

# Test methods for electrical wires and cables



# Legal Notice for Standards

Canadian Standards Association (operating as “CSA Group”) develops standards 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 Group 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 Group does not warrant the accuracy, completeness, or currency of any of the information published in this document. CSA Group makes no representations or warranties regarding this document’s compliance with any applicable statute, rule, or regulation.

IN NO EVENT SHALL CSA GROUP, 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 GROUP HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES, INJURY, LOSS, COSTS, OR EXPENSES.

In publishing and making this document available, CSA Group 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 Group accepts no responsibility whatsoever arising in any way from any and all use of or reliance on the information contained in this document.

CSA Group is a private not-for-profit company that publishes voluntary standards and related documents. CSA Group 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 Group and the users of this document (whether it be in printed or electronic form), CSA Group 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 Group’s and/or others’ intellectual property and may give rise to a right in CSA Group and/or others to seek legal redress for such use, modification, copying, or disclosure. To the extent permitted by treaty or by law, CSA Group 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 Group 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 Group 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 form.

Limited copies of this document in print or paper form may be distributed only to persons who are authorized by CSA Group 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 Group; 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.



# ***Revision History***

## **C22.2 No. 0.3-09, Test methods for electrical wires and cables**

<b>National Standard of Canada — May 2019</b>
Outside front cover, National Standard of Canada text, and title page.
This Standard has been developed in compliance with Standards Council of Canada requirements for National Standards of Canada. It has been published as a National Standard of Canada by CSA Group.

Currently in preview, click buy full version

# **Update No. 1**

## **C22.2 No. 0.3-09**

### **February 2010**

**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:** *Test methods for electrical wires and cables* — originally published September 2009

The following revisions have been formally approved and are marked by the symbol delta ( $\Delta$ ) in the margin on the attached replacement pages:

<b>Revised</b>	Table of Contents and Clause 2
<b>New</b>	Clause 5.10.6
<b>Deleted</b>	None

CSA C22.2 No. 0.3-09 originally consisted of **43 pages** (viii preliminary and 35 text), each dated **September 2009**. It now consists of the following pages:

<b>September 2009</b>	v–viii, 3–16, and 19–35
<b>February 2010</b>	iii, iv, 1–2A, 17, and 18

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

# Contents

Technical Committee on Wiring Products vi

Subcommittee on Test Methods for Wires and Cables vii

Preface viii

## 1 Scope 1

- 1.1 General 1
- 1.2 Acceptance requirements 1
- 1.3 Terminology 1

## 2 Reference publications 1

## 3 Definitions 2

## 4 General requirements 2

- 4.1 General 2
- 4.2 Deviation from procedures 2

## Δ 5 Test methods and calculations 2A

- Δ 5.1 Uninsulated conductors 2A
  - Δ 5.1.1 General 2A
  - 5.1.2 Resistance 3
  - 5.1.3 Physical properties 3
  - 5.1.4 Continuity of metal coating on copper conductor 3
  - 5.1.5 Adherence of metallic coating 4
  - 5.2 Thickness of insulation, jackets, and similar coverings 5
    - 5.2.1 Extruded insulation 5
    - 5.2.2 Taped insulation 5
    - 5.2.3 Mineral insulation — Minimum thickness 5
    - 5.2.4 Thermoplastic lacquered cotton braid or thermoplastic lacquered glass braid insulation 6
    - 5.2.5 Tubing — Minimum internal diameter 6
    - 5.2.6 Jackets and similar coverings 6
  - 5.3 Mechanical properties of extruded insulation, jackets, and similar coverings 6
    - 5.3.1 Tensile properties 6
    - 5.3.2 Accelerated aging 6
    - 5.3.3 Exposure to liquids 6
    - 5.3.4 Recovery 6
    - 5.3.5 Deformation of insulation and jackets 7
    - 5.3.6 Tensile strength 7
    - 5.3.7 Shrinkage 8
  - 5.4 Metallic sheaths — Thickness 8
  - 5.5 Nonmetallic tapes, braids, and servings as coverings 8
    - 5.5.1 Thickness 8
    - 5.5.2 Braid and serving characteristics 9
  - 5.6 Metal tape coverings 9
  - 5.7 Braided shields 9
  - 5.8 Dimensions over cables and components of cables 9
    - 5.8.1 General 9
    - 5.8.2 Overall diameter over sheathed cords 9
  - 5.9 Environmental tests 9
    - 5.9.1 Environmental stress cracking of polyethylene 9

February 2010

(Replaces p. iii, September 2009)

- 5.9.2 Ozone resistance 13
- 5.9.3 Weather resistance 16
- 5.10 Flame tests 17
  - 5.10.1 Vertical flame test/FT1 17
  - 5.10.2 Horizontal flame test/FT2 17
  - 5.10.3 Burning particles (dropping) test 17
  - 5.10.4 Vertical flame test — Cables in cable trays/FT4 17
  - 5.10.5 Flame test for portable cables/FT5 17
  - Δ 5.10.6 Horizontal flame and smoke test/FT6 18
- 5.11 Flexibility at any specified temperature 18
- 5.12 Abnormal low temperature — Impact 18
- 5.13 Cutting 18
  - 5.13.1 Apparatus 18
  - 5.13.2 Preparation for test 18
  - 5.13.3 Test 18
  - 5.13.4 Average force 18
- 5.14 Strength and elongation of cable in tension 19
  - 5.14.1 Apparatus 19
  - 5.14.2 Specimen preparation 19
  - 5.14.3 Procedure 19
  - 5.14.4 Examination 19
- 5.15 Tightness of armour 19
  - 5.15.1 Apparatus 19
  - 5.15.2 Specimen preparation 19
  - 5.15.3 Procedure 20
  - 5.15.4 Examination 20
- 5.16 Flexibility of armoured cable and metal-sheathed cable 20
  - 5.16.1 Method No. 1 (armoured cable) 20
  - 5.16.2 Method No. 2 (metal-sheathed cable) 20
- 5.17 Armoured cable bushing insertion 20
  - 5.17.1 Procedure 20
  - 5.17.2 Examination 20
- 5.18 Internal condition of armour 21
- 5.19 Copper sulphate test for zinc coating on steel strip and interlocking cable armour (Preece test) 21
  - 5.19.1 Apparatus 21
  - 5.19.2 Standard solution and wash water 21
  - 5.19.3 Specimen preparation 21
  - 5.19.4 Procedure 22
  - 5.19.5 Examination 22
- 5.20 Heat resistance — Mandrel test 22
  - 5.20.1 Method No. 1 22
  - 5.20.2 Method No. 2 — procedure 23
- 5.21 Baking test for insulating varnish 23
  - 5.21.1 Specimen preparation and baking 23
  - 5.21.2 Bending 23
- 5.22 Swelling and blistering 23
- 5.23 Electrical tests 23
  - 5.23.1 Dielectric strength 23
  - 5.23.2 Insulation resistance (IR) 25
  - 5.23.3 Spark test 26
  - 5.23.4 Permittivity (formerly SIC) 26
  - 5.23.5 Surface leakage resistivity — Method No. 1 26
  - 5.23.6 Surface leakage resistivity — Method No. 2 26
  - 5.23.7 Overload — Method No. 3 27

# C22.2 No. 0.3-09

## ***Test methods for electrical wires and cables***

### **1 Scope**

#### **1.1 General**

This Standard describes the apparatus, test methods, and formulas to be used in carrying out the tests and calculations required by CSA electrical wire and cable Standards.

#### **1.2 Acceptance requirements**

The acceptance requirements expected to be fulfilled through the testing of any particular type of wire or cable are contained in the Standard relating to that type and do not constitute a part of this Standard.

#### **1.3 Terminology**

In CSA Standards, “shall” is used to express a requirement, i.e., a provision that the user is obliged to satisfy in order to comply with the standard; “should” is used to express a recommendation or that which is advised but not required; and “may” is used to express an option or that which is permissible within the limits of the standard. Notes accompanying clauses do not include requirements or alternative requirements; the purpose of a note accompanying a clause is to separate from the text explanatory or informative material. Notes to tables and figures are considered part of the table or figure and may be written as requirements. Annexes are designated normative (mandatory) or informative (non-mandatory) to define their application.

### **2 Reference publications**

This Standard refers to the following publications, and where such reference is made, it shall be to the edition listed below, including all amendments published thereto.

#### **CSA (Canadian Standards Association)**

C22.1-09

*Canadian Electrical Code, Part I*

CAN/CSA-C22.2 No. 0 (under development)

*General Requirements — Canadian Electrical Code, Part II*

CAN/CSA-C22.2 No. 2556-07

*Wire and cable test methods*

#### **ASTM International (American Society for Testing and Materials)**

D 193-08

*Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics*

D 2863-09

*Standard Test Method for Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)*