IEEE Std C37.09™-1999 (R2007)
(Revision of
IEEE Std C37.09-1979)

IEEE Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis

Sponsor

Switchgear Committee
of the
IEEE Power Engineering Society

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Abstract: The testing procedures for all high-voltage circuit breakers that include all voltage ratings above 1000 V ac and comprise both indoor and outdoor types having the prefered ratings as listed in ANSI C37.06-1997 are covered. Typical circuit breakers covered by these standards have maximum voltage ratings from 4.76 kV through 800 kV, and continuous current ratings of 600 A, 1200 A, 2000 A, and 3000 A associated with the various maximum voltage ratings. The test procedures verify all assigned ratings, including continuous current, dielectric withstand voltages, short-circuit current, transient recovery voltage, and capacitor switching, plus associated capabilities such as mechanical endurance, load current, and out-of-phase switching. Production test procedures are also included. This standard does not cover generator circuit breakers as these are covered in IEEE Std C37.013-1993.

Keywords: fast transient recovery voltage, indoor, initial, mechanical endurance, operating duty, outdoor, power frequency, short-circuit current, short-line fault, single-phase testing, test data reporting, three-phase testing, unit test, voltage distribution synthetic test.

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Introduction

(This introduction is not part of IEEE Std C37.09-1999, IEEE Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.)

This standard is a major revision of ANSI/IEEE Std C37.09-1979 (R1996). This revision contains major substantive changes. Some editorial changes also have been included, and they are intended to eliminate duplication of words from IEEE Std C37.04-1999 and to reduce the word usage in general.

Listed here, for information and guidance, are the substantive changes.

This revision reflects the changes made in ANSI C37.06-1997 where the K factor has effectively been eliminated for all indoor circuit breakers by assigning to it a numerical value of K = 1. This has been done to take advantage of the newer interrupting technologies. Additionally, the traditional use of 1.6 as the multiplying factor for the asymmetrical root-mean-square (rms) current and 2.7 for the peak current has been revised to reflect the time constant of 45 ms (corresponding to an X/R ratio of 17 at 60 Hz or 14 at 50 Hz) on which the circuit breaker ratings are based, which yields the mathematically correct values of 1.55 and 2.6 respectively. With the implementation of this change, the information needed to properly test circuit breakers rated in accordance with the 1979 or earlier editions of ANSI C37.06 and IEEE Std C37.04 has been deleted from the main body of this document; however, Test Tables 1 and 2 from the 1979 version of ANSI/IEEE Std C37.09-1979 have been included as Annex B for reference purposes and to be used in those cases where circuit breakers designed to meet the prior standards requirement are being tested. Users must refer to the prior editions of the relevant standards for more concise information in order to properly test those earlier designs of circuit breakers. This major change has resulted in a consolidation of text and of test duty requirements for this revision.

ANSI C37.06.1-1997 is a new concept document and has been recognized and incorporated in this revision by reference and notes in applicable clauses.

All outstanding supplements of this standard have been included, with the exception of IEEE Std C37.09a-1991, Load Current Switching Tests, which has been replaced with a later revision that is included in 4.9.

Mechanical endurance (4.13) has also been upgraded.

A clause covering leakage tests (5.7) for gaseous and for vacuum interrupters has been added.

The Lightning impulse withstand testing clause (4.4.4.2) now includes the 3 × 9 method as part of the harmonization effort with IEC.

The Standard operating duty/standard duty cycle (4.5) for non-reclosing rated circuit breakers has been changed from O - 15s - CO to O - t - CO - t'- CO where t and t' are defined times between tests, while the test duty O - 0.3 sec - CO has been added for circuit breakers rated for reclosing duty applications.

Short-line fault tests have now been made mandatory for all outdoor circuit breakers rated 15.5 kV and above.

ANSI/IEEE Std 4-1978, IEEE Standard Techniques for High-Voltage Testing, is specifically referenced in this standard because its latest revision does not include critical test techniques needed for circuit breaker testing. When the latest issue of this standard is suitably revised, it will be officially recognized and will become part of this revision.

Sections of test requirements covering pressurized and non-ceramic pressurized insulating components, previously included in NEMA SG-4 Standard, have now been incorporated into this standard.

Indoor circuit breakers are recognized in this revision for their unique test and application requirements as dictated by their use in metal-clad switchgear and as covered in IEEE Std C37.20.2-1993.

Capacitor current testing (4.10) has been carried over without change, except for clause renumbering, from the 1979 publication. This clause is expected to change in the future as a result of a major harmonized revision, which is now being prepared by a joint IEEE and IEC working group.

This standard, with its companion standards, IEEE Std C37.04-1999, ANSI C37.06-1997, and IEEE Std C37.010-1999, establishes a total rating, test, and application basis for all high-voltage circuit breakers with the exception of generator circuit breakers, which are covered by IEEE Std C37.013-1997.

This standard was approved by the American National Standards Institute (ANSI) on 20 January 2000.

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IEEE Standard Test Procedure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis

1. Scope

This test procedure summarizes the various tests that are made on a high-voltage indoor and outdoor circuit breakers, except for generator circuit breakers, which are covered in IEEE Std C37.013-1997. It describes accepted methods used in making the tests and specifies the tests that will verify assigned ratings under ANSI/IEEE standards. This procedure does not preclude the use of other equivalent or more effective methods of demonstrating ratings.

The tests are divided into the following classifications:

a) Design tests (Referred to in IEC 60056-1987 and IEC 60694-1996 as Type Tests)
b) Production tests (Referred to in IEC 60056-1987 and IEC 60694-1996 as Routine Tests)
c) Tests after delivery
d) Conformance tests

2. References

When the following standards are superseded by an approved revision, the revision shall apply.

ANSI C37.06-1997, American National Standard for Switchgear—AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis—Preferred Ratings and Related Required Capabilities.[1]

ANSI C37.06.1-1997, Trial-Use Guide for High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis—Designated "Definite Purpose for Fast Transient Recovery Voltage Rise Times."

[1]ANSI publications are available from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036, USA (http://www.ansi.org/).