



IEEE Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures

IEEE Power & Energy Society

Sponsored by the
Switchgear Committee



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IEEE Std C37.13-1990)

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IEEE Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures

Sponsor
**Switchgear Committee
of the
IEEE Power & Energy Society**

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IEEE-SA Standards Board

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The Working Group especially acknowledges the contributions of Shaun Slattery, Member of the Working Group and Chair of the Low-Voltage Switchgear Devices Subcommittee, who passed away during the development of this revision.

Abstract: The following enclosed low-voltage ac power circuit breakers are covered in this standard: a) stationary or draw-out type of two-, three-, or four-pole construction, with one or more rated maximum voltages of 635 V (600 V for units incorporating fuses), 508 V, and 254 V for application on systems having nominal voltages of 600 V, 480 V, and 240 V; b) unfused or fused circuit breakers; c) manually or power operated; and d) with or without electromechanical or electronic trip devices. Service conditions, ratings, functional components, temperature limitations and classifications of insulating materials, insulation (dielectric) withstand voltage requirements, test procedures, and application are discussed in this standard.

Keywords: circuit breaker, fused circuit breaker, low-voltage ac power circuit breaker, open-fuse trip device, unfused circuit breaker

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Introduction

This introduction is not part of IEEE Std C37.13-2008, IEEE Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures.

The revisions to the 1990 version of this standard include the following:

- Clarification of the differences between fused circuit breaker including integrally fused and nonintegrally fused circuit breakers and separately fused circuit breakers as covered in IEEE Std C37.27™ [B7].^a The revisions of IEEE Std C37.27 [B7]^b were made concurrently with the revision of this standard.
- All units were updated to reference metric units.
- Review was made concerning lightning impulse withstand voltage (BIL) requirements. No BIL requirements were added to the standard.
- Update of the requirements associated with demonstrating circuit breaker capabilities with consideration of operation at 50 Hz, 60 Hz, or for dual-rated 50 Hz/60 Hz circuit breakers.
- Update of the requirements associated with the classification of insulating materials was made to the material definitions of UL 746A [B9].

The factors in Table 4 are based on the power frequency of 60 Hz. For 50 Hz circuits, the values in Table 4 can be used, but are conservative.

There was discussion concerning the service condition for the minimum temperature. The issue is that there are two references provided: 1) reference to the temperature inside the enclosure housing of $-5\text{ }^{\circ}\text{C}$ for the air surrounding the circuit breaker and 2) reference to the temperature of the air surrounding the enclosure as specified in IEEE Std C37.20.1™ (which is $-30\text{ }^{\circ}\text{C}$).^c In order not to hold up the publication of this standard, the original text in IEEE Std C37.13-1990 was used with one addition. Text was added to the application section that clarified that heaters should be used for low ambient temperature conditions. This issue will be reviewed in the next revision of this standard.

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^a The numbers in brackets correspond to those of the bibliography in Annex A.

^b IEEE Std C37.27-2008 will be available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, Piscataway, NJ 08854, USA, in April 2009.

^c Information on references can be found in Clause 2.

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IEEE Standard for ~~AC High~~Low- Voltage ~~Generator~~AC Power Circuit Breakers ~~Rated on a~~ ~~Symmetrical Current Basis~~Used in Enclosures

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1. Scope

The scope of this standard includes the following enclosed low-voltage ac power circuit breakers:

- a) Stationary or drawout type of two-, three-, or four-pole construction with one or more rated maximum voltages of 635 V (600 V for units incorporating fuses), 508 V, and 254 V for application on systems having nominal voltages of 600 V, 480 V, and 240 V
- b) Unfused or fused type
- c) Manually operated or power operated, with or without electromechanical or electronic trip devices
- d) Fused drawouts consisting of current-limiting fuses in a drawout assembly intended to be connected in series with a low-voltage ac power circuit breaker to form a nonintegrally fused circuit breaker

NOTE—In this standard, the term circuit breaker shall mean enclosed low-voltage ac power circuit breaker, either fused or unfused. The term unfused circuit breaker shall mean a circuit breaker without either integrally or nonintegrally mounted fuses, and the term fused circuit breaker shall mean a circuit breaker incorporating current-limiting fuses.¹

This document applies to both integrally and nonintegrally fused circuit breakers.

¹ Notes in text, tables, and figures of a standard are given for information only and do not contain requirements needed to implement this standard.

~~This standard applies to all ac high-voltage generator circuit breakers rated on a symmetrical current basis that are installed between the generator and the transformer terminals. Pumped storage installations are considered a special application, and their requirements are not completely covered by this standard.~~

~~NOTE—Since no other national or international standard on generator circuit breakers exists, this standard is used worldwide.~~

~~The revision of IEEE Std C37.013-1993 takes care of this fact by adapting its content in some places to international practice.~~

2. Normative references

The following referenced documents are indispensable for the application of this document (i.e., they must be understood and used, so each referenced document is cited in text and its relationship to this document is explained). For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

~~The standard shall be used in conjunction with the following publications. When the following publications are superseded by an approved revision, the revision shall apply.~~

ANSI C37.16, American National Standard for Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors—Preferred Ratings, Related Requirements, and Application Recommendations.^{2,3}

ANSI C37.17, American National Standard for Trip Devices for AC and General Purpose DC Low-Voltage Power Circuit Breakers.⁴

ANSI C37.50, American National Standard Switchgear Low-Voltage AC ~~High-Voltage~~ Power Circuit Breakers ~~Rated on a Symmetrical Current Basis (ANSI/DoD)~~. Used in Enclosures—Test Procedures.

ASTM D 229, Standard Test Methods for Rigid Sheet and Plate Materials Used for Electrical Insulation.⁵

IEC 60417, Graphical symbols for use on equipment.⁶

IEEE Std 1™, IEEE Recommended Practices—General Principles for Temperature Limits in the Rating of Electrical Equipment and for the Evaluation of Electrical Insulation.^{7,8}

IEEE Std 141™, IEEE Recommended Practice for Electric Power Distribution for Industrial Plants (*IEEE Red Book*™).

IEEE Std 241™, IEEE Recommended Practice for Electric Power Systems in Commercial Buildings (*IEEE Gray Book*™).

IEEE Std 242™, IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (*IEEE Buff Book*™).

IEEE Std C37.20.1™, IEEE Standard for Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear.

IEEE Std C37.100-1992™, IEEE Standard Definitions for Power Switchgear ~~(ANSI)~~.

NEMA CP 1, Shunt Capacitors.⁹

NFPA 70, National Electrical Code® (NEC®).¹⁰

² ANSI publications are available from the Sales Department, American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, NY 10036, USA (<http://www.ansi.org/>).

³ This standard is currently under revision as IEEE PC37.16.

⁴ This standard is currently under revision as IEEE PC37.17.

⁵ ASTM publications are available from the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, USA (<http://www.astm.org/>).

⁶ IEC publications are available from the Sales Department of the International Electrotechnical Commission, 3, rue de Varembe, P.O. Box 131, CH-1211 Geneva 20, Switzerland (<http://www.iec.ch/>). IEC publications are also available in the United States from the Sales Department, American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, NY 10036, USA.

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⁹ NEMA publications are available from Global Engineering Documents, 15 Inverness Way East, Englewood, Colorado 80112, USA (<http://global.ihs.com/>).

~~IEEE Std C57.13-1993, IEEE Standard Requirements for Instrument Transformers (ANSI).~~

~~NEMA MG 1-1993, Motors and Generators.⁵~~

~~NEMA SG 4-1990, Alternating Current High Voltage Circuit Breaker.~~

~~ANSI C37.06-1987 (R1994), Switchgear: AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis—Preferred Ratings and Related Required Capabilities.⁴~~

~~ASME Boiler and Pressure Vessel Code, 1995 Edition.²~~

~~IEC 60694: 1996, Common specifications for high voltage switchgear and controlgear standards.~~

~~IEEE Std 1-1986 (Reaff 1992), IEEE Standard General Principles for Temperature Limits in the Rating of Electrical Equipment and for the Evaluation of Electrical Insulation (ANSI).³~~

⁴ ANSI publications are available from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036-8002, USA.

² ASME publications are available from the American Society of Mechanical Engineers, 22 Law Drive, Fairfield, NJ 07007, USA.

³ IEEE publications are available from the Institute of Electrical and Electronics Engineers, Service Center, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA.

~~IEEE Std 4-1995, IEEE Standard Techniques for High Voltage Testing (~~

3. Definitions

The definitions of terms ~~contained~~ in this standard or in other ~~documents~~ standards referred to in this standard are not intended to embrace all legitimate meanings of the terms. They are applicable only to the subject treated in this standard. ~~For additional definitions, see IEEE Std C37.100-1992.~~

~~A letter symbol (For the purpose of this standard, the following terms and definitions apply. The *Authoritative Dictionary of IEEE Standards Terms* [B3]¹¹ and IEEE Std C37.100¹² should be referenced for terms not defined in this clause. An asterisk (*) following a) indicates that at the time this standard was approved, there was no corresponding definition in IEEE Std C37.100-1992. A letter symbol (^b) following the definition indicates that the definition in this standard is not contained in IEEE Std C37.100, while a dagger (†) indicates the definition differs from that appearing in IEEE Std C37.100-1992.~~

3.1 low-voltage fused power circuit breaker: An assembly of an ac low-voltage power circuit breaker with either integrally mounted or nonintegrally mounted current-limiting fuses that function together as a coordinated protective device. †

~~**3.1 design tests:** Those tests made to determine the adequacy of the design of a particular type, style, or model generator circuit breaker to meet its assigned ratings and to operate satisfactorily under usual service conditions or~~

⁴ IEEE Std 119-1974 has been withdrawn; however, copies can be obtained from Global Engineering, 15 Inverness Way East, Englewood, CO

3.2 low-voltage integrally fused power circuit breaker: An assembly of an ac low-voltage power circuit breaker with current-limiting fuses integrally mounted to the circuit breaker and that function together as a coordinated protective device.*

3.3 low-voltage nonintegrally fused power circuit breaker: An assembly of an ac low-voltage power circuit breaker and a close-coupled fused drawout assembly that function together as a coordinated protective device.*

3.4 open-fuse trip device: A device that operates to open (trip) all poles of a circuit breaker or definite purpose switching device in response to the opening, or absence, of one or more fuses integral or nonintegral to the circuit breaker with which the device is associated. After operating, the device shall prevent closing of the circuit breaker until a reset operation is performed. †

NOTE 1—Since some open-fuse trip devices may operate by sensing the voltage across the fuses, if they are reset with an open or missing fuse, they may not prevent closing of the circuit breaker. In most cases, if this type of operation is performed, it will cause an immediate trip. There is a practical limit of load impedance above which the device (sensing voltage across an open or missing fuse) will not function as described.

NOTE 2—See IEEE Std C37.13.1™ [B5] for definite purpose switching devices.

80112-5704, USA, tel. (303) 792-2181.

⁵NEMA publications are available from the National Electrical Manufacturers Association, 1300 N. 17th St., Ste. 1847, Rosslyn, VA 22209, USA.

~~under unusual conditions, if specified. Design tests are made only on representative circuit breakers of basically the same design, i.e., the same interrupters operating at the same contact speeds, and having at least the same dielectric strength. These tests are not intended to be used as a part of normal production. The applicable portions of these design tests may also be used to evaluate modifications of a previous design and to assure that performance has not been adversely affected. Test data from previous similar designs may be used for current designs, where appropriate.^b~~

~~**3.2 excitation current switching capability (of a generator circuit breaker):** The highest magnetizing current that a generator circuit breaker shall be required to switch at any voltage up to rated maximum voltage at power frequency without causing an overvoltage exceeding the levels agreed upon between the user and the manufacturer.^a~~

~~**3.3 generator source short circuit current:** The short circuit current when the source is entirely from a generator through no transformation.^a~~

~~**3.4 production tests:** Those tests made to check the quality and uniformity of workmanship and materials used in the manufacturing of generator circuit breakers.^b~~

~~**3.5 rated closing time (of a generator circuit breaker):** The interval between energizing of the close circuit at rated control voltage and rated fluid pressure of the operating mechanism and the closing of the main circuit.^a~~

~~**3.6 rated continuous current (of a generator circuit breaker):** The designated limit of current in rms amperes at power frequency that a generator circuit breaker shall be required to carry continuously without exceeding any of its designated limitations.^a~~

~~**3.7 rated interrupting time (of a generator circuit breaker):** The maximum permissible interval between the energizing of the trip circuit at rated control voltage and rated fluid pressure of the operating mechanism and the interruption of the main circuit in all poles on an opening operation.^a~~

~~**3.8 rated maximum voltage (of a generator circuit breaker):** The highest rms voltage for which the circuit breaker is designed, and the upper limit for operation. The rated maximum voltage is equal to the maximum operating voltage of the generator to which the circuit breaker is applied.^b~~

~~**3.9 rated mechanism fluid operating pressure (of a generator circuit breaker):** The pressure at which a gas or liquid operated mechanism is designed to operate.^a~~

~~**3.10 system source short circuit current:** The short circuit current when the source of the short circuit~~