

IEEE Application Guide for AC High-Voltage Circuit Breakers > 1000 Vac Rated on a Symmetrical Current Basis

IEEE Power and Energy Society

Sponsored by the
Switchgear Committee

IEEE
3 Park Avenue
New York, NY 10016-5997
USA

IEEE Std C37.010™-2016
(Revision of
IEEE Std C37.010-1999)

IEEE Application Guide for AC High-Voltage Circuit Breakers > 1000 Vac Rated on a Symmetrical Current Basis

Sponsor

Switchgear Committee
of the
IEEE Power and Energy Society

Approved 22 September 2016

IEEE-SA Standards Board

Currently in preview, click buy full version

Abstract: The application of indoor and outdoor high-voltage circuit breakers rated above 1000 Vac for use in commercial, industrial, and utility installations is covered in this guide. It deals with usage under varied service conditions, temperature conditions affecting continuous current compensation, reduced dielectrics, reclosing derating as applicable, calculation of system short-circuit current, compensation at different X/R ratios, detailed calculations with application curves, out-of-phase switching, and general application.

Keywords: ambient compensation/emergency operation, capacitor switching, high-voltage circuit breakers, IEEE C37.010™, indoor drawout, outdoor, pollution level creepage distance, power frequency, line closing, load current switching, rated maximum voltage, short-circuit consideration, transformer current switching, TRV

The Institute of Electrical and Electronics Engineers, Inc.
3 Park Avenue, New York, NY 10016-5997, USA

Copyright © 2017 by The Institute of Electrical and Electronics Engineers, Inc.
All rights reserved. Published 17 April 2017. Printed in the United States of America.

IEEE is a registered trademark in the U.S. Patent & Trademark Office, owned by The Institute of Electrical and Electronics Engineers, Incorporated.

PDF: ISBN 978-1-5044-2361-8 STD21135
Print: ISBN 978-1-5044-2362-5 STDPD21135

IEEE prohibits discrimination, harassment, and bullying.

For more information, visit <http://www.ieee.org/web/aboutus/whatis/policies/p9-26.html>.

No part of this publication may be reproduced in any form, in an electronic retrieval system or otherwise, without the prior written permission of the publisher.

Important Notices and Disclaimers Concerning IEEE Standards Documents

IEEE documents are made available for use subject to important notices and legal disclaimers. These notices and disclaimers, or a reference to this page, appear in all standards and may be found under the heading “Important Notice” or “Important Notices and Disclaimers Concerning IEEE Standards Documents.”

Notice and Disclaimer of Liability Concerning the Use of IEEE Standards Documents

IEEE Standards documents (standards, recommended practices, and guides), both full-use and trial-use, are developed within IEEE Societies and the Standards Coordinating Committees of the IEEE Standards Association (“IEEE-SA”) Standards Board. IEEE (“the Institute”) develops its standards through a consensus development process, approved by the American National Standards Institute (“ANSI”), which brings together volunteers representing varied viewpoints and interests to achieve the final product. Volunteers are not necessarily members of the Institute and participate without compensation from IEEE. While IEEE administers the process and establishes rules to promote fairness in the consensus development process, IEEE does not independently evaluate, test, or verify the accuracy of any of the information or the soundness of any judgments contained in its standards.

IEEE does not warrant or represent the accuracy or content of the material contained in its standards, and expressly disclaims all warranties (express, implied and statutory) not included in this or any other document relating to the standard, including, but not limited to, the warranties of: merchantability; fitness for a particular purpose; non-infringement; and quality, accuracy, effectiveness, currency, or completeness of material. In addition, IEEE disclaims any and all conditions relating to: results and workmanlike effort. IEEE standards documents are supplied “AS IS” and “WITH ALL FAULTS.”

Use of an IEEE standard is wholly voluntary. The existence of an IEEE standard does not imply that there are no other ways to produce, test, measure, purchase, market, or provide other goods and services related to the scope of the IEEE standard. Furthermore, the viewpoint expressed at the time a standard is approved and issued is subject to change brought about through developments in the state of the art and comments received from users of the standard.

In publishing and making its standards available, IEEE is not suggesting or rendering professional or other services for, or on behalf of, any person or entity nor is IEEE undertaking to perform any duty owed by any other person or entity to another. Any person utilizing any IEEE Standards document, should rely upon his or her own independent judgment in the exercise of reasonable care in any given circumstances or, as appropriate, seek the advice of a competent professional in determining the appropriateness of a given IEEE standard.

IN NO EVENT SHALL IEEE BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO: PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION), HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE PUBLICATION, USE OF, OR RELIANCE UPON ANY STANDARD, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE AND REGARDLESS OF WHETHER SUCH DAMAGE WAS FORESEEABLE.

Translations

The IEEE consensus development process involves the review of documents in English only. In the event that an IEEE standard is translated, only the English version published by IEEE should be considered the approved IEEE standard.

Official statements

A statement, written or oral, that is not processed in accordance with the IEEE-SA Standards Board Operations Manual shall not be considered or inferred to be the official position of IEEE or any of its committees and shall not be considered to be, or be relied upon as, a formal position of IEEE. At lectures, symposia, seminars, or educational courses, an individual presenting information on IEEE standards shall make it clear that his or her views should be considered the personal views of that individual rather than the formal position of IEEE.

Comments on standards

Comments for revision of IEEE Standards documents are welcome from any interested party, regardless of membership affiliation with IEEE. However, IEEE does not provide consulting information or advice pertaining to IEEE Standards documents. Suggestions for changes in documents should be in the form of a proposed change of text, together with appropriate supporting comments. Since IEEE standards represent a consensus of concerned interests, it is important that any responses to comments and questions also receive the concurrence of a balance of interests. For this reason, IEEE and the members of its societies and Standards Coordinating Committees are not able to provide an instant response to comments or questions except in those cases where the matter has previously been addressed. For the same reason, IEEE does not respond to interpretation requests. Any person who would like to participate in revisions to an IEEE standard is welcome to join the relevant IEEE working group.

Comments on standards should be submitted to the following address:

Secretary, IEEE-SA Standards Board
445 Hoes Lane
Piscataway, NJ 08854 USA

Laws and regulations

Users of IEEE Standards documents should consult all applicable laws and regulations. Compliance with the provisions of any IEEE Standards document does not imply compliance to any applicable regulatory requirements. Implementers of the standard are responsible for observing or referring to the applicable regulatory requirements. IEEE does not, by the publication of its standards, intend to urge action that is not in compliance with applicable laws, and these documents may not be construed as doing so.

Copyrights

IEEE draft and approved standards are copyrighted by IEEE under US and international copyright laws. They are made available by IEEE and are adopted for a wide variety of both public and private uses. These include both use, by reference, in laws and regulations, and use in private self-regulation, standardization, and the promotion of engineering practices and methods. By making these documents available for use and adoption by public authorities and private users, IEEE does not waive any rights in copyright to the documents.

Photocopies

Subject to payment of the appropriate fee, IEEE will grant users a limited, non-exclusive license to photocopy portions of any individual standard for company or organizational internal use or individual, non-commercial use only. To arrange for payment of licensing fees, please contact Copyright Clearance Center, Customer Service, 222 Rosewood Drive, Danvers, MA 01923 USA; +1 978 750 8400. Permission to photocopy portions of any individual standard for educational classroom use can also be obtained through the Copyright Clearance Center.

Updating of IEEE Standards documents

Users of IEEE Standards documents should be aware that these documents may be superseded at any time by the issuance of new editions or may be amended from time to time through the issuance of amendments, corrigenda, or errata. An official IEEE document at any point in time consists of the current edition of the document together with any amendments, corrigenda, or errata then in effect.

Every IEEE standard is subjected to review at least every 10 years. When a document is more than 10 years old and has not undergone a revision process, it is reasonable to conclude that its contents, although still of some value, do not wholly reflect the present state of the art. Users are cautioned to check to determine that they have the latest edition of any IEEE standard.

In order to determine whether a given document is the current edition and whether it has been amended through the issuance of amendments, corrigenda, or errata, visit the IEEE-SA Website at <http://ieeexplore.ieee.org/> or contact IEEE at the address listed previously. For more information about the IEEE-SA or IEEE's standards development process, visit the IEEE-SA Website at <http://standards.ieee.org>.

Errata

Errata, if any, for all IEEE standards can be accessed on the IEEE-SA Website at the following URL: <http://standards.ieee.org/findstds/errata/index.html>. Users are encouraged to check this URL for errata periodically.

Patents

Attention is called to the possibility that implementation of this standard may require use of subject matter covered by patent rights. By publication of this standard, no position is taken by the IEEE with respect to the existence or validity of any patent rights in connection therewith. If a patent holder or patent applicant has filed a statement of assurance via an Accepted Letter of Assurance, then the statement is listed on the IEEE-SA Website at <http://standards.ieee.org/about/sasb/patcom/patents.html>. Letters of Assurance may indicate whether the Submitter is willing or unwilling to grant licenses under patent rights without compensation or under reasonable rates, with reasonable terms and conditions that are demonstrably free of any unfair discrimination to applicants desiring to obtain such licenses.

Essential Patent Claims may exist for which a Letter of Assurance has not been received. The IEEE is not responsible for identifying Essential Patent Claims for which a license may be required, for conducting inquiries into the legal validity or scope of Patent Claims, or determining whether any licensing terms or conditions provided in connection with submission of a Letter of Assurance, if any, or in any licensing agreements are reasonable or non-discriminatory. Users of this standard are expressly advised that determination of the validity of any patent rights and the risk of infringement of such rights, is entirely their own responsibility. Further information may be obtained from the IEEE Standards Association.

Participants

At the time this IEEE guide was completed, the Switchgear Committee Working Group had the following membership:

Helmut Heiermeier, Chair
Xi Zhu, Vice Chair
Michael Skidmore, Secretary

Syed Shahab Uddin	Edgar Dullni	Mirko Palazzo
Ahmed	John Eastman	Shawn Patterson
Roy Alexander	Kenneth Edwards	Thomas Pellerito
Michael Anderson	Leslie Falkingham	Lise Phan
Mauricio Aristizabal	Thomas Field	Reynaldo Ramos
George Becker	Victor Hermosillo	Anthony Ricciu
Robert Behl	Todd Irwin	Jon Rogers
W. J. (Bill) Bergman	Richard Jackson	Charles Rose
Stan Billings	Cory Johnson	Roderick Sau
Anne Bosma	Stephen Lambert	Carl Smetz
Steven Brown	Hua Ying Liu	Jon Schumann
Arben Bufi	Albert Livshitz	Frank Varma
Eldridge Byron	Bill Long	Shubil Shinde
Gilbert Carmona	Gary Martin	Zachary Smith
Stephen Cary	Frank Mayle	Don Steigerwalt
Steven Chen	David Mitchell	James Van de Ligt
Chih Chow	Georges Montillet	John Webb
Michael Christian	Stephanie Montoya	Jan Weisker
Patrick Di Lillo	Tom Mulcahy	Jiong Zhang
Denis Dufournet	Jeffrey Nelson	

The following members of the individual balloting committee voted on this guide. Balloters may have voted for approval, disapproval, or abstention.

Satish Aggarwal	John Davis	Andrew Jones
Roy Alexander	Gar Donner	Laszlo Kadar
Chris Ambrose	Randall Dotson	John Kay
Mauricio Aristizabal	Denis Dufournet	Gael Kennedy
Ficheux Arnaud	Edgar Dullni	Yuri Khersonsky
Paul Barnhart	Donald Dunn	James Kinney
George Bartok	Douglas J. Edwards	Boris Kogan
George Becker	Kenneth Edwards	James Kulchisky
W. J. (Bill) Bergman	Keith Flowers	Saumen Kundu
Stan Billings	Rabiz Foda	Chung-Yiu Lam
William F. Blum	Marcel Fortin	Stephen Lambert
Anne Bosma	Doaa Galal	Benjamin Lanz
Jeffrey Bragg	Frank Gerleve	John Leach
Steven Brown	David Gilmer	Hua Ying Liu
Tom Burse	Mietek Glinkowski	Li Liu
William Byrd	Edwin Goodwin	Albert Livshitz
Eldridge Byron	James Graham	R. Long
Paul Cardinal	Randall Groves	Thomas Lundquist
Stephen Cary	Charles Hand	Omar Mazzoni
Steven Chen	John Harder	Nigel McQuin
Chih Chow	John Harley	Peter Meyer
Lucas Collette	Helmut Heiermeier	T. David Mills
Stephen Conrad	Jeffrey Helzer	David Mitchell
Michael Crawford	Todd Irwin	Georges Montillet

Thomas Mulcahy
Jerry Murphy
Arun Narang
Jeffrey Nelson
Arthur Neubauer
Michael Newman
Joe Nims
T. W. Olsen
Lorraine Padden
Mirko Palazzo
Shawn Patterson
Christopher Petrola
Iulian Profir
Moises Ramos
Reynaldo Ramos
Samala Santosh Reedy

Charles Rogers
Thomas Rozek
Steven Sano
Roderick Sauls
Bartien Sayogo
Carl Schneider
Carl Schuetz
Devki Sharma
Sushil Shinde
John Shullaw
Michael Sigmon
Veselin Skendzic
Michael Skidmore
James Smith
Jeremy Smith
R. Kirkland Smith

Gary Stoedter
David Stone
Malcolm Thaden
Wayne Timm
John Vergis
Mark Waldron
John Webb
Karl Weber
Jan Weisker
Yingli Yen
Kenneth White
James Wilson
Larry Yonce
Jian Yu
Xi Zhu

When the IEEE-SA Standards Board approved this guide on 22 September 2016, it had the following membership:

Jean-Philippe Faure, *Chair*
Ted Burse, *Vice Chair*
John Kulick, *Past Chair*
Konstantinos Karachalios, *Secretary*

Chuck Adams
Masayuki Ariyoshi
Stephen Dukes
Jianbin Fan
J. Travis Griffith
Gary Hoffman
Ronald W. Hotchkiss

Michael Janezic
Joseph L. Koepfinger**
Hung Ling
Kevin Lu
Annette D. Reilly
Gary Robinson
Mehmet Ulema

Yingli Wen
Philip Winston
Howard Wolfman
Don Wright
Yu Yuan
Daidi Zhong

*Member Emeritus

Introduction

This introduction is not part of IEEE Std C37.010–2016, IEEE Guide for AC High-Voltage Circuit Breakers > 1000 Vac Rated on a Symmetrical Current Basis.

This guide is a revision of IEEE Std C37.010™-1999 (Reaff 2005) and contains substantive changes due to the efforts of three coordinated Working Groups on revision and coordination of IEEE Std C37.04™, IEEE Std C37.09™, and IEEE Std C37.010.

Although much of the approach of IEEE Std C37.010–1999 has been retained, many editorial changes, significant enhancements, and some fundamental changes have been made.

Some of the major issues include the following:

- Some background information and clarification for controlled switching (IEEE Std C37.011™).
- Some background information and clarification for inductive current switching (IEEE Std C37.015™).

Evaluate existing test data for differing dc time constants (X/R).

Contents

1. Overview.....	14
1.1 Scope.....	14
1.2 Purpose.....	14
2. Normative references	14
3. General service conditions	15
3.1 Usual service conditions.....	15
3.2 Unusual service conditions.....	16
3.3 Mechanical considerations for outdoor circuit breakers	20
4. Application considerations	20
4.1 General	20
4.2 Maximum voltage for application	21
4.3 Voltage range factor.....	21
4.4 Frequency.....	21
4.5 Continuous current	21
4.6 Rated dielectric withstand	34
4.7 Standard operating duty.....	35
4.8 Interrupting time.....	35
4.9 Permissible tripping delay T (determined by short-time current stabilization).....	37
4.10 Reclosing time.....	38
4.11 Short-circuit current rating	42
4.12 Transient recovery voltage (TRV)	54
4.13 Load current switching capability and life (repetitive operation).....	54
4.14 Capacitance current switching.....	54
4.15 Line closing (line-closing switching surge factor for circuit breakers 362 kV and above).....	55
4.16 Switching lines with series capacitors	61
4.17 Conditions of use with respect to the output phase switching current rating.....	61
4.18 Shunt reactor current switching.....	62
4.19 Transformer current switching	63
4.20 Controlled switching	63
4.21 Transformer limited fault (TLF) duties.....	65
4.22 Mechanical endurance.....	65
4.23 Rated control voltage	66
4.24 Fluid operating pressure	66
4.25 Insulating oil for circuit breaker	66
4.26 Closed pressure system (gas-filled).....	66
4.27 Circuit breaker limiting factors for associated equipment.....	66
4.28 Circuit breakers equipped with resistors.....	67
4.29 Service capability	70
5. Short-circuit considerations	70
5.1 System short-circuit currents.....	70
5.2 Methods for calculating system short-circuit currents.....	73
5.3 Electrical quantities used.....	85
5.4 Selection of applicable circuit breaker ratings.....	90
Annex A (informative) Basis for E/X method corrected for ac and dc decrements in the calculation of short-circuit currents.....	92
Annex B (informative) Circuit breakers directly connected to motors	112

Annex C (informative) Bibliography 116

List of Figures

Figure 1—Current-time relationship to determine short-time load-current capability of high-voltage circuit breakers	27
Figure 2—Operating time	36
Figure 3—Interrupting capability factor for reclosing service	40
Figure 4—Examples of reclosing capability for some usual reclosing duty cycles	41
Figure 5—Graphical representation of asymmetrical current wave shape and identification of loops for single-phase condition	43
Figure 6—Clearing after a minor loop with first pole to clear factor 1.5.....	44
Figure 7—Clearing after a loop with intermediate asymmetry first pole to clear factor 1.5.....	45
Figure 8—First possible clearing after major loop with first pole to clear factor 1.5	46
Figure 9—Test performed for a time constant of 45 ms with an available time constant of 60 ms using the controlled closing method	47
Figure 10—Testing with an available time constant of 60 ms for a required time constant of 75 ms using the method to choose a different current loop.....	48
Figure 11—Duration and peak of current loop for major loops at 50 Hz	50
Figure 12—Duration and peak of current loop for minor loops at 50 Hz.....	51
Figure 13—Duration and peak of current loop for major loops at 60 Hz.....	51
Figure 14—Duration and peak of current loop for minor loops at 60 Hz.....	52
Figure 15—Power circuit breaker design requirements	53
Figure 16—Traveling wave model at contact S during step 1.....	58
Figure 17—Traveling wave model at contact S during step 2.....	58
Figure 18—Example of overvoltage surge on when reclosing a transmission line.....	60
Figure 19—PIR circuit breaker applied to the line	67
Figure 20—Comparison of different methods.....	68
Figure 21—Variation of switching overvoltage limitations on switching surge limitation (4.0 pu) achieved with different combinations of controlled switching and surge arrestors (SA) at the line end and the PIR [B32].....	68
Figure 22—AC and dc decrement factors for three-phase faults with local generation for 8-, 5-, 3-, and 2-cycle circuit breakers.....	77
Figure 23—AC and dc decrement factors for phase-ground faults with local generation for 8-, 5-, 3-, and 2-cycle circuit breakers.....	78
Figure 24—AC and dc decrement factors for three-phase and phase-ground faults with remote generation for 8-, 5-, 3-, and 2-cycle circuit breakers	79

Figure 25—Single line diagram of example power system	80
Figure 26—Output for separate X and R reductions.....	81
Figure 27—Fault study program output: Three-phase fault current contributions	83
Figure 28—Fault study output: Single-phase fault current contribution	83
Figure 29—System illustrating large short-circuit contribution from motors	86
Figure 30— X/R range for power transformers at 60 Hz.....	89
Figure 31— X/R range for three-phase induction motors at 60 Hz.....	89
Figure 32— X/R range for small solid rotor and salient pole generators and synchronous motors at 60 Hz....	90
Figure A.1—Symmetrical and total current decrement three-phase short-circuit 107 MVA 3600 r/min conductor-cooled turbine generator.....	94
Figure A.2—Symmetrical and total current decrement three-phase short-circuit with generator and system contribution	95
Figure A.3—Symmetrical and total current decrement three-phase short-circuit representative 95– 200 MVA conventional-cooled 3600 r/min turbine generators.....	96
Figure A.4—Symmetrical and total current decrement three-phase short circuits representative 35– 65 MVA 3600 r/min turbine generators	97
Figure A.5—Relationship of $\left(\frac{I_{asym}}{I_{sym}}\right)_{nacd}$ to X/R at 60 Hz for several circuit breaker contact parting times.....	98
Figure A.6—Relationship between X/R ratio and ac decrement from accurate fault calculation at 60 Hz	99
Figure A.7—Illustration of accuracy of fault determination of hydro generation three-phase fault at high side terminals of station step-up transformers	100
Figure A.8— E/X multiplier for equivalent symmetrical amperes for actual X/R at 60 Hz.....	101
Figure A.9—Relationship of I_{asym}/I_{sym} to X/R (at 60 Hz) for several circuit breaker contact parting times ...	103
Figure A.10—Three-phase fault multiplying factors that include effects of ac and dc decrement at 60 Hz..	104
Figure A.11—Line-to-ground fault multiplying factors that include effects of ac and dc decrement	105
Figure A.12—Three-phase and line-to-ground fault multiplying factors that include effects of dc decrement only	106
Figure A.13—Circuit breaker asymmetrical capability.....	107
Figure A.14—Illustration of accuracy of fault determination.....	108
Figure A.15—Illustration of accuracy of fault determination single line-to-ground fault	110
Figure A.16—Illustration of accuracy of fault determination line-to-ground fault at terminals	111
Figure B.1—Methods of ac motor starting	113

List of Tables

Table 1—Environmental examples by pollution level.....	18
Table 2—Minimum nominal specific creepage distance by pollution level	19
Table 3—Ratios of (I_e/I_r) for various ambient temperatures.....	25
Table 4—Typical thermal time constants	26
Table 5—Emergency load current-carrying capability factors (I_e/I_r) based on an ambient temperature of 40 °C	30
Table 6—Emergency load current-carrying capability factor (I_{ed}/I_r) for various ambient temperatures for 4 h emergency period.....	31
Table 7—Emergency load current-carrying capability factor (I_{ed}/I_r) for various ambient temperatures for 8 h emergency period.....	31
Table 8—Example of allowable overload current with rated initial current	33
Table 9—Example of allowable overload current with 50% initial rated current	33
Table 10—Example for comparison of tested and required parameters for asymmetrical current interruption.....	49
Table 11—Example of line-closing switching surge factors for circuit breakers specially designed to control switching surge maximum voltages and parameters of standard reference transmission lines.....	56
Table 12—Impedance values of a system based on 100 MVA.....	80
Table 13—Fault current contributions for three-phase fault.....	81
Table 14—Fault current contributions for single-phase-to-ground fault	81
Table 15—Values for reactances depending on generation source	82
Table 16—Multiplying factors for Figure 11 and Figure 12 for the X/R ratios	82
Table 17—Multiplying factors to determine adjusted symmetrical current.....	84
Table 18—Adjusted fault currents for comparison with rated circuit breaker current	84
Table 19—Comparative circuit breaker selection values	84
Table 20—Subtransient reactances for use in fault current determination.....	85
Table 21—Comparison of calculated currents against circuit breaker ratings.....	87
Table 22—Approximate values of resistance	87
Table 23—Range and typical values of X/R ratios of system components at 60 Hz	87
Table 24—Equivalent system X/R ratios at 60 Hz at typical locations for quick approximation.....	88
Table 25— X/R multiplier based on transformer cooling class	88
Table 26—Application checklist.....	90
Table A.1—Calculated symmetrical current component.....	93

IEEE Application Guide for AC High-Voltage Circuit Breakers > 1000 Vac Rated on a Symmetrical Current Basis

1. Overview

1.1 Scope

This application guide applies to the ac indoor and outdoor high-voltage circuit breakers rated in accordance with the methods given in IEEE Std C37.04 and IEEE Std C37.04a, listed in IEEE Std C37.06™, and tested in accordance with IEEE Std C37.09 and IEEE Std C37.09a.¹ Circuit breakers rated and manufactured to meet other standards should be applied in accordance with application procedures adapted to their specific ratings or applications.

1.2 Purpose

The purpose of this document is to provide guidance for the application of high-voltage circuit breakers which are rated in accordance with IEEE Std C37.04 and IEEE Std C37.06 and which are tested in accordance with IEEE Std C37.09 and other related standards.

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.

ANSI C37.7, Interrupting rating factors for reclosing service for AC high-voltage circuit breakers rated on a total current basis.²

IEC 62271-100, High-voltage switchgear and controlgear—Part 100: High-voltage alternating-current circuit-breakers.³

¹Information on references can be found in [Clause 2](#).

²ANSI 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/>).

³IEC publications are available from the Sales Department of the International Electrotechnical Commission, Case Postale 131, 3, rue de Varembe, CH-1211, Genève 20, Switzerland/Suisse (<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 (<http://www.ansi.org/>).