.

2.3.22 screwless terminals: 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.

2.3.23 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.

2.3.24 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.

2.3.25 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.

2.4 Conditions of operation

2.4.1 closing operation: An operation by which the CBE is brought from the open position to the closed position.

2.4.2 opening operation: An operation by which the CBE is brought from the closed position to the open position.

2.4.3 trip-free CBE: A CBE, 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.

CBEs of this design may be referred to as positively trip-free.

2.4.4 cycling trip-free CBE: A CBE, the moving contacts of which return to the open position when the automatic opening operation is initiated after the initiation of the closing operation, and which will then reclose repeatedly and momentarily, whilst the closing command is maintained.

2.5 Characteristic quantities

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 CBE is designed and built.

2.5.2 prospective current (of a circuit, and with respect to a CBE): The current that would flow in the circuit, if each pole of the CBE were replaced by a conductor of negligible impedance.

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

2.5.3 *Making and breaking capacities*

2.5.3.1 switching capacity: A value of current that a CBE is capable of making and breaking at a stated voltage under prescribed conditions of use and operation.

2.5.3.2 short-circuit (making and breaking) capacity: The alternating component of a prospective current, expressed by its r.m.s. value, which the CBE is designed to make, to carry for its opening time and to break under specified conditions.

2.5.4 applied voltage: The voltage which exists across the terminals of a pole of a CBE just before the making of the current.

In the case of a.c. it is the r.m.s. value.

2.5.5 tripping time: The time interval from the instant at which the associated tripping current begins to flow in the main circuit to the instant when this current is interrupted (in all poles).

Unless otherwise stated by the manufacturer, the tripping time refers to test conditions without any pre-loading of the CBE.

2.5.6 conventional non-tripping current (I_{nt}): A specified value of current which the CBE is capable of carrying for a specified time (conventional time) without tripping.

2.5.7 conventional tripping current (I_t): A specified value of current which causes the CBE to operate within a specified time (conventional time).

2.5.8 Instantaneous non-tripping current (I_{ni}): The value of current below which the CBE will not operate automatically (without intentional time-delay) within a time equal to or less than 0,1 s.

2.5.9 Instantaneous tripping current (I_i): The value of current above which the CBE will operate automatically (without intentional time-delay) within a time less than 0,1 s.

2.5.10 *Operating characteristics*

2.5.10.1 tripping characteristic: The time-current characteristic above which the CBE shall trip.

2.5.10.2 non-tripping characteristic: The time-current characteristic, below which the CBE shall not strip.

2.5.11 operating zone: The time-current zone limited by the operating characteristics of 2.5.10.1 and 2.5.10.2.

This zone takes into account the manufacturing and performance tolerances of the CBE.

2.5.12 Definitions concerning coordination of CBEs and SCPD's associated in the same circuit

2.5.12.1 conditional short-circuit current: A value of prospective current which a CBE protected by a short-circuit protective device (SCPD) in series can withstand under specified conditions of use and behaviour.

2.5.12.2 short-time withstand current of a CBE: The value of current which a CBE can satisfactorily withstand for a specified time without suffering any damage impairing its further use.

2.5.12.3 selectivity limit current (I_S): The selectivity limit current (see figure F1) is a limiting value of current:

- below which the CBE completes its breaking operation in time to prevent the SCPD from starting its operation (i.e. selectivity is ensured);
- above which the CBE may not complete its breaking operation in time to prevent the SCPD from starting its operation (i.e. selectivity is not ensured).

2.5.12.4 electrodynamic contact separation: The lowest value of peak current which causes a contact separation while the mechanism remains closed.

2.5.12.5 take-over current (I_B): The current coordinate of the intersection between the time-current characteristics of two overcurrent devices. [IEV 441-17-16 modified]

2.5.12.6 overcurrent discrimination between a CBE and its SCPD: Coordination of the operating characteristics of the CBE and its SCPD such that on the incidence of overcurrents within stated limits the CBE opens the circuit while the SCPD does not operate. [IEV 441-17-15 modified]

2.5.12.7 back-up protection (for a CBE): Over-current coordination of two over-current protective devices in series where the SCPD ensures the overcurrent protection with or without the assistance of the CBE and prevents any excessive stress on the CBE.

2.6 clearance: 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 were covered by a metal foil wherever it can be touched by a hand or by a standard test finger according to figure 7.

2.7 creepage distance: 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 on an insulating enclosure shall be considered conductive as if it were covered by a metal foil wherever it can be touched by a hand or by a standard test finger according to figure 7.

3 Classification

CBEs are classified:

3.1 According to:

- the number of poles;
- the number of protected poles.

The pole which is not a protected pole may be an unprotected pole or a switched neutral.

3.2 According to the method of mounting:

- surface type;
- flush type;
- panel-mounting type;
- integral-mounting type.

Panel-mounting types comprise snap-on types and flange types.

Integral-mounting types are types which are kept in place by fixation means and do not require any other mounting means.

3.3 According to the method of connection:

- CBEs, the connections of which are not associated with the mechanical mounting;
- CBEs, one or more connections of which are associated with the mechanical mounting, e.g.:
 - plug-in type;
 - bolt-on type;
 - screw-in type;
 - solder-in type.

Some CBEs 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.

3.4 According to the method of operation:

3.4.1 CBEs for automatic interruption and non-automatic (manual) resetting only (R-type CBE).

3.4.2 CBEs for automatic interruption and non-automatic (manual) resetting, provided with means for manual operation designed for occasional manual switching, but not designed for regular manual switching operations under normal load conditions (M-type CBE).

3.4.3 CBEs for automatic interruption and non-automatic (manual) resetting, provided with means for manual operations and designed for regular manual switching operations under normal load conditions (S-type CBE) (see note of 4.2.2).

3.5 According to the mode of tripping:

3.5.1 Tripping caused by current (overcurrent)

<i>Mode of tripping</i>	<i>Designation</i>
– thermal	TO
– thermal-magnetic	TM
– magnetic	MO
– hydraulic-magnetic	HM
– electronic-hybrid	EH

Electronic-hybrid type means an electronically controlled device associated with any of the other modes of tripping.

3.5.2 Tripping caused by voltage

<i>Mode of tripping</i>	<i>Designation</i>
– overvoltage	OV
– undervoltage	UV

3.6 According to the influence of the ambient temperature:

3.6.1 CBEs, the operation of which is temperature dependent.

3.6.2 CBEs, the operation of which is not temperature dependent.

3.7 According to the degree of trip-free behaviour:

3.7.1 Trip-free (positively trip-free).

3.7.2 Cycling trip-free.

3.7.3 Non-trip-free.

Attention is drawn to the fact that the non-trip-free type should not be used where access is possible without the use of a tool.

3.8 According to the influence of the mounting position:

3.8.1 Independent of the mounting position.

3.8.2 Dependent of the mounting position.

4 Characteristics of CBEs

4.1 List of characteristics

The characteristics of a CBE shall be stated in the following terms, as applicable:

- number of poles, protected poles and, if any, neutral paths (see 3.1);
- method of mounting (see 3.2);

- method of connection (see 3.3);
- method of operation (see 3.4);
- rated quantities (see 4.2);
- operating characteristics (see 2.5.10 and 2.5.11).

4.2 *Rated quantities*

4.2.1 *Rated voltages*

A CBE is defined by the following rated voltages:

4.2.1.1 *Rated operational voltage (U_o)*

The rated operational voltage (hereinafter referred to as "rated voltage") of a CBE is the value of voltage to which the performance is referred.

The same CBE may be assigned a number of rated voltages and associated rated switching capacities.

4.2.1.2 *Rated insulation voltage (U_i)*

The rated insulation voltage of a CBE is the value of voltage to which dielectric tests, clearances and creepage distances are referred.

Unless otherwise stated, the rated insulation voltage is the value of the maximum rated voltage of the CBE. 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 (in accordance with table 6) as the current which the CBE is designed to carry uninterrupted duty (see 2.2.14) at a specified reference ambient air temperature.

The standard reference ambient air temperature is $(23 \pm 2) ^\circ\text{C}$.

For S-type CBEs a rated current different from that assigned in accordance with table 6 may be stated by the manufacturer for inductive loads.

4.2.3 *Rated frequency*

The power frequency for which the CBE is defined and to which the values of the other characteristics correspond.

4.2.4 *Rated switching capacity (rated making and breaking capacity)*

The value of switching capacity (see 2.5.3) assigned to the CBE by the manufacturer.

It is expressed by a value of current, r.m.s., if a.c.

4.2.5 *Rated conditional short-circuit current (I_{nc})*

The value of the conditional short-circuit current (see 2.5.12.1) assigned to the CBE by the manufacturer.

This standard gives only values of rated conditional short-circuit currents for a.c. Values for rated conditional short-circuit currents for d.c. are under consideration.

For the purpose of this standard, two categories of performance are specified (see 4.2.5.1 and 4.2.5.2).

4.2.5.1 *Rated conditional short-circuit current I_{nc} , performance category PC1*

The value of rated conditional short-circuit current for which the prescribed conditions do not include the fitness of the CBE for its further use.

4.2.5.2 *Rated conditional short-circuit current I_{nc} , performance category PC2 (optional)*

The value of rated conditional short-circuit current for which the prescribed conditions do include the fitness of the CBE for its further use.

4.2.6 *Rated short-circuit capacity I_{cn}*

The rated short-circuit capacity of a CBE is the value of current assigned to the CBE by the manufacturer according to 2.5.3.2.

The rated short-circuit capacity shall not be less than:

- $6 I_n$ for a.c.;
- $4 I_n$ for d.c.

4.3 *Standard and preferred values*

4.3.1 *Preferred values of rated voltage*

Preferred values of rated voltage are:

- a.c.
60, 120, 240/120, 220, 230, 240, 380/220, 400/230, 415/240, 380, 400, 415, 440 V;
- d.c.
12, 24, 48, 60, 120, 240, 250 V.

In IEC 38 the network voltage value of 400/230 V a.c. has been standardized. This value should progressively replace the values 380/220 V and 415/240 V.

4.3.2 *Standard rated frequencies*

Standard rated frequencies are: 50, 60 and 400 Hz.

4.3.3 *Standard values of rated conditional short-circuit current*

Standard values of rated conditional short-circuit current are:

300, 600, 1000, 1 500, 3 000 A.

5 **Marking and other product information**

Each CBE shall be marked in a durable manner with the following:

- a) manufacturer's name or trade mark;
- b) type designation or serial number;
- c) rated voltage(s);
- d) rated current: for S-type CBEs, the rated current for inductive loads, if applicable, shall additionally be given in brackets;
- e) rated frequency, if the CBE is designed for a frequency other than both 50 Hz and 60 Hz;
- f) reference temperature for CBEs calibrated at a reference ambient temperature different from the standard value (see 4.2.2), e.g. "T40" for a reference temperature of 40 °C;
- g) operating voltage limit(s) (of a voltage-sensitive CBE);
- h) CBEs of a type with a contact gap less than the specified clearance shall be marked with the symbol "μ";
- i) method of operation R, M or S (see 3.4);
- k) mode of tripping;
- l) degree of trip-free behaviour (see 3.7);
- m) overvoltage category, if different from II; and pollution degree, if different from 2 (see 7.1.3);
- n) rated conditional short-circuit current, performance category PC1;
- o) rated conditional short-circuit current, performance category PC2.

If, on small apparatus, the available space is insufficient for all the listed markings, at least a) and b) and, if applicable, g) and h) shall be marked on the device, and, if possible, c) and d), whilst the other information may be given in the catalogue.

For CBEs other than those operated by means of push-buttons, the open position shall be indicated by the symbol "0" and the closed position by the symbol "I" (a short vertical straight line).

For CBEs 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 "0".

National symbols additional to 0 and I are allowed.

Red shall not be used for any other push-button, but may be used for other types of actuators, e.g. handles, rockers, provided the ON and OFF positions are clearly identified.

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

Other national or international indications, e.g. 1, 3, 5 for the supply terminals and 2, 4, 6 for the load terminals, are allowed.

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).

Compliance is checked by inspection and by the test of 8.3.

Wherever possible, CBEs shall be provided with a wiring diagram unless the correct mode of connection is evident.

On the wiring diagram the terminals shall be indicated by the symbol $\rightarrow \circ$.

The marking shall be durable and easily legible, and shall not be placed on screws, washers or other removable parts.

6 Standard conditions for operation in service

CBEs complying with this standard shall be capable of operating under the following standard conditions:

6.1 Ambient air temperature

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.

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

6.2 Altitude

The altitude of the site of installation does not exceed 2 000 m (6 600 ft).

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.

CBEs intended to be so used shall be specially designed, or used according to an agreement between manufacturer and user.

Information given in the manufacturer's catalogue may take the place of such an agreement.

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, e.g. 90 % at +20 °C.

Care should be taken by appropriate means (e.g. draining holes) of moderate condensation which may occasionally occur due to variations in temperature.

7 Requirements for construction and operation

7.1 Mechanical design

7.1.1 General

A CBE shall be so designed and constructed that, in normal use, its performance is reliable and without danger to the user or surroundings.

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

7.1.2 Mechanism

The moving contacts of a multipole CBE shall be so mechanically coupled that all protected and unprotected poles make and break substantially together, whether operated manually or automatically, even if an overload occurs on one pole only. The manufacturer shall indicate in his literature if a CBE is trip-free, cycling trip-free or non-trip-free.

A CBE shall be provided with means for indicating its closed and open positions which shall be easily discernible from the front of the CBE when fitted with its cover(s) or cover-plate(s), if any. When the operating means is used to indicate the position of the contacts it shall have two distinct rest positions corresponding to the position of the contacts, and the operating means, when released, shall automatically take up the position corresponding to that of the moving contacts; 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.

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.

Compliance with the above requirements is checked by inspection and by manual test.

7.1.3 Clearances and creepage distances (see annex B)

The clearances and creepage distances are based on IEC 664 and 664A. It is assumed that for CBEs the following conditions are generally applicable:

- overvoltage category II;
- pollution degree 2;
- comparative tracking index (CTI): 600 V, 400 V or 100 V.

Based on these assumptions, the clearances and creepage distances for functional and basic insulation are as shown in table 1.

Clearances and creepage distances shall not be less than the values shown in table 1.

For double and reinforced insulation, the values are under consideration. However, for double and reinforced insulation the values given in note 3) of table 1 apply provisionally.

Table 1 – Clearances and creepage distances

Clearances			
Voltage phase to earth V (a.c., r.m.s. or d.c.)	Rated impulse withstand voltage V peak	Basic insulation ^{1) 2) 3)} Clearance mm	
Up to and including 50	500	0,2	
over 50 up to and including 100	800	0,2	
over 100 up to and including 150	1 500	0,5	
over 150 up to and including 300	2 500	1,5	
over 300 up to and including 600	4 000	3,0	
Creepage distances			
Voltage across creepage distances V (a.c., r.m.s. or d.c.)	Basic insulation ³⁾ Creepage distance mm		
	Material CTI ⁴⁾		
	600	400	100
Up to and including 50	0,6	0,85	1,2
over 50 up to and including 125	1,0	1,1	1,5
over 125 up to and including 250	1,5	1,8	2,5
over 250 up to and including 400	2,0*	2,8*	4,0*

* Also valid for 440 V

1) The values for clearances for basic insulation are based on IEC 664.

2) Information about rated impulse withstand voltage classifies the relevant overvoltage category.

3) For double and reinforced insulation the values of clearances and of creepage distances are provisionally twice those given for basic insulation.

4) The CTI corresponds to IEC 664A, with the groups IIIa and IIIb combined in one group. For the testing of insulating materials, see IEC 112.

CBEs with a contact gap less than the specified clearance are permitted, but shall be marked with the symbol "μ".

In environments where pollution degree 3 may occur, the user shall provide the necessary protective covers.

For conditions of use of overvoltage Category I, the smallest clearances as defined in IEC 664 may be used. Such CBEs shall be marked "CAT. I".