

IEEE Std 404-2000

(Revision of
IEEE Std 404-1993)

IEEE Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V to 500 000 V

Sponsor

**Insulated Conductors Committee
of the
IEEE Power Engineering Society**

Approved 21 September 2000

IEEE-SA Standards Board

Abstract: This standard establishes electrical ratings and test requirements of cable joints used with extruded and laminated dielectric shielded cable rated in preferred voltage steps from 2500 V to 500 000 V. It also defines a variety of common joint constructions. This standard is designed to provide uniform testing procedures that can be used by manufacturers and users to evaluate the ability of underground power cable joints to perform reliably in service.

Keywords: cable joints, dielectric integrity tests, extruded dielectric cable, impulse withstand voltage (BIL), laminated dielectric cable, sheath/shield sectionalizers, transition joints, withstand voltage

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

Copyright © 2001 by the Institute of Electrical and Electronics Engineers, Inc.
All rights reserved. Published 13 July 2001. Printed in the United States of America.

Print: ISBN 0-7381-2607-1 SH94876
PDF: ISBN 0-7381-2608-X SS94876

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.

IEEE Standards documents are developed within the IEEE Societies and the Standards Coordinating Committees of the IEEE Standards Association (IEEE-SA) Standards Board. The 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 the IEEE administers the process and establishes rules to promote fairness in the consensus development process, the IEEE does not independently evaluate, test, or verify the accuracy of any of the information contained in its standards.

Use of an IEEE Standard is wholly voluntary. The 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 this, or any other IEEE Standard document.

The IEEE does not warrant or represent the accuracy or content of the material contained herein, 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 herein 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 five years for revision or reaffirmation. When a document is more than five years old and has not been reaffirmed, 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 this document available, the IEEE is not suggesting or rendering professional or other services for, or on behalf of, any person or entity. Nor is the IEEE undertaking to perform any duty owed by any other person or entity to another. Any person utilizing this, and any other IEEE Standards document, should rely upon the advice of a competent professional in determining the exercise of reasonable care in any given circumstances.

Interpretations: Occasionally questions may arise regarding the meaning of portions of standards as they relate to specific applications. When the need for interpretations is brought to the attention of IEEE, the Institute will initiate action to prepare appropriate responses. Since IEEE Standards represent a consensus of concerned interests, it is important to ensure that any interpretation has also received 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 interpretation requests except in those cases where the matter has previously received formal consideration.

Comments for revision of IEEE Standards are welcome from any interested party, regardless of membership affiliation with IEEE. Suggestions for changes in documents should be in the form of a proposed change of text, together with appropriate supporting comments. Comments on standards and requests for interpretations should be addressed to:

Secretary, IEEE-SA Standards Board
445 Hoes Lane
P.O. Box 1331
Piscataway, NJ 08855-1331
USA

Note: 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 with respect to the existence or validity of any patent rights in connection therewith. The IEEE shall not be responsible for identifying patents for which a license may be required by an IEEE standard or for conducting inquiries into the legal validity or scope of those patents that are brought to its attention.

IEEE is the sole entity that may authorize the use of certification marks, trademarks, or other designations to indicate compliance with the materials set forth herein.

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; (978) 750-8400. Permission to photocopy portions of any individual standard for educational classroom use can also be obtained through the Copyright Clearance Center.

Introduction

(This introduction is not part of IEEE Std 404-2000, IEEE Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V to 500 000 V.)

This revision of IEEE Std 404-1993 now includes a test protocol for joints used on extruded dielectric cables rated 161 000 V to 500 000 V with a corresponding change in the title of the standard. In addition, this latest revision has adopted the ac voltage design levels specified in the international standards IEC 60502-4 and IEC 60840 for the “high voltage time test.”

Future revisions of this standard will address the increasing interest in extruded dielectric cable systems with reduced insulation wall thicknesses and with temperature ratings of 105 °C (normal operation)/140 °C (emergency operation).

The work of preparing this standard was carried out by Task Force B2W (formerly Group 10-27 of the Accessories Subcommittee #10) of the Insulated Conductors Committee of the IEEE Power Engineering Society. At the time this standard was approved, the task force had the following membership:

Glenn J. Luzzi, *Chair*
Frank DiGuglielmo, *Vice-Chair*

Thomas C. Champion, III	Stanley R. Howell	Jim Ripper
Philip Cox	Roy Jazowski	Roger A. Schoneman
Chinh Dang	Donald Jondahl	Abe Shockett
Russ Dantzler	Carlos Katz	Gilbert L. Smith
Frank DiGuglielmo	Gael Kennedy	Matt Spalding
John P. DuPont	Patrick Lyons	Gregory Stano
George Foote	John M. Makal	Frank Stepniak
Robert D. Fulcomer	Jim Markham	Bill Taylor
Daniel Fournier	Jean Marquez	Duc Trinh
Wolfgang Haverkamp	Serge Pelissou	Carl Wentzel
Harry Hayes	Alain Pinet	

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

Torben Aabo	Robert B. Gear	Arthur V. Pack, Jr.
Theodore A. Balaska	Richard L. Harp	Neal K. Parker
Earle C. Bascom, III	Wolfgang B. Haverkamp	Ronald J. Ponist
Martin Baur	Stanley V. Heyer	Dennis C. Pratt
Michael G. Bayer	Lauri J. Hiivala	Robert A. Resuali
Kenneth E. Bow	Stanley R. Howell	Gilbert L. Smith
Kent W. Brown	Richard A. Huber	Peter W. Spencer
Paul S. Cardello	Edward Jankowich	Nagu N. Srinivas
Jack E. Cherry	C. Katz	John Tanaka
John H. Cooper	Frank L. Kuchta	Duc B. Trinh
James M. Daly	Carl Landinger	Daniel J. Ward
Russ C. Dantzler	Gabor Ludasi	Roland H. W. Watkins
John R. Densley	Glenn J. Luzzi	Carl J. Wentzel
John P. DuPont	John M. Makal	William D. Wilkens
Arthur R. Fitzpatrick	J.D. Medek	Joseph T. Zimnoch
Robert E. Fleming	Gary L. Michel	

When the IEEE-SA Standards Board approved this standard on 21 September 2000, it had the following membership:

Donald N. Heirman, *Chair*
James T. Carlo, *Vice-Chair*
Judith Gorman, *Secretary*

Satish K. Aggarwal
Mark D. Bowman
Gary R. Engmann
Harold E. Epstein
H. Landis Floyd
Jay Forster*
Howard M. Frazier
Ruben D. Garzon

James H. Gurney
Richard J. Holleman
Lowell G. Johnson
Robert J. Kennelly
Joseph L. Koepfinger*
Peter H. Lips
L. Bruce McClung
Daleep C. Mohla

James W. Moore
Robert F. Munzner
Ronald C. Petersen
Gerald H. Peterson
John B. Posey
Gary S. Robinson
Akio Tojo
Donald W. Zipse

*Member Emeritus

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

Alan Cookson, *NIST Representative*
Donald R. Volzka, *TAB Representative*

Noelle D. Humenick
IEEE Standards Project Editor

Contents

1. Scope	1
2. References	1
3. Definitions	2
3.1 Cable joint types.....	2
3.2 Cable joint constructions.....	3
3.3 Other terms.....	3
4. Service conditions	3
4.1 Usual service conditions	3
4.2 Unusual service conditions.....	4
5. Ratings	4
5.1 Voltage ratings.....	4
5.2 Current and temperature ratings.....	4
6. Construction	4
6.1 Identification.....	4
6.2 Shielding	6
6.3 Sheath/shield sectionalizers.....	6
7. Testing.....	6
7.1 Production tests	6
7.2 Design tests and testing sequence.....	6
7.3 Design test conditions	8
7.4 Dielectric integrity tests	8
7.5 Withstand tests	9
7.6 Short-time current test.....	11
7.7 Cyclic aging test for extruded dielectric and transition joints.....	11
7.8 High-voltage time test	14
7.9 Sectionalizer tests.....	15
7.10 Shielding tests	15
7.11 Connector thermal and mechanical tests.....	15
Annex A (informative) Bibliography	16

IEEE Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V to 500 000 V

1. Scope

This standard establishes electrical ratings and test requirements of cable joints used with extruded and laminated dielectric shielded cables rated in preferred voltage steps from 2500 V to 500 000 V. It also defines a variety of common joint constructions.

Joints that connect more than two cables or connect cables with two different conductor sizes are not covered by this standard. However, manufacturers and users are encouraged to use appropriate parts of this standard to evaluate these joints.

2. References

This standard shall be used in conjunction with the following references.

AEIC CS1-90, Specifications for Impregnated-Paper-Insulated Metallic Sheathed Cable, Solid Type (Withdrawn).¹

AEIC CS2-97, Specification for Impregnated Paper and Laminated Paper Polypropylene Insulated Cable, High-Pressure-Pipe Type.

AEIC CS3-90, Specifications for Impregnated-Paper-Insulated Metallic Sheathed Cable, Low Pressure Gas-Filled Type.

AEIC CS4-93, Specifications for Impregnated-Paper-Insulated Low and Medium Pressure Self-Contained Liquid Filled Cable.

AEIC CS5-94, Specifications for Cross-linked Polyethylene Insulated Shielded Power Cables Rated 5 Through 46 kV.

¹AEIC publications are available from the Association of Edison Illuminating Companies, 600 N. 18th Street, P.O. Box 2641, Birmingham, AL 35291-0992, USA (<http://www.aeic.org/>). AEIC publications are also available from Global Engineering Documents, 15 Inverness Way East, Englewood, Colorado 80112-5704, USA (<http://global.ihs.com/>).