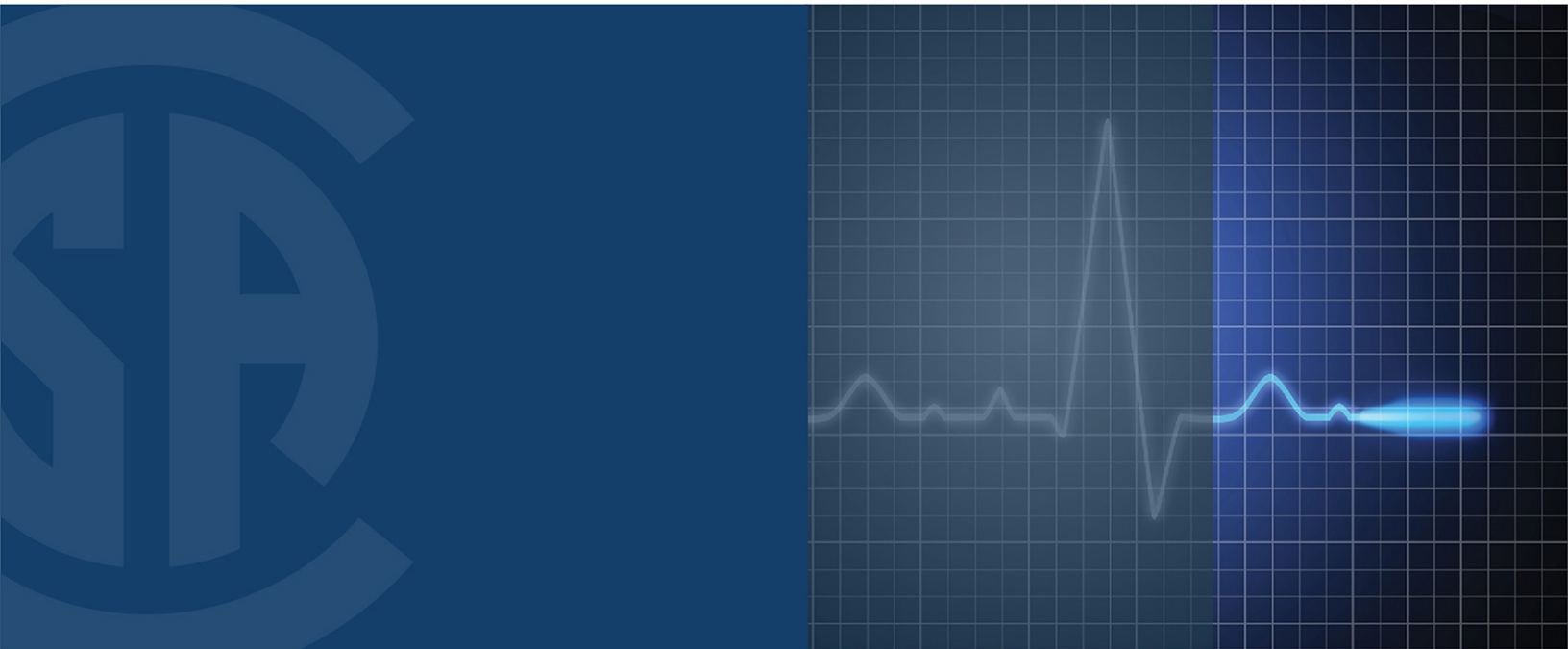




**CSA Z32:21**  
National Standard of Canada



# Electrical safety and essential electrical systems in health care facilities



scc  ccn

# 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 licence 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 format.

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***

## **CSA Z32:21, Electrical safety and essential electrical systems in health care facilities**

<b>Errata — January 2022</b>	<b>Revision symbol (in margin)</b>
Technical Committee on Application of Electricity in Health Care, and Subcommittee on Electrical Safety and Essential Electrical Systems in Health Care Facilities	Δ

<b>Administrative update — September 2021</b>
National Standard of Canada page: French version now available

# *Standards Update Service*

*CSA Z32:21*

*May 2021*

**Title:** *Electrical safety and essential electrical systems in health care facilities*

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 **2429069**.

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 well-being, 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 est disponible en versions française et anglaise.

*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”*

*National Standard of Canada*

*CSA Z32:21*

***Electrical safety and essential  
electrical systems in health care  
facilities***



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



*Published in May 2021 by CSA Group  
A not-for-profit private sector organization  
178 Rexdale Boulevard, Toronto, Ontario, Canada M9W 1R3*

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

*ICS 11.020; 11.040  
ISBN 978-1-4883-3607-2*

*© 2021 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.*

# Contents

Technical Committee on Application of Electricity in Health Care	4
Subcommittee on Electrical Safety and Essential Electrical Systems in Health Care Facilities	6
Preface	8
<b>1 Scope</b>	<b>9</b>
1.1 General	9
1.1.1 Application	9
1.1.2 Exclusions	9
1.1.3 Relationship to the <i>Canadian Electrical Code</i>	9
1.2 Electrical safety	9
1.2.1 Areas	9
1.2.2 Electrical equipment	9
1.2.3 Aspects of electrical safety	10
1.2.4 Medical risks or benefits	10
1.3 Building electrical installations	10
1.4 Essential electrical systems	10
1.5 Terminology	10
<b>2 Reference publications</b>	<b>11</b>
<b>3 Definitions</b>	<b>13</b>
<b>4 Electrical safety</b>	<b>18</b>
4.1 Safety philosophy	18
4.1.1 Underlying principle	18
4.1.2 Risks in patient procedures	19
4.1.3 Risks of medical devices	19
4.1.4 Risk management program	19
4.1.5 Procedure classification	19
4.1.6 Equipment and area classification	19
4.1.7 Management of safety factors	19
4.2 Electrical safety program	19
4.2.1 General	19
4.2.2 Responsibilities	20
4.2.3 Qualified personnel	20
4.2.4 Basic elements	20
4.2.5 Education	20
4.2.6 Patient care area classification	20
4.3 Electrical equipment control and use	21
4.3.1 General	21
4.3.2 Medical electrical equipment	22
4.3.3 Safety requirements for medical electrical systems	22
4.3.4 Non-medical electrical equipment used in patient care areas	23
4.3.5 Patient-owned electrical devices	23

4.3.6	Specific equipment	24
4.3.7	Electromagnetic interference and electromagnetic compatibility	25
4.3.8	Line-borne electrical interference	27
4.4	Inspection, testing, acquisition, and maintenance of electrical equipment	27
4.4.1	General	27
4.4.2	Maintenance	27
4.4.3	Action criteria and maintenance log	27
4.4.4	Notification	27
4.4.5	Training	28
4.4.6	Documented process for equipment acquisition	28
4.4.7	Acceptance tests	28
4.5	Maintenance of medical and non-medical electrical equipment	28
4.5.1	General	28
4.5.2	Verification criteria	28
4.5.3	Inspection and maintenance criteria	28
<b>5</b>	<b>Building electrical system</b>	<b>29</b>
5.1	General	29
5.2	Inspection and testing	29
5.2.1	Application	29
5.2.2	Measurement circuits	29
5.2.3	Testing equipment used for recorded values	29
5.2.4	Design and review	30
5.2.5	Conditions for inspection and testing	30
5.2.6	Fault or substandard condition	30
5.3	Conductor insulation integrity test	30
5.3.1	General	30
5.3.2	Insulation resistance	30
5.3.3	Measurement	30
5.4	Circuits in patient care areas	31
5.4.1	General	31
5.4.2	Voltage and voltage drop requirements for solidly grounded systems	31
5.4.3	Voltage and voltage drop test for solidly grounded systems	31
5.5	Branch circuit breakers — Mechanical operation test	32
5.6	Receptacles	32
5.6.1	General requirements	32
5.6.2	Connection	33
5.6.3	Isolated ground receptacles	33
5.6.4	Computerized equipment	33
5.6.5	Receptacle identification	33
5.6.6	Testing	34
5.7	Panelboards	34
5.7.1	General	34
5.7.2	Location	34
5.7.3	Identification	35
5.7.4	Load directory	35
5.7.5	Branch identification in panelboards	35
5.8	Bonding to ground	35
5.9	Voltage difference between ground points	35

5.9.1	Voltage difference limits	35
5.9.2	Test method	35
5.10	Ground return path voltage rise for solidly grounded systems	36
5.10.1	General	36
5.10.2	Test method	36
5.11	Isolated power systems	37
5.11.1	General	37
5.11.2	Test of impedance to ground (single-phase and three-phase isolated systems)	37
5.12	Wiring accessories	38
5.12.1	Power cord adapters	38
5.12.2	Ground fault circuit interrupters	39
<b>6</b>	<b>Essential electrical systems</b>	<b>39</b>
6.1	General	39
6.2	Transfer	40
6.2.1	Vital and delayed vital branches	40
6.2.2	Conditional branch	40
6.3	Essential areas and functions	40
6.4	Maintenance or repair	40
6.5	Battery-operated emergency lighting	41
6.5.1	Illumination levels, duration, and location	41
6.5.2	Power connection	41
6.6	Normal electrical power supply	41
6.6.1	Scope	41
6.6.2	Normal power supply	41
6.7	Emergency electrical power supply	42
6.7.1	General	42
6.7.2	Generator set redundancy	42
<hr/>		
Annex A (informative)	— Electric shock	65
Annex B (informative)	— HCF examples by class	68
Annex C (informative)	— Risk management	73
Annex D (informative)	— Electrical equipment in oxygen-enriched atmospheres	75
Annex E (informative)	— Certification programs	77
Annex F (informative)	— Electromagnetic interference and electromagnetic compatibility	78
Annex G (informative)	— Purchasing considerations for health care facility equipment	80
Annex H (informative)	— Test sheets	83
Annex I (informative)	— Building electrical systems	90
Annex J (informative)	— Generator set redundancy	96
Annex K (informative)	— Use of uninterruptible power supplies (UPS) in health care facilities	100
Annex L (informative)	— Interaction of the Canadian Electrical Code with related ISO and IEC standards	104
Annex M (informative)	— Sequence of tests	106

# △ *Technical Committee on Application of Electricity in Health Care*

<b>G. Hughes</b>	University of New Brunswick Department of Health, Fredericton, New Brunswick, Canada <i>Category: Government and/or Regulatory Authority</i>	<i>Chair</i>
<b>A. Z. Tsisserev</b>	AES Engineering Ltd., Vancouver, British Columbia, Canada <i>Category: General Interest</i>	<i>Vice-Chair</i>
<b>D. Moase</b>	Mississauga, Ontario, Canada <i>Category: Producer Interest</i>	<i>Vice-Chair</i>
<b>N. Boudreau</b>	Service New Brunswick, Dieppe, New Brunswick, Canada <i>Category: User Interest</i>	
<b>M. Brossoit</b>	CSA Group, Montréal, Québec, Canada <i>Category: General Interest</i>	
<b>I. Brown</b>	BKIN Technologies Ltd., Kingston, Ontario, Canada	<i>Non-voting</i>
<b>R. B. Buckler</b>	ASCO Power Technologies Canada, Brantford, Ontario, Canada <i>Category: Producer Interest</i>	
<b>K. C. Cheong</b>	MKC Engineering Corp., Vancouver, British Columbia, Canada	<i>Non-voting</i>
<b>S. Dain</b>	Ontario Mobile Anesthesia, London, Ontario, Canada <i>Category: User Interest</i>	
<b>A. M. Dolan</b>	University of Toronto, Toronto, Ontario, Canada <i>Category: General Interest</i>	
<b>D. Dove</b>	Joseph Brant Hospital, Burlington, Ontario, Canada	<i>Non-voting</i>

<b>M. Firat</b>	Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada <i>Category: User Interest</i>	
<b>P. M. Gelinas</b>	CIUSSS du Nord-de-L'île-de-Montréal Hôpital, Montréal, Québec, Canada <i>Category: User Interest</i>	
<b>N. Hanna</b>	Electrical Safety Authority, Mississauga, Ontario, Canada <i>Category: Government and/or Regulatory Authority</i>	
<b>C. J. Lavoie</b>	Health Canada, Ottawa, Ontario, Canada <i>Category: Government and/or Regulatory Authority</i>	
<b>D. McPherson</b>	Crandall, a division of Englobe Corp., Moncton, New Brunswick, Canada	<i>Non-voting</i>
<b>A. Mojtahed</b>	Bender Canada Inc., Mississauga, Ontario, Canada <i>Category: Producer Interest</i>	
<b>M. Rice</b>	Toronto General Hospital, Toronto, Ontario, Canada	<i>Non-voting</i>
<b>T. J. Smith</b>	TJS Technical Services Inc., Airdrie, Alberta, Canada	<i>Non-voting</i>
<b>R. Smith</b>	Health Canada, Ottawa, Ontario, Canada	<i>Non-voting</i>
<b>B. Steeves</b>	Vancouver Coastal Health Vancouver Acute, Vancouver, British Columbia, Canada <i>Category: User Interest</i>	
<b>T. Qasim</b>	CSA Group, Toronto, Ontario, Canada	<i>Project Manager</i>

# △ ***Subcommittee on Electrical Safety and Essential Electrical Systems in Health Care Facilities***

<b>A. Z. Tsisserev</b>	AES Engineering Ltd., Vancouver, British Columbia, Canada	<i>Chair</i>
<b>G. Hughes</b>	University of New Brunswick Department of Health, Fredericton, New Brunswick, Canada	<i>Vice-Chair</i>
<b>S. Aspinwall</b>	Smith + Andersen, Toronto, Ontario, Canada	
<b>K. W. Blazey</b>	Total Power Limited, Mississauga, Ontario, Canada	
<b>N. Boudreau</b>	Service New Brunswick, Dieppe, New Brunswick, Canada	
<b>M. Brossoit</b>	CSA Group, Montréal, Québec, Canada	
<b>R. B. Buckler</b>	ASCO Power Technologies Canada, Brantford, Ontario, Canada	
<b>K. C. Cheong</b>	MKC Engineering Corp., Vancouver, British Columbia, Canada	
<b>P. Chow</b>	H. H. Angus & Associates Ltd., Toronto, Ontario, Canada	
<b>R. P. de Lhorbe</b>	Schneider Electric Canada, Inc., North Vancouver, British Columbia, Canada	
<b>R. Dodds</b>	B.C. Provincial Health Service Authority, Vancouver, British Columbia, Canada	
<b>D. Dove</b>	Joseph Brant Hospital, Burlington, Ontario, Canada	

---

<b>M. Firat</b>	Sunnybrook Health Sciences Centre, Toronto, Ontario, Canada	
<b>P. M. Gelinas</b>	CIUSSS du Nord-de-L'île-de-Montréal Hôpital, Montréal, Québec, Canada	
<b>N. Hanna</b>	Electrical Safety Authority, Mississauga, Ontario, Canada	
<b>G. Leese</b>	Vancouver Industrial Electric Ltd., Langley, British Columbia, Canada	
<b>R. Mayer</b>	Optum Engineering Inc., Thunder Bay, Ontario, Canada	
<b>D. McPherson</b>	Crandall, a division of Englobe Corp., Moncton, New Brunswick, Canada	
<b>D. Moase</b>	Mississauga, Ontario, Canada	
<b>A. Mojtahed</b>	Bender Canada Inc., Mississauga, Ontario, Canada	
<b>B. Parent</b>	Cummins Canada ULC, Candiac, Quebec, Canada	
<b>M. B. Raber</b>	M. B. Raber, P. Eng., Winnipeg, Manitoba, Canada	
<b>M. R. Ramirez</b>	The Hospital For Sick Children, Toronto, Ontario, Canada	
<b>B. Steeves</b>	Vancouver Coastal Health Vancouver Acute, Vancouver, British Columbia, Canada	
<b>B. Van Skiver</b>	Alberta Health Services, Edmonton, Alberta, Canada	
<b>T. J. Whitehead</b>	Enbridge Gas Distribution, Toronto, Ontario, Canada	
<b>T. Qasim</b>	CSA Group, Toronto, Ontario, Canada	<i>Project Manager</i>

# Preface

This is the fifth edition of CSA Z32, *Electrical safety and essential electrical systems in health care facilities*. It supersedes the previous editions, published in 2015, 2009, 2004, and 1999, and is harmonized with CSA C22.1, *Canadian Electrical Code, Part I*, and CSA C282, *Emergency electrical power supply for buildings*.

This edition features several important revisions. Table 6 has been updated to be harmonized with CSA Z8000, *Canadian health care facilities*, and similar health care facility standards. An informative Annex has been added to suggest a sequence of testing when performing the tests within this Standard. The test methods in Clause 5 have been updated.

CSA Group acknowledges that the development of this Standard was made possible, in part, by the financial support of the governments of Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland and Labrador, Northwest Territories, Nova Scotia, Nunavut, Ontario, Prince Edward Island, Québec, Saskatchewan, and Yukon, as administered by the Canadian Agency for Drugs and Technologies in Health (CADTH).

This Standard was prepared by the Subcommittee on Electrical Safety and Essential Electrical Systems in Health Care Facilities, under the jurisdiction of the Technical Committee on Application of Electricity in Health Care and the Strategic Steering Committee on Health and Well-being, and has been formally approved by the Technical Committee.

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.

## 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.csa.ca](http://standardsactivities.csa.ca).*

- 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.*

# CSA Z32:21

## ***Electrical safety and essential electrical systems in health care facilities***

### **1 Scope**

#### **1.1 General**

##### **1.1.1 Application**

This Standard deals with the following subjects:

- a) electrical safety associated with health care provision; and
- b) essential electrical systems for health care facilities.

**Note:** See Clause [3](#) for the definition of “health care facility”.

##### **1.1.2 Exclusions**

###### **1.1.2.1 Veterinary facilities**

This Standard is not intended to apply to veterinary facilities, although its electrical safety principles could prove useful in the design, construction, and operation of such facilities.

###### **1.1.2.2 Uninterruptible power systems**

Uninterruptible power systems (UPS), which may be used for specific critical applications, are not covered by this Standard.

**Note:** If a UPS is used within a health care facility, refer to Annex [K](#) for more information.

##### **1.1.3 Relationship to the *Canadian Electrical Code***

Provisions of this Standard are supplementary to the installation requirements specified in Sections 24 and 52 of CSA C22.1, *Canadian Electrical Code, Part I*, and require compliance with *Canadian Electrical Code, Part II* standards.

### **1.2 Electrical safety**

#### **1.2.1 Areas**

This Standard applies to

- a) patient care areas of Class A, Class B, and Class C health care facilities; and
- b) areas outside health care facilities that are intended for patient diagnosis, treatment, or care involving intentional electrical contact of any kind between patients and medical electrical equipment.

#### **1.2.2 Electrical equipment**

This Standard applies to

- a) medical electrical equipment;
- b) health-care-facility-owned non-medical electrical equipment;
- c) patient-owned electrical devices; and