UL 1066

STANDARD FOR SAFETY

Power Circuit Breakers up to 1000 V AC and 1500 V DC Used in Enclosures

UL Standard for Safety for Power Circuit Breakers up to 1000 V AC and 1500 V DC Used in Enclosures, UL 1066

Fifth Edition, Dated August 8, 2022

Summary of Topics

This new edition of ANSI/UL 1066 dated August 8, 2022 is the Binational Standard for Power Circuit Breakers up to 1000 V AC and 1500 V DC Used in Enclosures, previously titled Standard for Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures.

The new requirement are substantially in accordance with Proposal(s) on this subject dated July 30, 2021 and April 8, 2022.

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Underwriters Laboratories Inc.
UL 1066
Fifth Edition

Power Circuit Breakers up to 1000 V AC and 1500 V DC Used in Enclosures

August 8, 2022

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ANSI/UL 1066-2022

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Commitment for Amendments

This standard is issued jointly by the Canadian Standards Association (operating as “CSA Group”) and Underwriters Laboratories Inc. (UL). Comments or proposals for revisions on any part of the standard may be submitted to CSA Group or UL at anytime. Revisions to this standard will be made only after processing according to the standards development procedures of CSA Group and UL. CSA Group and UL will issue revisions to this standard by means of a new edition or revised or additional pages bearing their date of issue.

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This Standard is subject to review within five years from the date of publication, and suggestions for its improvement will be referred to the appropriate committee. To submit a proposal for change, please send the following information to inquiries@csagroup.org and include "Proposal for change" in the subject line: Standard designation (number); relevant clause, table, and/or figure number; wording of the proposed change; and rationale for the change.

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This ANSI/UL Standard for Safety consists of the Fifth Edition. The most recent designation of ANSI/UL 1066 as an American National Standard (ANSI) occurred on August 1, 2022. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, Title Page (front and back), or the Preface.

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PREFACE

This is the harmonized CSA Group and UL standard for Circuit Breakers up to 1000 V AC and 1500 V DC Used in Enclosures. It is the second edition of CSA C22.2 No. 268:22 and the fifth edition of UL 1066. This second edition of CSA C22.2 No. 268 supersedes the previous edition published April 13, 2012. This fifth edition of UL 1066 supersedes the previous edition published April 13, 2012.

This harmonized standard was prepared by the CSA Group and Underwriters Laboratories Inc. (UL). The efforts and support of the Technical Harmonization Committee for Power Circuit Breakers on the Harmonization of Electrotechnical Standards of the Nations of the Americas (CANENA), are gratefully acknowledged.

This standard is considered suitable for use for conformity assessment within the stated scope of the standard.

This standard was reviewed by the CSA Subcommittee on Low Voltage Power Circuit Breakers, under the jurisdiction of the CSA Technical Committee on Industrial Products and the CSA Strategic Steering Committee on requirements for Electrical Safety, and has been formally approved by the CSA Technical Committee. This standard has been developed in compliance with the Standards Council of Canada requirements for National Standards of Canada. It has been published as a National Standard of Canada by CSA Group.

Application of Standard

Where reference is made to a specific number of samples to be tested, the specified number is to be considered a minimum quantity.

Note: Although the intended primary application of this standard is stated in its scope, it is important to note that it remains the responsibility of the users of the standard to judge its suitability for their particular purpose.

Level of harmonization

This standard uses the IEC format, but is not based on, nor is it to be considered equivalent to, an IEC standard.

This standard is published as an equivalent standard for CSA Group and UL.

An equivalent standard is a standard that is substantially the same in technical content, except as follows: Technical national differences are allowed for codes and governmental regulations as well as those recognized as being in accordance with NAFTA Article 905, for example, because of fundamental climatic, geographical, technological, or infrastructural factors, scientific justification, or the level of protection that the country considers appropriate. Presentation is word for word except for editorial changes.

Reasons for differences from IEC

There is no corresponding IEC standard.

Interpretations

The interpretation by the standards development organization of an identical or equivalent standard is based on the literal text to determine compliance with the standard in accordance with the procedural rules of the standards development organization. If more than one interpretation of the literal text has been

identified, a revision is to be proposed as soon as possible to each of the standards development organizations to more accurately reflect the intent.

INTRODUCTION

1 Scope

1.1 These requirements apply to low-voltage AC power circuit breakers as follows:

a) Stationary-mounted or drawout-mounted types,

b) 2-pole, 3-pole, and 4-pole constructions,

c) Manually operated or power operated, and

d) With or without electromechanical or solid-state type trip device.

1.2 These requirements apply to drawout-mounted type low-voltage AC integrally fused power circuit breakers, consisting of low-voltage AC power circuit breakers with integral fuses.

1.3 These requirements apply to low-voltage AC fuse draw-outs consisting of fuses in a drawout assembly intended to be connected in series with a low-voltage AC power circuit breaker to form a fused circuit breaker.

1.4 These requirements apply to general purpose type DC power circuit breakers.

1.5 These requirements apply to equipment rated 1000 V or less nominal, 1058 V maximum AC and 1500 V maximum DC.

1.6 These requirements apply to equipment intended for use in ordinary locations in accordance with Annex A, Ref. No. 1.

1.7 These requirements are intended to supplement and be used in conjunction with the:

a) Standard for Low-Voltage AC Power Circuit Breakers Used In Enclosures, IEEE C37.13 (see Annex A, Ref. No. 7),

b) Standard for DC (3200 V and below) Power Circuit Breakers Used in Enclosures, IEEE C37.14 (see Annex A, Ref. No. 8),

c) Standard for Metal-Enclosed Low-Voltage (1000 Vac and below, 3200 Vdc and below) Power Circuit Breaker Switchgear, IEEE C37.20.1 (see Annex A, Ref. No. 9),

d) Test Procedures for Switchgear – Low-Voltage AC Power Circuit Breakers Used In Enclosures, ANSI C37.50 (see Annex A, Ref. No. 10), and

e) Conformance Test Procedures for Switchgear – Metal-Enclosed Low-Voltage AC Power Circuit Breaker Switchgear Assemblies, ANSI C37.51 (see Annex A, Ref. No. 11).

1.8 This Standard does not apply to molded-case circuit breakers.

1.9 These circuit breakers are intended for installation in circuit breaker enclosures, switchboards (switchgear), panelboards, and the like. Drawout-mounted devices are intended for use with specific adapters or receiving equipment. The acceptability of the combination of a circuit breaker with respect to any overall enclosure will be determined when the complete product is considered.

2 Normative References

2.1 For undated references to Standards, such reference shall be considered to refer to the latest edition and all revisions to that edition up to the time when this Standard was approved. For dated references to Standards, such reference shall be considered to refer to the dated edition and all revisions published to that edition up to the time the Standard was approved. See Annex A.

2.2 Products covered by this standard shall comply with the referenced installation codes and standards noted in this clause as appropriate for the country where the product is to be used. When the product is intended for use in more than one country, the product shall comply with the installation codes and standards for all countries where it is intended to be used. (See Annex A, Ref. No. 1.)

2.3 In Canada, general requirements are as indicated in Annex A, Ref. No. 2, and bonding requirements are as indicated in Annex A, Ref. No. 3. In the US, these do not apply.

3 Components

3.1 A component of a product covered by this Standard shall:

a) Comply with the requirements for that component as specified in this Standard;

b) Be used in accordance with its rating(s) established for the intended conditions of use; and

c) Be used within its established use limitations or conditions of acceptability.

3.2 A component of a product covered by this Standard is not required to comply with a specific component requirement that:

a) Involves a feature or characteristic not required in the application of the component in the product;

b) Is superseded by a requirement in this Standard; or

c) Is separately investigated when forming part of another component, provided the component is used within its established ratings and limitations.

3.3 Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.

3.4 A component that is also intended to perform other functions such as overcurrent protection, ground-fault circuit-interruption, surge suppression, any other similar functions, or any combination thereof, shall comply additionally with the requirements of the applicable standard(s) that cover devices that provide those functions.

4 Units of Measurement

4.1 The values given in SI (metric) units shall be normative, except for AWG/kcmil conductor sizes. Values in parentheses are explanatory or approximate information.

5 Definitions

5.1 The terms used in this Standard are as indicated in Annex A, Ref. No. 4. For the purpose of this Standard, the following definitions shall apply.

5.2 ADAPTER – A device designed to interface between a drawout-mounted device and the receiving devices – such as individual enclosures, deadfront switchboards, and panelboards.

5.3 CIRCUIT BREAKER – A type of AC and DC power circuit breaker, when a requirement applies specifically to either an AC or DC type, but not both, the term AC circuit breaker or DC circuit breaker is used.

5.4 DRAWOUT-MOUNTED DEVICE – A device having disconnecting devices, and in which the removable portion may be removed from the stationary portion without the necessity of unbolting connections or mounting supports.

5.5 FUSED CIRCUIT BREAKER – An integrally fused power circuit breaker or the combination of a fuse drawout and a circuit breaker.

5.6 STATIONARY-MOUNTED DEVICE – A device that cannot be removed except by the unbolting of connections and mounting supports.

CONSTRUCTION

6 General

6.1 The requirements in this Standard shall be applied in addition to those contained in the following documents:

a) Standard for Low-Voltage AC Power Circuit Breakers Used In Enclosures, IEEE C37.13 (Annex A, Ref. No. 7),

b) Standard for DC (3200 V and below) Power Circuit Breakers Used in Enclosures, IEEE C37.14 (Annex A, Ref. No. 8),

c) Test Procedures for Switchgear – Low-Voltage AC Power Circuit Breakers Used In Enclosures, ANSI C37.50 (Annex A, Ref. No. 10), and

d) Conformance Test Procedures for Switchgear – Metal-Enclosed Low-Voltage AC Power Circuit Breaker Switchgear Assemblies, ANSI C37.51 (Annex A, Ref. No. 11).

6.2 A fuse draw-out shall include an open-fuse trip device that will cause tripping of the series circuit breaker, when one or more of the fuses open.

6.3 A fused circuit breaker shall include an open-fuse trip device that will cause tripping of the circuit breaker, when one or more of the fuses open.

6.4 A circuit breaker shall be so formed and assembled that it will have the strength and rigidity necessary to resist the tests specified in these requirements, without increasing the risk of fire or electric shock due to partial or total collapse with a resulting loosening or displacement of parts or other serious defects.

6.5 An adapter shall be evaluated in conjunction with the intended drawout-mounted device.

7 Corrosion Protection

7.1 Iron and steel parts shall be protected against corrosion by enameling, galvanizing, plating or an equivalent means.

7.2 Corrosion protection is not required for thermal elements, magnet pole faces, and hardened and polished parts, such as latching surfaces.

8 Insulating Materials

8.1 An insulating material shall comply with the requirements of Annex A, Ref. No. 7. Temperature limits for insulating materials are established based on the Relative Thermal Index in accordance with Annex A, Ref. No. 5.

8.2 An insulating material having values below those specified in 8.1 may be accepted based on acceptable end-product performance tests in Annex A, Ref. No. 6.

9 Current-Carrying Parts

9.1 A current-carrying part shall be of silver, a silver alloy, copper, a copper alloy, or other metal that has been shown by tests to be acceptable for the application.

9.2 Uninsulated live metal parts shall be so secured to the mounting surfaces that they will be kept from turning, where turning would reduce electrical spacings.

9.3 Friction between surfaces is not acceptable as a means to keep uninsulated live metal parts from turning. Parts shall be kept from turning by the use of two screws or rivets, by shoulders or mortises, by a dowel pin, lug, or offset, by a connecting strap or other clip fitted into an adjacent part, or by an equivalent method.

10 Terminations

10.1 Disconnecting means shall be provided on drawout-mounted devices for mating with intended receiving equipment or adapters.

10.2 Terminals shall be provided on stationary-mounted devices for mounting pressure wire connectors or for connecting to a bus system.

11 Operating Mechanism

11.1 When a circuit breaker is equipped with an operating handle that is made of a conductive material, the handle shall be in electrical connection with the frame or shall be so constructed that when it is mounted in the intended manner, it will be grounded.

12 Grounding and Bonding

Note: The term “grounding” as used in this clause relates to “bonding” in Canada.

12.1 All dead metal parts that are exposed to personnel when the device is energized shall be grounded.

12.2 To determine the compliance with the requirements in Section 20, the configuration of the grounding means between a metal part of a drawout-mounted device intended to be grounded and any permanently grounded part shall be such that grounding continuity is established at a distance of 3.2 mm (1/8 inch) or more before either primary or secondary disconnects of the drawout unit are energized; and also maintained until both primary and secondary disconnects have been deenergized by at least 3.2 mm (1/8 inch).

13 Trip Devices

13.1 A trip device shall be of the dual, selective, or triple-selective type as defined in Annex A, Ref. No. 12.

14 Interlocks

14.1 Mechanical interlocks shall be provided for draw-out type devices to provide the functions outlined in Annex A, Ref. No. 9. The interlock mechanism shall be on the draw-out device, the receiving adapter, or a combination of the two.

15 Control Circuit Wiring

15.1 The internal wiring of control circuits shall consist of general use insulated conductors or Appliance Wiring Material (AWM) acceptable for the particular application, when considered with respect to the temperature and voltage and conditions of service to which the conductor is likely to be subjected.

15.2 Wireways shall be smooth and entirely free from sharp edges, burrs, fins, moving parts and the like, which may cause abrasion of the insulation on conductors.

15.3 A splice, where used, shall be provided with insulation equivalent to that of the insulated conductors involved.

16 Control Circuit Field Wiring Connections

16.1 Secondary disconnects for drawout-mounted devices shall be tested in accordance with Section 17, where the control circuits are not connected when the device is in the "disconnected" position, and secondary disconnects are to be connected in the "connected" and "test" positions.

16.2 Terminals or bus connections shall be provided on stationary-mounted devices for the connection of wiring to stationary-mounted devices, including an accessory.

16.3 For terminal connections, pressure terminal connectors shall be used, except that for a 10 AWG (5.3 mm^2) or smaller insulated conductors, the parts to which wiring connections are made may consist of clamps or wire-binding screws with terminal plates having upturned lugs or the equivalent to hold the conductors in position.

16.4 A wire-binding screw to which field-wiring connections are made shall not be smaller than No. 8, except that a No. 6 or larger screw may be used for a terminal to which 14 AWG (2.1 mm^2) or smaller insulated conductors is intended to be connected.

16.5 Notwithstanding 16.6, a terminal plate tapped for a wire-binding screw shall be of metal not less than 0.76 mm (0.030 inch) thick for a 14 AWG (2.1 mm^2) or smaller insulated conductors, and not less than 1.27 mm (0.050 inch) thick for a conductor larger than 14 AWG. In either case, there shall not be fewer than two full threads in the metal.

16.6 With reference to 16.5, a terminal plate formed from stock having the minimum thickness, may have the metal extruded at the tapped hole for the binding screw to provide two full threads. Two full threads are not required if fewer threads result in a sufficiently secure connection in which the threads will not strip upon the application of a 2.3 N·m (20 lb-in) tightening torque.

16.7 A wire-binding screw shall thread into metal.

PERFORMANCE

17 General

17.1 Power circuit breakers shall be tested in accordance to Section 17 and to the additional requirement listed in Table 17.1 .

Table 17.1
Product Standards

Product	Standard designation
DC circuit breakers	IEEE C37.14 (Annex A, Ref. No. 8)
AC circuit breakers	IEEE C37.13 and ANSI C37.50 (Annex A, Ref. No. 7 & 10)
Fuse draw-outs	17.2
Trip devices	ANSI C37.50 and ANSI C37.17 (Annex A, Ref. No. 10 & 12)
Accessory devices	ANSI C37.50 (Annex A, Ref. No. 10)

17.2 A fuse draw-out shall be tested in combination with the specific circuit breaker with which it is intended to be used. Two elements shall be housed in separate enclosures (adaptors) and test in accordance to the requirement for fused circuit breaker in Annex A, Ref. No. 10. Fuses are to be selected in accordance with 17.3 – 17.5.

17.3 Fused circuit breakers shall be tested with the specific fuses selected in accordance with 17.4 and 17.5. The specific type shall be constructed so that a standard fuse cannot replace it without deliberately defeating a non-interchangeability feature.

17.4 Fused circuit breakers employing standard fuses shall be tested with fuses having characteristics representing the peak let-through current (I_p) and maximum I^2t associated with the maximum rated fuses the device is constructed to accept. Each of these fuses is to be of such characteristics that, when tested on a single-phase circuit, it will permit a peak let-through current (I_p) and a maximum I^2t of not less than the corresponding value specified in the requirements for the current and voltage rating of the class fuse intended for use in the device being tested. To obtain the required values of these characteristics, it may be necessary to employ a fuse having a current rating larger than that of the fuse that the device accommodates and of a different class. If the fuse cannot be physically accommodated, it is to be mounted externally and dummy fuses mounted inside in the fuse clip assemblies.

17.5 Fuses, referenced in 17.4, used for tests are to be selected from a lot from which one sample has been selected and calibrated to determine that its I^2t and I_p characteristics comply with the prescribed values called for in 17.4.

17.6 In accordance with Annex A, Ref. No. 10, the intermediate short-circuit current rating test for a fuse draw-out with a continuous current rating of 4000 A shall be at 130 kA, plus 20 percent, minus 10 percent.

17.7 The temperature rise limit for fuse draw-out terminal connections when silver plated and intended to be enclosed, is 65 °C (117 °F).

17.8 Both single-phase and 3-phase tests are to be conducted to determine the acceptability of the single-phase and 3-phase short-circuit or short-time current ratings.

17.9 Proper operation of functional components is to be determined as part of the sequential testing in accordance with Annex A, Ref. No. 8, or Annex A, Ref. No. 10, or both.

17.10 It is not necessary to test the accessory devices as part of the sequential testing.

18 Interlock Verification Tests

18.1 The interlock mechanism for draw-out devices shall be subjected to a mechanical performance test in accordance with Annex A, Ref. No. 11.

19 Dielectric Voltage-Withstand Tests

19.1 With a draw-out device in the "test" and "disconnected" position, and any other definite position other than the "connected" position, it shall withstand for one minute without breakdown the application of a 60 Hz sinusoidal potential of 1000 V plus twice the voltage rating of the primary circuit between the primary circuit of the circuit breaker and the primary terminals of the adapter.

20 Grounding Resistance Tests

20.1 The grounding continuity shall be such that the resistance does not exceed 0.06 ohm when tested as specified in 20.2:

a) Between the handle of conductive material, as described in 11.1, and the frame or enclosure, and

b) Between any metal part of a drawout-mounted device intended to be grounded, as described in 12.2, and the member of the stationary part that is intended to provide the grounding path.

20.2 Compliance with 20.1 is to be determined by measuring the voltage when a current of 30 A is passed between the parts in question. The current is to be derived from a 48 – 62 Hz or dc source, having an open circuit voltage preferably not exceeding 30 V. A drawout-mounted device is to be in any position providing less than 3.2 mm (1/8 inch) clearance between the disconnect (primary and secondary) and the associated live part of the stationary member. The voltage drop is to be measured between the two parts – within 150 mm (6 inches) of the stationary member to the farthest point on the drawout unit – and the resistance is to be computed therefrom.

21 Trip Device Calibration Tests

21.1 Notwithstanding 21.2, the calibration tests shall be performed as part of the sequence testing of the circuit breaker and the test results shall be in accordance to Annex A, Ref. No. 12 and the manufacturer's published curves.

21.2 In accordance to 21.1, if the test results comply with Annex A, Ref. No. 12 but do not meet the manufacturer's published curves, additional calibration tests may be performed where at least 6 points on the manufacturer's curve are checked. The results of all points shall comply with requirements in Annex A, Ref. No. 12.

RATINGS

22 General

22.1 Each AC device shall have one or more maximum voltage ratings of 254, 508, 635, 730, 847, 953 or 1058 V for application on systems having nominal voltage ratings of 240, 480, 600, 690, 800, 900, and 1000 V ac. AC integrally fused power circuit breakers and AC power circuit breakers intended to be connected in series with fuse drawouts shall be rated 600 V maximum.

22.2 General purpose type low-voltage DC power circuit breakers shall be rated 300, 600, 800, 1000 or 1500 V maximum.

22.3 The 3-phase short-circuit or short-time current rms symmetrical ratings shall be in accordance with Annex A, Ref. No. 7. The single-phase rating shall be 87 percent of the 3-phase ratings.

22.4 The short-circuit current ratings for DC circuit breakers shall be in accordance with Annex A, Ref. No. 8.

MARKINGS

Advisory Note: Markings required by this Standard may have to be provided in other languages to conform with the language requirements of the country or region where the product is to be used. In Canada, there are two official languages, English and French. Annex E provides translations in French of the English safety markings specified in this Standard.

23 General

23.1 All markings shall be in the appropriate language for the country in which the power circuit breaker will be installed.

23.2 An AC circuit breaker shall be marked in accordance with Annex A, Ref. No. 7.

23.3 A DC circuit breaker shall be marked in accordance with Annex A, Ref. No. 8.

23.4 A drawout-mounted device shall be marked with at least one of the following:

a) To show the designation of an intended adapter,

b) To show the minimum enclosure size, insulation requirements and ventilation requirements, or

c) To refer to a drawing showing the minimum requirements, and ventilation requirements.

23.5 Voltage and current requirements for each control circuit or auxiliary circuit shall be marked on the circuit breaker or provided with other information shipped with the circuit breaker.

23.6 Circuit breakers with ground-fault elements that have settings greater than 1200 A shall be marked "Not For Use As Service Equipment" or the equivalent.

23.7 A fuse draw-out shall be marked to indicate the circuit breaker, or circuit breakers, with which it is intended to be used.

23.8 A circuit breaker that has been tested in combination with a fuse draw-out shall be marked to indicate the fuse draw-out with which it is intended to be used and that the increased short-circuit current rating associated with the fuse, or current limiter, applies only when the circuit breaker is connected in series with the fuse draw-out.

23.9 A circuit breaker without an integral direct acting trip device shall be marked to indicate that over-current protection is not provided or to indicate the catalog number or type of protective relay that is to be used to achieve over-current protection.

ANNEX A (Normative) – Reference Standards

Ref. No.	United States	Canada
1	ANSI/NFPA 70, National Electrical Code	CSA C22.1, Canadian Electrical Code, Part I
2	No equivalent	CSA C22.2 No. 0, General Requirements – Canadian Electrical Code, Part II
3	No equivalent	CSA C22.2 No. 0.4, Bonding of Electrical Equipment
4	IEEE C37.20.10, Standard Definitions for AC (52 kV and below) and DC (3.2 kV and below) Switchgear Assemblies	IEEE C37.20.10, Standard Definitions for AC (52 kV and below) and DC (3.2 kV and below) Switchgear Assemblies
5	UL 746B, Standard for Polymeric Materials – Long Term Property Evaluations	CSA C22.2 No. 0.17, Evaluation of Properties of Polymeric Materials
6	UL 746C, Standard for Polymeric Materials – Used in Electrical Equipment Evaluations	No Equivalent
7	IEEE C37.13, Standard for Low-Voltage AC Power Circuit Breakers Used In Enclosures	IEEE C37.13, Standard for Low-Voltage AC Power Circuit Breakers Used In Enclosures
8	IEEE C37.14, Standard for DC (3200 V and below) Power Circuit Breakers Used in Enclosures	IEEE C37.14, Standard for DC (3200 V and below) Power Circuit Breakers Used in Enclosures
9	IEEE C37.20.1, Standard for Metal-Enclosed Low-Voltage (1000 Vac and below, 3200 Vdc and below) Power Circuit Breaker Switchgear	IEEE C37.20.1, Standard for Metal-Enclosed Low-Voltage (1000 Vac and below, 3200 Vdc and below) Power Circuit Breaker Switchgear
10	NEMA C37.50, Test Procedures for Switchgear – Low-Voltage AC Power Circuit Breakers Used In Enclosures	NEMA C37.50, Test Procedures for Switchgear – Low-Voltage AC Power Circuit Breakers Used In Enclosures
11	NEMA C37.51, Switchgear – Metal-Enclosed Low Voltage AC Power Circuit Breaker Switchgear Assemblies – Conformance Test Procedures	NEMA C37.51, Switchgear – Metal-Enclosed Low Voltage AC Power Circuit Breaker Switchgear Assemblies – Conformance Test Procedures
12	IEEE C37.17, Trip systems for Low-voltage (1000 V and below) AC and General Purpose (1500 V and below) DC Power Circuit Breakers	IEEE C37.17, Trip systems for Low-voltage (1000 V and below) AC and General Purpose (1500 V and below) DC Power Circuit Breakers
13	IEEE C37.59, Requirements for Conversion of Power Switchgear Equipment	IEEE C37.59, Requirements for Conversion of Power Switchgear Equipment

ANNEX B (Normative) – Low-Voltage AC Power Circuit Breakers – Naval Use (For United States Only)

INTRODUCTION

B1 Scope

B1.1 These requirements cover low-voltage AC power circuit breakers intended for use aboard non-combatant and auxiliary naval ships. A naval circuit breaker shall comply with the applicable requirements of the preceding Sections of this Standard and of this Annex.

PERFORMANCE

B2 Endurance Test

B2.1 The test is to be performed in accordance with Annex A, Ref. No. 10 except that the number of operations shall be in accordance with Table B2.1, and servicing, as described in Annex A, Ref. No. 7, is not permitted.

Table B2.1
Endurance Requirements for Low-Voltage AC Power Circuit Breakers (Navy Applications)

Circuit breaker frame size, amperes	Number of operating cycles[a]		
	Electrical endurance	Mechanical endurance	Total
1600/2000	1000	3000	4000
3000	500	1000	1500
4000	500	1000	1500

[a] All operating cycle requirements are without servicing.

B3 Continuous Current Test

B3.1 The test is to be conducted in accordance with Annex A, Ref. No. 7 and Annex A, Ref. No. 10 except that the temperature rise limit for insulating material is to be based on an ambient temperature of 50 °C (122 °F).

B4 Calibration Test

B4.1 Circuit breakers with trip devices that are sensitive to ambient temperatures are to be calibrated or ambient compensated for use in an ambient of 50 °C (122 °F).

B5 Inclined Operations

B5.1 Calibration Check Tests as described in Annex A, Ref. No. 10 are to be performed with the test device inclined 30 degrees from the horizontal plane. Results shall not exceed ±5 percent of the limits from the manufacturer's operating curves or the limits in Annex A, Ref. No. 12.

B6 Vibration Test

B6.1 General

B6.1.1 During and after the vibration tests specified in B6.2 and B6.3, a naval circuit breaker shall not open the contacts when they are in the closed position.

B6.1.2 After the vibration tests specified in B6.2 and B6.3, a naval circuit breaker:

a) Shall continue to operate as intended without adjustments or repairs,

b) Shall meet the limits of the specified time bands for calibration,

c) Fuse units shall not open the circuit, change protective characteristics, lose filler material, or show signs of deformation, and

d) Shall have a minimum insulation resistance of 10 megohms.

B6.1.3 To determine whether the contacts open during the vibration tests, an oscillograph is to be connected across the circuit breaker contacts.

B6.1.4 For these tests, peak-to-peak amplitude is defined as the maximum displacement of sinusoidal motion (total table displacement).

B6.2 Resonance frequency test

B6.2.1 A circuit breaker is to be vibrated at a peak-to-peak amplitude of 0.51 ±0.05 mm (0.020 ±0.002 inch) in three rectilinear axes, horizontal, vertical, and lateral at frequencies starting at 4 Hz (or the lowest attainable frequency but not greater than 10 Hz) to 33 Hz. A change in frequency is to be made in discrete intervals of 1 Hz and maintained at each frequency for 15 seconds. The frequency and orientation at which resonances occur is to be noted.

Table B6.1
Displacement of Vibration

Frequency range, Hz	Table amplitude	
	mm	(Inches)
4 to 15	1.52 ±0.15	(0.060 ±0.006)
16 to 25	1.02 ±0.10	(0.040 ±0.004)
26 to 33	0.51 ±0.05	(0.020 ±0.002)

B6.2.2 If a resonance has been determined in accordance with B6.2.1, the circuit breaker is to be subjected to that resonant frequency, displacement, and orientation in accordance with B6.2.1 for 2 hours. If resonance is not observed in accordance with B6.2.1 the test is to be conducted at 33 Hz at an amplitude of 0.51 ±0.05 mm (0.020±0.002 inch) for 2 hours in any plane.

B6.3 Variable frequency test

B6.3.1 A variable frequency test is to be conducted separately in each of the three rectilinear axes, horizontal, vertical, and lateral. All tests in one direction are to be completed before proceeding to the tests in another direction. The circuit breaker is to be energized as intended in actual service during the test. The test is to be conducted at an ambient temperature of 25 °C (77 °F).

B6.3.2 A circuit breaker is to be mounted in a horizontal plane and subjected to the vibration displacement ranges and amplitude specified in Table B6.1. The vibration equipment is to be varied in discrete frequency intervals of 1 Hz and is to be maintained at each interval for 5 minutes.

B6.3.3 A circuit breaker is to be mounted in a one-high cubicle or other suitable enclosure, which is in turn to be secured to the test fixtures secured to the vibration table. Unsupported panel surfaces are to be maintained to reduce the likelihood of resonance of the panels within the test frequency range. Each circuit breaker is to be wired with stranded copper conductors of the appropriate size for the rating properly torqued. The wires are to be connected to a power supply and instrumentation located off the platform of the vibration-test machine. The wiring is to be installed to simulate a normal installation and is to be secured within 179 mm (7 inches) of the terminals. As installed, the wiring is not to be resonant.

B7 Calibration Test

B7.1 A calibration test is to be made as described in Annex A, Ref. No. 10. The test is to be conducted at 50 °C (122 °F) if the trip device is sensitive to ambient temperatures.

MARKINGS

B8 General

B8.1 A low-voltage ac power circuit breaker intended for naval use aboard non-combatant and auxiliary naval ships shall be marked "Naval", or the equivalent, where visible after installation with the circuit breaker enclosure door in the open position.