

# Dead-end/suspension composite insulators for overhead lines $\leq 75$ kV



Currently in preview, click buy full version

# Legal Notice for Standards

Canadian Standards Association (CSA) standards are developed through a consensus standards development process approved by the Standards Council of Canada. This process brings together volunteers representing varied viewpoints and interests to achieve consensus and develop a standard. Although CSA administers the process and establishes rules to promote fairness in achieving consensus, it does not independently test, evaluate, or verify the content of standards.

## Disclaimer and exclusion of liability

This document is provided without any representations, warranties, or conditions of any kind, express or implied, including, without limitation, implied warranties or conditions concerning this document's fitness for a particular purpose or use, its merchantability, or its non-infringement of any third party's intellectual property rights. CSA does not warrant the accuracy, completeness, or currency of any of the information published in this document. CSA makes no representations or warranties regarding this document's compliance with any applicable statute, rule, or regulation.

IN NO EVENT SHALL CSA, ITS VOLUNTEERS, MEMBERS, SUBSIDIARIES, OR AFFILIATED COMPANIES, OR THEIR EMPLOYEES, DIRECTORS, OR OFFICERS, BE LIABLE FOR ANY DIRECT, INDIRECT, OR INCIDENTAL DAMAGES, INJURY, LOSS, COSTS, OR EXPENSES, HOWSOEVER CAUSED, INCLUDING BUT NOT LIMITED TO SPECIAL OR CONSEQUENTIAL DAMAGES, LOST REVENUE, BUSINESS INTERRUPTION, LOST OR DAMAGED DATA, OR ANY OTHER COMMERCIAL OR ECONOMIC LOSS, WHETHER BASED IN CONTRACT, TORT (INCLUDING NEGLIGENCE), OR ANY OTHER THEORY OF LIABILITY, ARISING OUT OF OR RESULTING FROM ACCESS TO OR POSSESSION OR USE OF THIS DOCUMENT, EVEN IF CSA HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES, INJURY, LOSS, COSTS, OR EXPENSES.

In publishing and making this document available, CSA is not undertaking to render professional or other services for or on behalf of any person or entity or to perform any duty owed by any person or entity to another person or entity. The information in this document is directed to those who have the appropriate degree of experience to use and apply its contents, and CSA accepts no responsibility whatsoever arising in any way from any and all use of or reliance on the information contained in this document.

CSA is a private not-for-profit company that publishes voluntary standards and related documents. CSA has no power, nor does it undertake, to enforce compliance with the contents of the standards or other documents it publishes.

## Intellectual property rights and ownership

As between CSA and the users of this document (whether it be in printed or electronic form), CSA is the owner, or the authorized licensee, of all works contained herein that are protected by copyright, all trade-marks (except as otherwise noted to the contrary), and all inventions and trade secrets that may be contained in this document, whether or not such inventions and trade secrets are protected by patents and applications for patents. Without limitation, the unauthorized use, modification, copying, or disclosure of this document may violate laws that protect CSA's and/or others' intellectual property and may give rise to a right in CSA and/or others to seek legal redress for such use, modification, copying, or disclosure. To the extent permitted by licence or by law, CSA reserves all intellectual property rights in this document.

## Patent rights

Attention is drawn to the possibility that some of the elements of this standard may be the subject of patent rights. CSA shall not be held responsible for identifying any or all such patent rights. Users of this standard are expressly advised that determination of the validity of any such patent rights is entirely their own responsibility.

## Authorized use of this document

This document is being provided by CSA for informational and non-commercial use only. The user of this document is authorized to do only the following:

If this document is in electronic form:

- load this document onto a computer for the sole purpose of reviewing it;
- search and browse this document; and
- print this document if it is in PDF format.

Limited copies of this document in print or paper form may be distributed only to persons who are authorized by CSA to have such copies, and only if this Legal Notice appears on each such copy.

In addition, users may not and may not permit others to

- alter this document in any way or remove this Legal Notice from the attached standard;
- sell this document without authorization from CSA; or
- make an electronic copy of this document.

If you do not agree with any of the terms and conditions contained in this Legal Notice, you may not load or use this document or make any copies of the contents hereof, and if you do make such copies, you are required to destroy them immediately. Use of this document constitutes your acceptance of the terms and conditions of this Legal Notice.



CANADIAN STANDARDS  
ASSOCIATION

# **Update No. 1**

## **C411.5-10**

### **August 2011**

**Note:** General Instructions for CSA Standards are now called Updates. Please contact CSA Information Products Sales or visit [www.ShopCSA.ca](http://www.ShopCSA.ca) for information about the **CSA Standards Update Service**.

**Title:** *Dead-end/suspension composite insulators for overhead lines  $\leq 75$  kV* — originally published March 2010

The following revisions have been formally approved:

<b>Revised</b>	Outside front cover and title page
<b>New</b>	National Standards of Canada text
<b>Deleted</b>	None

- Update your copy by inserting these revised pages.
- Keep the pages you remove for reference.

Currently in preview, click buy full version

**Dead-end/suspension composite  
insulators for overhead lines  $\leq 75$  kV**



# Legal Notice for Standards

Canadian Standards Association (CSA) standards are developed through a consensus standards development process approved by the Standards Council of Canada. This process brings together volunteers representing varied viewpoints and interests to achieve consensus and develop a standard. Although CSA administers the process and establishes rules to promote fairness in achieving consensus, it does not independently test, evaluate, or verify the content of standards.

## Disclaimer and exclusion of liability

This document is provided without any representations, warranties, or conditions of any kind, express or implied, including, without limitation, implied warranties or conditions concerning this document's fitness for a particular purpose or use, its merchantability, or its non-infringement of any third party's intellectual property rights. CSA does not warrant the accuracy, completeness, or currency of any of the information published in this document. CSA makes no representations or warranties regarding this document's compliance with any applicable statute, rule, or regulation.

IN NO EVENT SHALL CSA, ITS VOLUNTEERS, MEMBERS, SUBSIDIARIES, OR AFFILIATED COMPANIES, OR THEIR EMPLOYEES, DIRECTORS, OR OFFICERS, BE LIABLE FOR ANY DIRECT, INDIRECT, OR INCIDENTAL DAMAGES, INJURY, LOSS, COSTS, OR EXPENSES, HOWSOEVER CAUSED, INCLUDING BUT NOT LIMITED TO SPECIAL OR CONSEQUENTIAL DAMAGES, LOST REVENUE, BUSINESS INTERRUPTION, LOST OR DAMAGED DATA, OR ANY OTHER COMMERCIAL OR ECONOMIC LOSS, WHETHER BASED IN CONTRACT, TORT (INCLUDING NEGLIGENCE), OR ANY OTHER THEORY OF LIABILITY, ARISING OUT OF OR RESULTING FROM ACCESS TO OR POSSESSION OR USE OF THIS DOCUMENT, EVEN IF CSA HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES, INJURY, LOSS, COSTS, OR EXPENSES.

In publishing and making this document available, CSA is not undertaking to render professional or other services for or on behalf of any person or entity or to perform any duty owed by any person or entity to another person or entity. The information in this document is directed to those who have the appropriate degree of experience to use and apply its contents, and CSA accepts no responsibility whatsoever arising in any way from any and all use of or reliance on the information contained in this document.

CSA is a private not-for-profit company that publishes voluntary standards and related documents. CSA has no power, nor does it undertake, to enforce compliance with the contents of the standards or other documents it publishes.

## Intellectual property rights and ownership

As between CSA and the users of this document (whether it be in printed or electronic form), CSA is the owner, or the authorized licensee, of all works contained herein that are protected by copyright, all trade-marks (except as otherwise noted to the contrary), and all inventions and trade secrets that may be contained in this document, whether or not such inventions and trade secrets are protected by patents and applications for patents. Without limitation, the unauthorized use, modification, copying, or disclosure of this document may violate laws that protect CSA's and/or others' intellectual property and may give rise to a right in CSA and/or others to seek legal redress for such use, modification, copying, or disclosure. To the extent permitted by licence or by law, CSA reserves all intellectual property rights in this document.

## Patent rights

Attention is drawn to the possibility that some of the elements of this standard may be the subject of patent rights. CSA shall not be held responsible for identifying any or all such patent rights. Users of this standard are expressly advised that determination of the validity of any such patent rights is entirely their own responsibility.

## Authorized use of this document

This document is being provided by CSA for informational and non-commercial use only. The user of this document is authorized to do only the following:

If this document is in electronic form:

- load this document onto a computer for the sole purpose of reviewing it;
- search and browse this document; and
- print this document if it is in PDF format.

Limited copies of this document in print or paper form may be distributed only to persons who are authorized by CSA to have such copies, and only if this Legal Notice appears on each such copy.

In addition, users may not and may not permit others to

- alter this document in any way or remove this Legal Notice from the attached standard;
- sell this document without authorization from CSA; or
- make an electronic copy of this document.

If you do not agree with any of the terms and conditions contained in this Legal Notice, you may not load or use this document or make any copies of the contents hereof, and if you do make such copies, you are required to destroy them immediately. Use of this document constitutes your acceptance of the terms and conditions of this Legal Notice.



CANADIAN STANDARDS  
ASSOCIATION

**The Canadian Standards Association (CSA)**, under whose auspices this National Standard has been produced, was chartered in 1919 and accredited by the Standards Council of Canada to the National Standards system in 1973. It is a not-for-profit, nonstatutory, voluntary membership association engaged in standards development and certification activities.

CSA standards reflect a national consensus of producers and users — including manufacturers, consumers, retailers, unions and professional organizations, and governmental agencies. The standards are used widely by industry and commerce and often adopted by municipal, provincial, and federal governments in their regulations, particularly in the fields of health, safety, building and construction, and the environment.

Individuals, companies, and associations across Canada indicate their support for CSA's standards development by volunteering their time and skills to CSA Committee work and supporting the Association's objectives through sustaining memberships. The more than 7000 committee volunteers and the 2000 sustaining memberships together form CSA's total membership from which its Directors are chosen. Sustaining memberships represent a major source of income for CSA's standards development activities.

The Association offers certification and testing services in support of and as an extension to its standards development activities. To ensure the integrity of its certification process, the Association regularly and continually audits and inspects products that bear the CSA Mark.

In addition to its head office and laboratory complex in Toronto, CSA has regional branch offices in major centres across Canada and inspection and testing agencies in eight countries. Since 1919, the Association has developed the necessary expertise to meet its corporate mission: CSA is an independent service organization whose mission is to provide an open and effective forum for activities facilitating the exchange of goods and services through the use of standards, certification and related services to meet national and international needs.

For further information on CSA services, write to Canadian Standards Association  
5060 Spectrum Way, Suite 100  
Mississauga, Ontario, L4W 5N6  
Canada



Cette Norme nationale du Canada est offerte en anglais et en français.

*Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users to judge its suitability for their particular purpose.*

®Registered trade-mark of Canadian Standards Association

**The Standards Council of Canada (SCC)** is the coordinating body of the National Standards System, a coalition of independent, autonomous organizations working towards the further development and improvement of voluntary standardization in the national interest.

The principal objects of the SCC are to foster and promote voluntary standardization as a means of advancing the national economy, benefiting the health, safety, and welfare of the public, assisting and protecting the consumer, facilitating domestic and international trade, and furthering international cooperation in the field of standards.

A National Standard of Canada (NSC) is a standard prepared or reviewed by an accredited Standards Development Organization (SDO) and approved by the SCC according to the requirements of CAN-P-2. Approval does not refer to the technical content of the standard; this remains the continuing responsibility of the SDO. An NSC reflects a consensus of a number of capable individuals whose collective interests provide, to the greatest practicable extent, a balance of representation of general interests, producers, regulators, users (including consumers), and others with relevant interests, where appropriate to the subject in hand. It normally is a standard which is capable of making a significant and timely contribution to the national interest.

Those who have a need to apply standards are encouraged to use NSCs. These standards are subject to periodic review. Users of NSCs are cautioned to obtain the latest edition from the SDO which publishes the standard.

The responsibility for approving standards as National Standards of Canada rests with the Standards Council of Canada  
270 Albert Street, Suite 200  
Ottawa, Ontario, K1P 6N7  
Canada



**Standards Council of Canada**  
**Conseil canadien des normes**

(National Standards of Canada text inserted August 2011)

Currently in preview, click buy full version

*National Standard of Canada*  
*(approved August 2011)*

**CAN/CSA-C411.5-10**  
***Dead-end/suspension composite insulators***  
***for overhead lines  $\leq 75$  kV***

*Prepared by*



**CANADIAN STANDARDS  
ASSOCIATION**

® Registered trade-mark of Canadian Standards Association

*Approved by*  
*Standards Council of Canada*



*Published in March 2010 by Canadian Standards Association*  
*A not-for-profit private sector organization*  
*5060 Spectrum Way, Suite 100, Mississauga, Ontario, Canada L4W 5N6*  
*1-800-463-6727 • 416-747-4044*

**Visit our Online Store at [www.ShopCSA.ca](http://www.ShopCSA.ca)**



The Canadian Standards Association (CSA) prints its publications on Rolland Enviro100, which contains 100% recycled post-consumer fibre, is EcoLogo and Processed Chlorine Free certified, and was manufactured using biogas energy.

To purchase CSA Standards and related publications, visit CSA's Online Store at [www.ShopCSA.ca](http://www.ShopCSA.ca) or call toll-free 1-800-463-6727 or 416-747-4044.

ISBN 978-0-55491-401-2

**Technical Editor:** Tania Donovanka

© Canadian Standards Association — 2010

All rights reserved. No part of this publication may be reproduced in any form whatsoever without the prior permission of the publisher.

(Copyright page replaced August 2011)

# ***CSA Standards Update Service***

***C411.5-10***

***March 2010***

**Title:** *Dead-end/suspension composite insulators for overhead lines  $\leq 75$  kV*

**Pagination:** **57 pages** (vii preliminary and 50 text), each dated **March 2010**

To register for e-mail notification about any updates to this publication

- go to **[www.ShopCSA.ca](http://www.ShopCSA.ca)**
- click on **E-mail Services** under **MY ACCOUNT**
- click on **CSA Standards Update Service**

The **List ID** that you will need to register for updates to this publication is **2420627**.

If you require assistance, please e-mail [techsupport@csa.ca](mailto:techsupport@csa.ca) or call 416-747-2233.

Visit CSA's policy on privacy at [www.csagroup.org/legal](http://www.csagroup.org/legal) to find out how we protect your personal information.



*CSA Standard*

*C411.5-10*

***Dead-end/suspension composite insulators  
for overhead lines  $\leq 75$  kV***



**CANADIAN STANDARDS  
ASSOCIATION**

®Registered trade-mark of Canadian Standards Association

*Published in March 2010 by Canadian Standards Association  
A not-for-profit private sector organization  
5060 Spectrum Way, Suite 100, Mississauga, Ontario, Canada L4W 5N6  
1-800-463-6727 • 416-747-4044*

***Visit our Online Store at [www.ShopCSA.ca](http://www.ShopCSA.ca)***



The Canadian Standards Association (CSA) prints its publications on Rolland Enviro100, which contains 100% recycled post-consumer fibre, is EcoLogo and Processed Chlorine Free certified, and was manufactured using biogas energy.

To purchase CSA Standards and related publications, visit CSA's Online Store at [www.ShopCSA.ca](http://www.ShopCSA.ca) or call toll-free 1-800-463-6727 or 416-747-4044.

ISBN 978-1-55491-401-2

**Technical Editor:** Tania Donovska

© Canadian Standards Association — 2010

All rights reserved. No part of this publication may be reproduced in any form whatsoever without the prior permission of the publisher.

# Contents

Technical Committee on Insulators v

Preface vii

## 1 Scope 1

## 2 Reference publications 1

## 3 Definitions 3

## 4 Dead-end/suspension composite insulator requirements 4

4.1 General 4

4.2 Design 4

## 5 Design tests 4

5.1 General 4

5.2 Water penetration test 4

5.2.1 Test specimens 4

5.2.2 Test procedure 4

5.2.3 Test evaluation 5

5.3 Accelerated weathering test 5

5.3.1 Test specimens 5

5.3.2 Test procedure 6

5.3.3 Test evaluation 6

5.4 Dye penetration test 6

5.4.1 Procedure 6

5.4.2 Acceptance criteria 6

5.5 Water diffusion test 6

5.5.1 General 6

5.5.2 Test specimens 6

5.5.3 Pre-stressing 6

5.5.4 Voltage test 7

5.5.5 Acceptance criteria 7

5.6 Power arc test 7

5.6.1 Test specimens 7

5.6.2 Test procedure 7

5.6.3 Test evaluation 7

5.7 Tracking and erosion test 7

5.7.1 Test specimens 7

5.7.2 Test transformer 8

5.7.3 Test procedure 8

5.7.4 Test evaluation 8

5.8 Tensile load test 8

5.9 Torsional load test 8

5.9.1 Test specimens 8

5.9.2 Test procedure 8

5.9.3 Test evaluation 8

5.10 Thermal mechanical test 9

5.10.1 Test specimens 9

5.10.2 Test procedure 9

5.10.3 Test evaluation 9

- 5.11 Flammability test 9
- 5.11.1 Procedure 9
- 5.11.2 Acceptance criteria 9

## 6 Type tests 9

- 6.1 General 9
- 6.2 Low-frequency wet flashover test 9
- 6.3 Positive critical impulse flashover test 10
- 6.4 Radio-influence voltage test 10

## 7 Sample tests 10

- 7.1 General 10
- 7.2 Lot and sample size 10
- 7.3 Dimensions, markings, and metal fittings 10
- 7.4 Cotter key operation for socket type end fittings 10
- 7.5 Tensile load test 10
- 7.6 Galvanizing test 10
- 7.7 End fitting seal test 10
- 7.8 Dye penetration test 10
- 7.9 Retest procedure 11

## 8 Routine tests 11

- 8.1 General 11
- 8.2 Tensile load test 11
- 8.3 Visual examination 11
- 8.4 Rejection criteria 11

## 9 Quality management system 11

## 10 Markings 11

## 11 Packaging 12

### Annexes

- A** (normative) — Tracking wheel no. 1 21
- B** (normative) — Tracking wheel no. 2 23
- C** (informative) — Type tests: Guidelines for selection of insulators 25
- D** (informative) — Example of *Design test report: Dead-end/ suspension composite insulator* 35
- E** (informative) — Example of *Type test report: Dead-end/suspension composite insulator* 44
- F** (informative) — Example of *Sample/routine test report* 49

---

### Tables

- 1** — Design requirements for dead-end/suspension composite insulators 13
- 2** — Dead-end/suspension composite insulator requirements 14

---

### Figures

- 1** — Dead-end/suspension composite insulator 15
- 2** — Samples for dye penetration test 16
- 3** — Example of boiling container for water diffusion test 17
- 4** — Electrodes for the voltage test 18
- 5** — Voltage test circuit 19
- 6** — Thermal test cycles 19
- 7** — Rotational misalignment set-up 20

# Technical Committee on Insulators

<b>G. Watt</b>	Hydro One Networks Inc., Toronto, Ontario	<i>Chair</i>
<b>R.A. Bernstorf</b>	Hubbell/The Ohio Brass Company, Wadsworth, Ohio, USA	
<b>S. Canuel</b>	Hydro-Québec Distribution, Montréal, Québec	<i>Associate</i>
<b>T. Carreira</b>	K-Line Insulators Limited, Toronto, Ontario	
<b>A. Cinicolo</b>	Canadian Electricity Association, Ottawa, Ontario	<i>Associate</i>
<b>E. Del Bello</b>	Seves Canada Inc., Saint-Laurent, Québec	
<b>K. Dostie</b>	BC Hydro, Burnaby, British Columbia	<i>Associate</i>
<b>J. Duxbury</b>	Surrey, British Columbia	
<b>E.P. Gnanndt</b>	T&D High Voltage Consulting Ltd., White Rock, British Columbia	
<b>R. Hill</b>	MacLean Power Systems, Bitely, Michigan, USA	
<b>H. Khalil</b>	British Columbia Transmission Corporation, Vancouver, British Columbia	
<b>J. Kuffel</b>	Kinectrics Inc., Toronto, Ontario	
<b>Z. Lodi</b>	Seves Canada Inc., San Francisco, California, USA	<i>Associate</i>
<b>S. Marra</b>	K-Line Insulators Limited, Toronto, Ontario	<i>Associate</i>
<b>R. Martin</b>	Brossard, Québec	
<b>H. Navis</b>	FortisAlberta, Airdrie, Alberta	
<b>C. Ng</b>	Manitoba Hydro, Winnipeg, Manitoba	
<b>C. Pelkey</b>	NB Power Transmission Corporation, Fredericton, New Brunswick	
<b>A.E. Schwalm</b>	Victor Insulators Inc., Victor, New York, USA	

<b>R. Tanii</b>	NGK Insulators of Canada Limited, Mississauga, Ontario	
<b>V.L. Vo Van</b>	Hydro-Québec TransÉnergie, Montréal, Québec	
<b>E.H. Wiebe</b>	Manitoba Hydro, Winnipeg, Manitoba	
<b>T. Donovska</b>	Canadian Standards Association, Mississauga, Ontario	<i>Project Manager</i>

*The Technical Committee wishes to acknowledge the role played by R. Martin as Chair of the Technical Committee during the development of this Standard.*

# Preface

This is the first edition of CSA C411.5, *Dead-end/suspension composite insulators for overhead lines  $\leq 75$  kV*.

This Standard is based on the requirements of Canadian Electricity Association (CEA) LWIWG-01 (96), *Dead-End/Suspension Composite Insulator for Overhead Distribution Lines* (used with permission from CEA).

CSA C411.5 covers the requirements for dead-end/suspension composite insulators used on overhead distribution lines. Its main objective is to define terms, prescribe test methods, and specify acceptance or failure criteria. [Clauses 4 to 8](#) specify the material, product qualification, construction, and test requirements applicable to these insulators. Annexes D, E, and F provide examples of design, type, and sample/routine test reports.

The co-operation of CEA and the contribution of its members are gratefully acknowledged. Funding in support of the preparation of this Standard was provided by CEA.

This Standard was prepared by the Technical Committee on Insulators, under the jurisdiction of the Strategic Steering Committee on Power Engineering and Electromagnetic Compatibility, and has been formally approved by the Technical Committee. It will be submitted to the Standards Council of Canada for approval as a National Standard of Canada.

March 2010

## Notes:

- (1) Use of the singular does not exclude the plural (and vice versa) when the sense allows.
- (2) Although the intended primary application of this Standard is stated in its Scope, it is important to note that it remains the responsibility of the users of the Standard to judge its suitability for their particular purpose.
- (3) This publication was developed by consensus, which is defined by CSA Policy governing standardization — Code of good practice for standardization as “substantial agreement. Consensus implies much more than a simple majority, but not necessarily unanimity”. It is consistent with this definition that a member may be included in the Technical Committee list and yet not be in full agreement with all clauses of this publication.
- (4) CSA Standards are subject to periodic review, and suggestions for their improvement will be referred to the appropriate committee.
- (5) All enquiries regarding this Standard, including requests for interpretation, should be addressed to Canadian Standards Association, 5060 Spectrum Way, Suite 100, Mississauga, Ontario, Canada L4W 5N6.
  - Requests for interpretation should
    - (a) define the problem, making reference to the specific clause, and, where appropriate, include an illustrative sketch;
    - (b) provide an explanation of circumstances surrounding the actual field condition; and
    - (c) be phrased where possible to permit a specific “yes” or “no” answer.

Committee interpretations are processed in accordance with the CSA Directives and guidelines governing standardization and are published in CSA's periodical Info Update, which is available on the CSA Web site at [www.csa.ca](http://www.csa.ca).