



**CSA C865.1:23**  
National Standard of Canada



# Light-emitting diode drivers — Methods of measurement



# 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.



# ***Standards Update Service***

***CSA C865.1:23***

***June 2023***

**Title:** *Light-emitting diode drivers — Methods of measurement*

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

- go to [www.csagroup.org/store/](http://www.csagroup.org/store/)
- click on **Product Updates**

The **List ID** that you will need to register for updates to this publication is **2730755**.

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

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

**Canadian Standards Association (operating as “CSA Group”)**, 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 Group 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.

More than 10 000 members indicate their support for CSA Group’s standards development by volunteering their time and skills to Committee work.

CSA Group 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, CSA Group regularly and continually audits and inspects products that bear the CSA Group Mark.

In addition to its head office and laboratory complex in Toronto, CSA Group has regional branch offices in major centres across Canada and inspection and testing agencies in fourteen countries. Since 1919, CSA Group has developed the necessary expertise to meet its corporate mission: CSA Group 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 Group services, write to  
CSA Group  
178 Rexdale Boulevard  
Toronto, Ontario, M9W 1R3  
Canada

A National Standard of Canada is a standard developed by a Standards Council of Canada (SCC) accredited Standards Development Organization, in compliance with requirements and guidance set out by SCC. More information on National Standards of Canada can be found at [www.scc.ca](http://www.scc.ca).

SCC is a Crown corporation within the portfolio of Innovation, Science and Economic Development (ISED) Canada. With the goal of enhancing Canada’s economic competitiveness and social wellbeing, SCC leads and facilitates the development and use of national and international standards. SCC also coordinates Canadian participation in standards development, and identifies strategies to advance Canadian standardization efforts.

Accreditation services are provided by SCC to various customers, including product certifiers, testing laboratories, and standards development organizations. A list of SCC programs and accredited bodies is publicly available at [www.scc.ca](http://www.scc.ca).

Standards Council of Canada  
600-55 Metcalfe Street  
Ottawa, Ontario, K1P 6L5  
Canada



Cette Norme Nationale du Canada n’est disponible qu’en anglais.

*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.*

*®A trademark of the Canadian Standards Association, operating as “CSA Group”*

# ***CSA Technical Committee on Performance of Lighting Equipment***

<b>C. Suvagau</b>	BC Hydro, Vancouver, British Columbia, Canada <i>Category: User Interest/Regulatory Authority</i>	<i>Chair</i>
<b>A. Silbiger</b>	Andrew Silbiger Management Inc., Thornhill, Ontario, Canada <i>Category: General Interest</i>	<i>Vice-Chair</i>
<b>M. J. Barry</b>	MJB Technologies, Caledon East, Ontario, Canada	<i>Non-voting</i>
<b>G. Benjamin</b>	ABB Électrification Canada SRI, Dorval, Québec, Canada <i>Category: Producer Interest</i>	
<b>D. Charest</b>	Natural Resources Canada, Ottawa, Ontario, Canada	<i>Non-voting</i>
<b>G. Chopra</b>	Electro-Federation Canada, Toronto, Ontario, Canada	<i>Non-voting</i>
<b>M. T. Cole</b>	Hubbell Canada Inc., Pickering, Ontario, Canada <i>Category: Producer Interest</i>	
<b>S. Constant</b>	Hydro-Québec, Montréal, Québec, Canada <i>Category: User Interest/Regulatory Authority</i>	
<b>M. E. Duffy</b>	Shaker Heights, Ohio, USA	<i>Non-voting</i>
<b>P. Gallant</b>	Natural Resources Canada, Ottawa, Ontario, Canada <i>Category: User Interest/Regulatory Authority</i>	
<b>L. Horvath</b>	Quantum Lighting Inc., Coquitlam, British Columbia, Canada	<i>Non-voting</i>
<b>H. Khakmardani</b>	Winnipeg, Manitoba, Canada	<i>Non-voting</i>

<b>S. Krsikapa</b>	Ontario Ministry of Energy, Toronto, Ontario, Canada <i>Category: User Interest/Regulatory Authority</i>	
<b>K. Lam</b>	Independent Electricity System Operator (IESO), Toronto, Ontario, Canada	<i>Non-voting</i>
<b>D. Lenasi</b>	Signify Canada Ltd., Langley, British Columbia, Canada	<i>Non-voting</i>
<b>J. Li</b>	Ontario Ministry of Energy, Toronto, Ontario, Canada	<i>Non-voting</i>
<b>R. Martin</b>	Ledvance LLC, Versailles, Kentucky, USA	<i>Non-voting</i>
<b>T. McGowan</b>	American Lighting Association, Oberlin, Ohio, USA <i>Category: Producer Interest</i>	
<b>E. Mendoza</b>	Signify, Rosemont, Illinois, USA <i>Category: Producer Interest</i>	
<b>J. Parisella</b>	Acuity Brands, Wilmington, Massachusetts, USA	<i>Non-voting</i>
<b>J. Rintamaki</b>	GE Lighting a Savant company, East Cleveland, Ohio, USA <i>Category: Producer Interest</i>	
<b>R. J. Singlehurst</b>	Natural Resources Canada, Ottawa, Ontario, Canada	<i>Non-voting</i>
<b>W. A. Smelser</b>	Laurilliam Lighting Technologies Inc., Niagara-on-the-Lake, Ontario, Canada <i>Category: General Interest</i>	
<b>M. K. Timmings</b>	Binbrook, Ontario, Canada <i>Category: General Interest</i>	
<b>V. Venkataramanan</b>	McRae Imaging, Mississauga, Ontario, Canada	<i>Non-voting</i>

**E. Witkowski**

QSS Inc.,  
Calgary, Alberta, Canada  
*Category: User Interest/Regulatory Authority*

**H. L. Wolfman**

Lumispec Consulting,  
Northbrook, Illinois, USA  
*Category: General Interest*

**B. Korucu**

CSA Group,  
Toronto, Ontario, Canada

*Project Manager*

Currently in preview, click buy full version

# ***CSA Subcommittee on Methods of Performance Measurement of LED Drivers***

<b>E. Mendoza</b>	Signify, Rosemont, Illinois, USA	<i>Chair</i>
<b>C. Suvagau</b>	BC Hydro, Vancouver, British Columbia, Canada	<i>Vice-Chair</i>
<b>H. L. Wolfman</b>	Lumispec Consulting, Northbrook, Illinois, USA	<i>Vice-Chair</i>
<b>C. Blackburn</b>	Cooper Lighting Solutions, Peachtree City, Georgia, USA	
<b>G. Chopra</b>	Electro-Federation Canada, Toronto, Ontario, Canada	
<b>P. Gallant</b>	Natural Resources Canada, Ottawa, Ontario, Canada	
<b>L. Horvath</b>	Quantum Lighting Inc., Coquitlam, British Columbia, Canada	
<b>J. Iverson</b>	Liteline Corporation, Richmond Hill, Ontario, Canada	
<b>H. Khakmardani</b>	Winnipeg, Manitoba, Canada	
<b>T. McGowan</b>	American Lighting Association, Oberlin, Ohio, USA	
<b>J. Parisella</b>	Acuity Brands, Wilmington, Massachusetts, USA	
<b>J. Pantanaki</b>	GE Lighting, a Savant company, East Cleveland, Ohio, USA	

**M. K. Timmings**

Binbrook, Ontario, Canada

**B. Korucu**

CSA Group,  
Toronto, Ontario, Canada

*Project Manager*

Currently in preview, click buy full version

*National Standard of Canada*

*CSA C865.1:23*

***Light-emitting diode drivers —  
Methods of measurement***



*®A trademark of the Canadian Standards Association,  
operating as "CSA Group"*



ICS 29.140.99, 31.260

# *Light-emitting diode drivers — Methods of measurement*

JUNE 30, 2023



**CSA Group**  
**CSA C865.1:23**  
First Edition



**National Electrical Manufacturers  
Association**  
**ANSI C82.16-2023**  
First Edition



**ANSI C82.16-2023**

### **Commitment for Amendments**

This standard is issued jointly by the Canadian Standards Association (operating as “CSA Group”) and the National Electrical Manufacturers Association (NEMA). Comments or proposals for revisions on any part of the standard may be submitted to CSA Group or NEMA at anytime. Revisions to this standard will be made only after processing according to the standards development procedures of CSA Group and NEMA. CSA Group and NEMA will issue revisions to this standard by means of a new edition or revised or additional pages bearing their date of issue.

---

### **ISBN 978-1-4883-4800-6 © 2023 Canadian Standards Association**

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

This Standard is subject to review within five years from the date of publication, and suggestions for its improvement will be referred to the appropriate committee. To submit a proposal for change, please send the following information to [inquiries@csagroup.org](mailto:inquiries@csagroup.org) and include “Proposal for change” in the subject line: Standard designation (number); relevant clause, table, and/or figure number; wording of the proposed change; and rationale for the change.

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

---

### **© 2023 National Electrical Manufacturers Association**

All rights, including translation into other languages, reserved under the Universal Copyright Convention, the Berne Convention for the Protection of Literary and Artistic Works, and the International and Pan American copyright conventions.

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

---

## **NOTICE AND DISCLAIMER (NEMA)**

The information in this publication was considered technically sound by the consensus of persons engaged in the development and approval of the document at the time it was developed. Consensus does not necessarily mean that there is unanimous agreement among every person participating in the development of this document.

American National Standards Institute (ANSI) standards and guideline publications, of which the document contained herein is one, are developed through a voluntary consensus standards development process. This process brings together volunteers and/or seeks out the views of persons who have an interest in the topic covered by this publication. While NEMA administers the process and establishes rules to promote fairness in the development of consensus, it does not write the document and it does not independently test, evaluate, or verify the accuracy or completeness of any information or the soundness of any judgments contained in its standards and guideline publications.

NEMA disclaims liability for any personal injury, property, or other damages of any nature whatsoever, whether special, indirect, consequential, or compensatory, directly or indirectly resulting from the publication, use of, application, or reliance on this document. NEMA disclaims and makes no guaranty or warranty, express or implied, as to the accuracy or completeness of any information published herein, and disclaims and makes no warranty that the information in this document will fulfill any of your particular purposes or needs. NEMA does not undertake to guarantee the performance of any individual manufacturer or seller's products or services by virtue of this standard or guide.

In publishing and making this document available, NEMA is not undertaking to render professional or other services for or on behalf of any person or entity, nor is NEMA undertaking to perform any duty owed by any person or entity to someone else. Anyone using this document should rely on his or her own independent judgment or, as appropriate, seek the advice of a competent professional in determining the exercise of reasonable care in any given circumstances. Information and other standards on the topic covered by this publication may be available from other sources, which the user may wish to consult for additional views or information not covered by this publication.

NEMA has no power, nor does it undertake to police or enforce compliance with the contents of this document. NEMA does not certify, test, or inspect products, designs, or installations for safety or health purposes. Any certification or other statement of compliance with any health or safety-related information in this document shall not be attributable to NEMA and is solely the responsibility of the certifier or maker of the statement.

**CONTENTS**

- 1 General ..... 1**
  - 1.1 Purpose ..... 1
  - 1.2 Scope..... 1
- 2 References ..... 1**
  - 2.1 Normative References..... 1
  - 2.2 Informative References ..... 2
- 3 Definitions ..... 2**
  - 3.1 Direct Current (DC) Ripple Factor ..... 2
  - 3.2 LED Driver Operation Points Definitions ..... 2
  - 3.3 LED Load..... 3
  - 3.4 PWM LED Driver ..... 3
  - 3.5 Run-Up Time ( $t_{Ru}$ )..... 4
  - 3.6 Fade Time ( $t_f$ ) ..... 5
  - 3.7 Start Time ..... 6
  - 3.8 Stable..... 6
- 4 General ..... 6**
  - 4.1 General Characteristics ..... 6
  - 4.2 Power Supply Electrical Characteristics ..... 7
  - 4.3 Pertinent Measurements ..... 8
  - 4.4 Instruments ..... 8
- 5 LED Driver Electrical Parameters Test Conditions ..... 10**
- 6 LED Driver Input Voltage ..... 10**
- 7 LED Driver Input Current ..... 11**
- 8 LED Driver Input Power ..... 11**
- 9 LED Driver Input Power Factor ..... 12**
- 10 LED Driver Input Current Total Harmonic Distortion (THD)..... 13**
- 11 Inrush Current..... 13**
  - 11.1 Indirect Verification ..... 13
  - 11.2 Inrush Current Model Basics ..... 13
  - 11.3 Inrush Current Model Calibration..... 14
  - 11.4 Simulation Execution ..... 15
  - 11.5 Direct Testing Measurement ..... 16
- 12 LED Driver Output Electrical Parameters Test Conditions ..... 17**
  - 12.1 Constant Voltage LED Driver Output Electrical Parameters ..... 17
  - 12.2 Constant Current LED Driver Output Electrical Parameters ..... 22
- 13 Start Time, Run-Up Time, and Fade Time ..... 28**
  - 13.1 Start Time ..... 28
  - 13.2 Run-Up Time or Fade Time..... 29
- 14 Transient Protection..... 29**
- 15 Standby Power Methods of Measurement ..... 29**
  - 15.1 Instrumentation ..... 30
  - 15.2 Test Method Selection..... 30
  - 15.3 Sample Preparation ..... 30
  - 15.4 Reporting ..... 31
  - 15.5 Standby Power Method of Measurement — Direct Power Method..... 31
  - 15.6 Standby Power Method of Measurement — Averaging Methods ..... 31
  - 15.7 Standby Power Method of Measurement — Sampling Method ..... 32
- 16 0 to 10 VDC Dimming Interface Test Methods..... 32**
  - 16.1 0 to 10 V Equipment ..... 32
  - 16.2 0 to 10 V Setup and Measurement Procedure Building Blocks ..... 33

16.3	0 to 10 V Setup Procedures .....	38
16.4	0 to 10 V Measurement Procedures.....	39
16.5	LED Driver Hysteresis Test Procedure .....	39
<b>17</b>	<b>PWM Test Methods.....</b>	<b>40</b>
17.1	PWM Output Parameters .....	41
<b>18</b>	<b>Uncertainty Calculation .....</b>	<b>42</b>
<b>Annex A (normative) — Deviations for the Canadian Marketplace.....</b>		<b>43</b>

## Figures

Figure 1	LED Driver Voltage Versus LED Driver Current Operational Range .....	2
Figure 2	LED Driver Current Versus LED Driver Voltage Operational Range .....	3
Figure 3a	LED Loads.....	3
Figure 3b	PWM LED Driver Schematic and Example of Modulated Output .....	4
Figure 4a	Run-Up Time .....	5
Figure 4b	Fade Time .....	5
Figure 5	Start Time.....	6
Figure 6	Input Power, Input Current, Power Factor, and THD Test Setup.....	11
Figure 7	Computer-Assisted Inrush Current Test Model.....	14
Figure 8	Computer-Assisted Inrush Current Test Model.....	16
Figure 9	LED Driver Output Voltage, Current, and Power .....	17
Figure 10	Voltage and Current Ripple Test Setup .....	18
Figure 11	Periodic Waveform Observation Window.....	19
Figure 12	Non-Periodic Observation Window .....	20
Figure 13	LED Driver Temperature Test .....	22
Figure 14	LED Driver Operating Envelope.....	25
Figure 15	Start Time, Run-Up Time, and Fade Time .....	28
Figure 16	Schematic of Equipment Layout .....	32
Figure 17	Setup and Measurement Procedure Building Blocks.....	34
Figure 18	Basic Function Testing Procedure to Determine the Driver Dimming Interface Sourcing Capability, Its Maximum Output Voltage, and Current Range .....	34
Figure 19	LED Driver 0 to 10 Dimming Interface Testing for Sustaining Reverse Polarity.....	35
Figure 20	LED Driver Dimming Interface Testing to Determine the Maximum Output Power and Verify Whether the Maximum Output Power Is Reached When Applying the V_Control Hi Value to the Dimming Interface Port.....	35
Figure 21	LED Driver Dimming Interface Testing to Determine the Minimum Output Power and Verify Whether the Minimum Output Power Is Reached When Applying the V_Control Lo Value to the Dimming Interface Port.....	36
Figure 22	Procedure for Testing Dimming Curve.....	36
Figure 23	Procedure for Testing Dimming Curve and Dimming Response .....	37
Figure 24	Procedure Testing Related to Standby Mode .....	37
Figure 25	Procedure for Tests Related to Transitions to and from Standby Mode.....	38
Figure 26	PWM Test Setup .....	41

## Tables

Table 1	Source Impedance .....	7
Table 2	Instrumentation.....	9
Table 3	Power Analyzer Characteristics for PWM Measurements .....	9
Table 4	Driver Output Power and Efficiency Calculations Example.....	27

## Equations

Equation 1.....	10
Equation 2.....	11
Equation 3.....	12
Equation 4a.....	12

Equation 4b..... 12  
Equation 4c..... 13  
Equation 4d..... 13  
Equation 5..... 18  
Equation 6..... 20  
Equation 7..... 21  
Equation 8..... 22  
Equation 9..... 23  
Equation 10..... 28  
Equation 11..... 31

## ***C82 Preface***

This foreword is not part of ANSI C82.16-2023.

This is a revision of ANSI C82.16-2022.

Suggestions for improvement on this standard will be welcome. They should be sent to the following address:

Secretary of C82  
National Electrical Manufacturers Association  
1300 North 17<sup>th</sup> Street, Suite 900  
Rosslyn, VA 22209

This standard was developed and approved for submittal to ANSI by the C82 Committee. Approval of this standard is not meant to imply that all committee members voted to approve it.

Note: The user's attention is called to the possibility that compliance with this standard could require use of an invention covered by patent rights.

By publication of this standard, no position is taken with respect to the validity of any such claim(s) or of any patent rights in connection therewith. If a patent holder has filed a statement of willingness to grant a license under these rights on reasonable and non-discriminatory terms and conditions to applicants desiring to obtain such a license, then details may be obtained from the Secretary.

# CSA Preface

This is the first edition of CSA C865.1, *Light-emitting diode drivers — Methods of measurement*.

CSA Group acknowledges that the development of this Standard was made possible, in part, by the financial support of BC Hydro, Fortis BC Electric, Nova Scotia Department of Energy, Efficiency Manitoba, Independent Electricity System Operator, and Efficiency Nova Scotia.

This Standard is considered suitable for use for conformity assessment within the stated scope of the Standard.

This Standard was reviewed by the CSA Subcommittee on Methods of Performance Measurement of LED Drivers, under the jurisdiction of the CSA Technical Committee on Performance of Lighting Equipment and the CSA Strategic Steering Committee on Performance, Energy Efficiency, and Renewables, and has been formally approved by the CSA Technical Committee.

This Standard has been developed in compliance with the Standards Council of Canada requirements for National Standards of Canada. It has been published as a National Standard of Canada by CSA Group.

**Interpretations:** The Strategic Steering Committee on Performance, Energy Efficiency, and Renewables has provided the following direction for the interpretation of standards under its jurisdiction: “The literal text shall be used in judging compliance of products with the safety requirements of this Standard. When the literal text cannot be applied to the product, such as for new materials or construction, and when a relevant CSA committee interpretation has not already been published, CSA Group’s procedures for interpretation shall be followed to determine the intended safety principle.”

## 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 Standard 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 Standard.*
- 4) *To submit a request for interpretation of this Standard, please send the following information to [inquiries@csagroup.org](mailto:inquiries@csagroup.org) and include “Request for interpretation” in the subject line:*
  - 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. *where possible, phrase the request in such a way that a specific “yes” or “no” answer will address the issue.*

*Committee interpretations are processed in accordance with the CSA Directives and guidelines governing standardization and are available on the Current Standards Activities page at [standardsactivities.csagroup.org](http://standardsactivities.csagroup.org).*
- 5) *This Standard is subject to review within five years from the date of publication. Suggestions for its improvement will be referred to the appropriate committee. To submit a proposal for change, please send the following information to [inquiries@csagroup.org](mailto:inquiries@csagroup.org) and include “Proposal for change” in the subject line:*
  - a. *Standard designation (number);*
  - b. *relevant clause, table, and/or figure number;*
  - c. *wording of the proposed change; and*
  - d. *rationale for the change.*