

IEEE Standard for Shunt Power Capacitors

IEEE Power and Energy Society

Sponsored by the
Transmission and Distribution Committee

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

IEEE Std 18™-2012
(Revision of
IEEE Std 18-2002)

15 February 2013

Currently in preview, click buy full version

IEEE Standard for Shunt Power Capacitors

Sponsor

**Transmission and Distribution Committee
of the
IEEE Power and Energy Society**

Approved 5 December 2012

IEEE-SA Standards Board

Currently in preview, click buy full versio

Grateful Acknowledgment from The IEEE/PES Shunt Capacitor Standard Working Group to the International Electrotechnical Commission (IEC) for permission to reproduce information from its International Standard IEC 60871-4 ed. 1.0. (1996). All such extracts are copyright of IEC, Geneva, Switzerland. All rights reserved. Further information on the IEC is available from www.iec.ch. IEC has no responsibility for the placement and context in which the extracts and contents are reproduced by the Shunt Capacitor Standard Working Group, nor is IEC in any way responsible for the other content or accuracy therein. Non-exclusive, irrevocable, royalty-free permission to use this material is granted for world rights distribution, with permission to modify and reprint in all future revisions and editions of the resulting draft and approved IEEE standard, and in derivative works based on the standard, in all media known or hereinafter known.

Abstract: Power capacitors rated 216 V or higher, 2.5 kvar or more, and designed for shunt connection to alternating-current transmission and distribution systems operating at a nominal frequency of 50 Hz or 60 Hz, are considered.

Keywords: capacitors, IEEE 18™, shunt connection, transmission and distribution systems

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

Copyright © 2013 by The Institute of Electrical and Electronics Engineers, Inc.
All rights reserved. Published 15 February 2013. 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 978-0-7381-8154-7 STD98103
Print: ISBN 978-0-7381-8155-4 STDPD98103

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.

Notice and Disclaimer of Liability Concerning the Use of IEEE Documents: IEEE Standards documents are developed within the IEEE Societies and the Standards Coordinating Committees of the IEEE Standards Association (IEEE-SA) Standards Board. IEEE develops its standards through a consensus development process, approved by the American National Standards Institute, which brings together volunteers representing varied viewpoints and interests to achieve the final product. Volunteers are not necessarily members of the Institute and serve without compensation. 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.

Use of an IEEE Standard is wholly voluntary. IEEE disclaims liability for any personal injury, property or other damage, of any nature whatsoever, whether special, indirect, consequential, or compensatory, directly or indirectly resulting from the publication, use of, or reliance upon any IEEE Standard document.

IEEE does not warrant or represent the accuracy or content of the material contained in its standards, and expressly disclaims any express or implied warranty, including any implied warranty of merchantability or fitness for a specific purpose, or that the use of the material contained in its standards is free from patent infringement. IEEE Standards documents are supplied "AS IS."

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. Every IEEE standard is subjected to review at least every ten years. If a document is more than ten 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 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.

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 the official position of IEEE or any of its committees and shall not be considered to be, nor be relied upon as, a formal position of IEEE. At conferences, symposia, seminars, or educational courses, an individual presenting information on IEEE standards shall make 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 to ensure that any response 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. Any person who would like to participate in evaluating comments or revisions to an IEEE standard is welcome to join the relevant IEEE working group at <http://standards.ieee.org/develop/wg/>.

Comments on standards should be submitted to the following address:

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

Photocopies: Authorization to photocopy portions of any individual standard for internal or personal use is granted by The Institute of Electrical and Electronics Engineers, Inc., provided that the appropriate fee is paid to Copyright Clearance Center. To arrange for payment of licensing fee, 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.

Notice to users

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

This document is copyrighted by the IEEE. It is made available 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 this document available for use and adoption by public authorities and private users, the IEEE does not waive any rights in copyright to this document.

Updating of IEEE 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. 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://standards.ieee.org/index.html> or contact the IEEE at the address listed previously. For more information about the IEEE Standards Association or the IEEE standards development process, visit IEEE-SA Website at <http://standards.ieee.org/index.html>.

Errata

Errata, if any, for this and all other standards can be accessed 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 Patents 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.

Currently in preview, click buy full version

Participants

At the time this IEEE standard was completed, the Shunt Capacitor Standards Working Group had the following membership:

Jeffrey Nelson, *Chair*

Roy Alexander
Steve Ashmore
Antone Bonner
Bill Chai
Vencent Deslauriers
Stuart Edmondson
Bruce English
Clay Fellers
Karl Fender

Chuck Gougler
Thomas Grebe
John Harder
Ivan Horvat
Mike Hulse
John Joyce
Per Lindberg
Daniel Luke

Halim Malaj
Mark McVey
Joe Meisner
Vittal Rebbapragada
Kurt Reim
Mark Reynolds
Rao Thallam
Richard Sevigny
Lisa VoVann

The Shunt Capacitor Standards Working Group is part of the Capacitor Subcommittee. At the time this IEEE Standard was completed, the Capacitor Subcommittee had the following membership:

Roy Alexander
Steve Ashmore
Antone Bonner
Tom Callsen
Bill Chai
Vencent Deslauriers
Stuart Edmondson
Bruce English
Cliff Ervin
Clay Fellers
Karl Fender
Chuck Gougler
Thomas Grebe
John Harder

Ivan Horvat
Mike Hulse
Aron Kalyuzhny
Gerald Lee
Per Lindberg
Daniel Luke
Halim Malaj
Paul Mark
Mark McVey
Ben Menraban
Joe Meisner
Jeffrey Nelson
Jeff Peggs
Piere-Andre Rancourt

Vittal Rebbapragada
Kurt Reim
Mark Reynolds
Sebastian Rios-Marcuello
Thomas Rozek
Don Ruthman
Shree Sathe
Richard Sevigny
David Simmons
Biswajit Singh
Rao Thallam
Richard Sevigny
Lisa VoVann
Ahmed Zobaa

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

William Ackerman
Ali Al Awazi
Roy Alexander
Saleman Alibhay
Peter Balma
Wallace Binder
Anne Bosma
Gustavo Brunello
Mark Bushnell
William Byrd
Thomas Callsen
Arvind K. Chaudhary
Frank Decesaro
Gary Donner
Randall Dotson
Gary Engmann
Cliff Erven
Dan Evans
Marcel Fortin
Fredric Friend
David Garrett
David Gilmer
Mietek Glinkowski
Edwin Goodwin

Thomas Grebe
Randall Groves
Bal Gupta
Daryl Hallmark
John Harder
Timothy Hayden
Jeffrey Helzer
Werner Hoelzl
John Kay
Gael Kennedy
Yuri Khersonsky
James Kinney
Joseph L. Koepfing
Jim Kulchisky
Chung-Yiu Lam
Benjamin Lanz
Greg Luri
William McBride
Aadi Mulawarman
Daniel Mulkey
Jerry Murphy
Jeffrey Nelson
Arthur Neubauer
Michael S. Newman

Joe Nims
Ted Olsen
Lorraine Padden
Mirko Palazzo
Donald Parker
Bansi Patel
Christopher Petrola
Iulian Profir
Michael Roberts
Thomas Rozek
Steven Sano
Bartien Sayogo
Richard Sevigny
Gil Shultz
James Smith
Jerry Smith
Gary Stoeck
Heinz Ty
John Vergis
Dennis Ward
Ronnie White
Jian Yu
Luis Zambrano

When the IEEE-SA Standards Board approved this standard on 1 December 2012, it had the following membership:

Richard H. Hulett, Chair
John Kulick, Vice Chair
Robert M. Row, Past Chair
Konstantinos Karachalios, Secretary

Satish Aggarwal
Masayuki Ariyoshi
Peter Balma
William Bartley
Ted Burse
Clint Chaplin
Wael William Diab
Jean-Phillippe Faure

Michael Gelman
Paul Houzé
Jim Hughes
Young Kyun Kim
Joseph L. Koepfing*
John Kulick
David J. Law
Thomas Lee
Hung Ling

Oleg Logvinov
Ted Olsen
Gary Robinson
Jon Walter Rosdahl
Mike Seavey
Yatin Trivedi
Phil Winston
Yu Yuan

*Member Emeritus

Also included are the following nonvoting IEEE-SA Standards Board liaisons:

Richard DeBlasio, *DOE Representative*
Michael Janezic, *NIST Representative*

Michelle D. Turner
IEEE Standards Program Manager, Document Development

Erin Spiewak
IEEE Standards Program Manager, Technical Program Development

Introduction

This introduction is not part of IEEE Std 18-2012, IEEE Standard for Shunt Power Capacitors.

This standard's principal objective is to provide a basis for uniformity in design, manufacturing and testing of shunt power capacitors.

As part of this revision, portions of NEMA CP1 have been incorporated into IEEE Std 18-2012. After approval and publication of this revision, NEMA plans to withdraw NEMA CP1. In the future, the NEMA working group for power capacitors will provide input to the IEEE Shunt Capacitor Standard Working Group to update IEEE Std 18.

A subclause on internal fuses for internally fused capacitors has been added to Clause 6.

Clause 7, the testing clause, has been divided into sections on design tests and production tests. Appropriate design and production tests have been added for internally fused capacitors. In addition, a significant new design test, 7.1.6 Performance test, has been added to the standard.

A new annex has been added to cover the test procedure for the disconnecting test of internal fuses for internally fused capacitors.

Contents

1. Scope	1
2. Normative references	1
3. Definitions	2
4. Service conditions	3
4.1 Normal service conditions	3
4.2 Abnormal service conditions	4
5. Ratings and capabilities	4
5.1 Standard ratings	4
5.2 Capacitance tolerance	5
5.3 Maximum operating voltage, current and kvar	5
5.4 Typical voltage and reactive power ratings for capacitors.....	5
5.5 Insulation classes	6
5.6 Frequency	6
5.7 Ambient temperature	6
5.8 Overvoltage and overcurrent withstand capabilities.....	7
6. Manufacturing	7
6.1 Thermal stability.....	7
6.2 Basic impulse insulation level	7
6.3 Internal discharge devices.....	8
6.4 Radio influence voltage (RIV).....	8
6.5 Bushings	8
6.6 Connection provisions	8
6.7 Internal fuses for internally fused capacitors	10
6.8 Information to be provided with capacitor and capacitor equipment.....	11
6.9 Dimensions	12
6.10 Electrical bonding provisions	15
6.11 Color	15
7. Testing	15
7.1 Design tests.....	15
7.2 Production tests.....	22
Annex A (informative) Bibliography	25
Annex B (normative) Test procedure for the disconnecting test on internal fuses	26

IEEE Standard for Shunt Power Capacitors

IMPORTANT NOTICE: IEEE Standards documents are not intended to ensure safety, health, or environmental protection, or ensure against interference with or from other devices or networks. Implementers of IEEE Standards documents are responsible for determining and complying with all appropriate safety, security, environmental, health, and interference protection practices and all applicable laws and regulations.

This IEEE document is made available for use subject to important notices and legal disclaimers. These notices and disclaimers appear in all publications containing this document and may be found under the heading “Important Notice” or “Important Notices and Disclaimers Concerning IEEE Documents.” They can also be obtained on request from IEEE or viewed at <http://standards.ieee.org/IPR/disclaimers.html>.

1. Scope

This standard applies to power capacitors rated 216 V or higher, 2.5 kvar or more, and designed for shunt connection to alternating current transmission and distribution systems operating at a nominal frequency of 50 Hz or 60 Hz.

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.

ASTM D1535, Standard Practice for Specifying Color by the Munsell System.¹

IEEE Std 1036™, IEEE Guide for Application of Shunt Power Capacitors.^{2, 3}

IEEE Std 1313.2™-1999, IEEE Guide for the Application of Insulation Coordination

¹ ASTM publications are available from the American Society for Testing Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19248-2959, USA (<http://www.astm.org/>).

² IEEE publications are available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA (<http://standards.ieee.org/>).

³ The IEEE standards referred to in Clause 2 are trademarks belonging to the Institute of Electrical and Electronics Engineers, Inc.