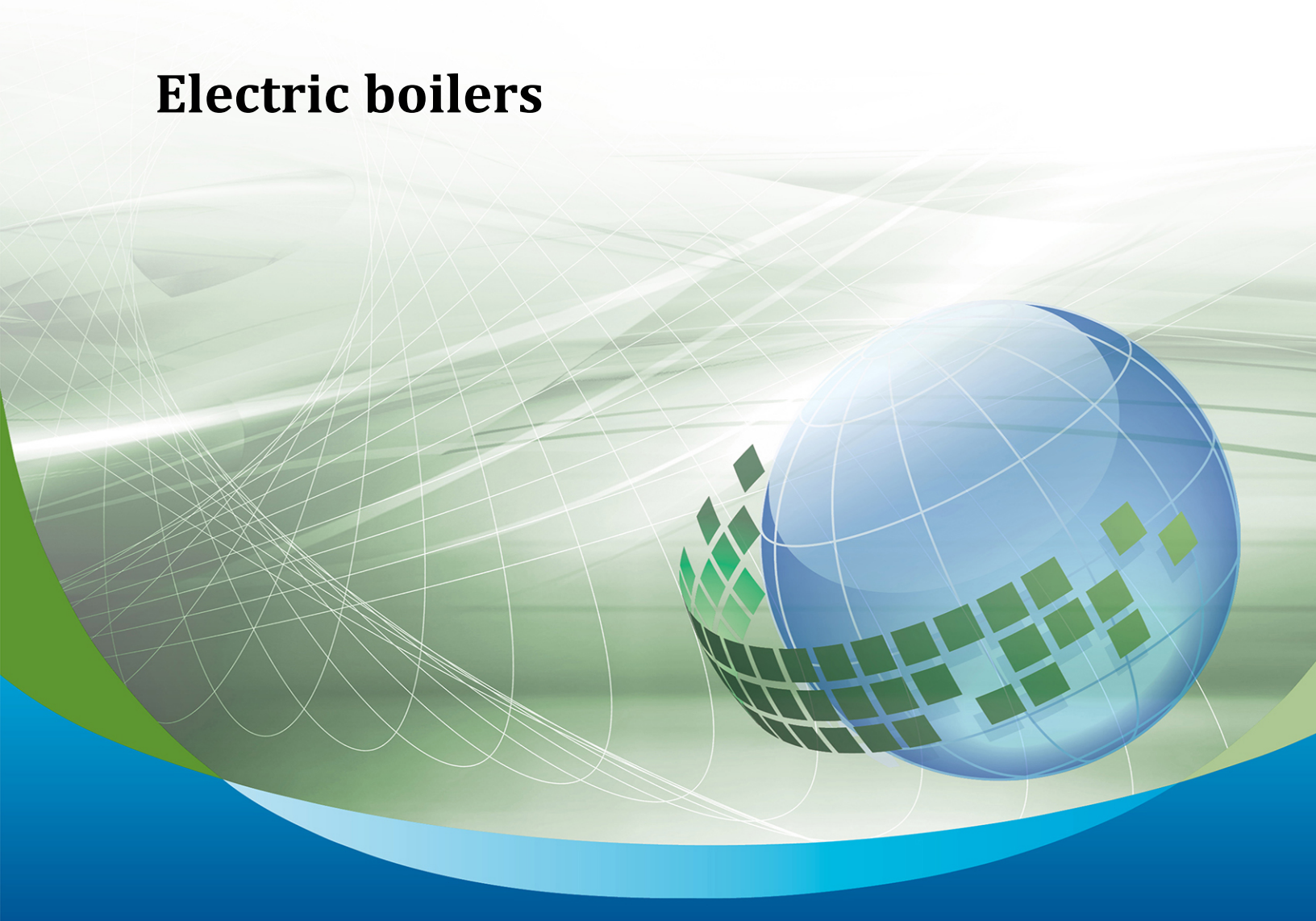




**CSA
Group**

C22.2 No. 165-17

Electric boilers



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.



Standards Update Service

***C22.2 No. 165-17
August 2017***

Title: *Electric boilers*

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

- go to shop.csa.ca
- click on **CSA Update Service**

The **List ID** that you will need to register for updates to this publication is **2425299**.

If you require assistance, please e-mail techsupport@csagroup.org or call 416-747-2233.

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

C22.2 No. 165-17

Electric boilers



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

*Published in August 2017 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 shop.csa.ca
or call toll-free 1-800-463-6727 or 416-747-4044.*

ISBN 978-1-4883-0827-7

© 2017 CSA Group

*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 Industrial Products	3
Subcommittee on Electric Boilers	5
Preface	6
1 Scope	8
2 Reference publications	8
3 Definitions	10
4 General requirements	11
5 Construction	11
5.1 General	11
5.1.1 Electrical components	11
5.1.2 Boilers	12
5.2 Frame and enclosure	12
5.2.1 General	12
5.2.2 Thickness of sheet metal enclosures	13
5.2.3 Openings in enclosures	13
5.2.4 Doors, covers, and guards	14
5.2.5 Protection against corrosion	15
5.3 Mechanical assembly	15
5.4 Accessibility of parts	15
5.5 Electrical supply connections	15
5.5.1 General	15
5.5.2 Field wiring terminals and leads	16
5.5.3 Busway connections	16
5.6 Current-carrying parts	16
5.7 Internal wiring	17
5.8 Electrical insulation	18
5.9 Thermal insulation	18
5.10 Heater elements	18
5.11 Transformers	18
5.12 Motors	19
5.13 Switches and controls	19
5.14 Limit controls	20
5.15 Low-water cut-off	21
5.16 Pressure-relieving devices	22
5.17 Overload, overcurrent, and ground-fault protection	23
5.17.1 Motor circuits	23
5.17.2 Control circuits	23
5.17.3 Heater element circuits	23
5.17.4 Internal conductors for power circuits	24
5.17.5 Transformers	24

5.17.6	Protective devices	25
5.18	Spacings	26
5.19	Separation of circuits	27
5.20	Bonding to ground	27

6 Marking 27

7 Tests 29

7.1	Sequence of tests	29
7.2	Test conditions	30
7.2.1	Voltage	30
7.2.2	Frequency	30
7.2.3	Test enclosures	30
7.3	Rating	31
7.4	Safety limit control cut-out	31
7.5	Temperature (normal)	32
7.6	Dielectric strength	33
7.7	Pump failure	33
7.8	Blocked water flow	34
7.9	Low-water abnormal	34
7.10	Bonding continuity	35
7.11	Proof test for steel boilers constructed in accordance with Clause 5.1.2.3	35
7.12	Overload (transformers)	35
7.13	Burnout (transformers)	36
7.14	Limited short-circuit (protective devices)	37

Technical Committee on Industrial Products

R.M. Bartholomew	Electric Power Equipment Ltd., Vancouver, British Columbia <i>Category: Producer Interest</i>	<i>Chair</i>
R.P. de Lhorbe	Schneider Electric Canada, Inc., Richmond, British Columbia <i>Category: Producer Interest</i>	<i>Vice-Chair</i>
B.M. Baldwin	Baldwin Services Inc., Saskatoon, Saskatchewan <i>Category: General Interest</i>	
R.B. Buckler	ASCO Power Technologies Canada, Brantford, Ontario <i>Category: Producer Interest</i>	
C.C. Cormier	Alberta Municipal Affairs, Edmonton, Alberta <i>Category: Regulatory Authority</i>	
V.V. Gagachev	Eaton, Burlington, Ontario <i>Category: Producer Interest</i>	
N. Hanna	Electrical Safety Authority, Mississauga, Ontario <i>Category: Regulatory Authority</i>	
R.J. Kelly	Government of Nunavut, Department of Community & Government Services, Iqaluit, Nunavut <i>Category: Regulatory Authority</i>	
D.R. MacLeod	Department of Labour and Advanced Education, Halifax, Nova Scotia <i>Category: Regulatory Authority</i>	
D. Mascarenhas	Brampton, Ontario <i>Category: General Interest</i>	

R. Pack	SaskPower, Saskatoon, Saskatchewan <i>Category: Regulatory Authority</i>	
M. Smith	Kitchener, Ontario <i>Category: General Interest</i>	
A.Z. Tsisserev	AES Engineering, Vancouver, British Columbia <i>Category: General Interest</i>	
M. Humphries	CSA Group, Toronto, Ontario	<i>Project Manager</i>

Preface

This is the second edition of CSA C22.2 No. 165, *Electric boilers*, one of a series of Standards issued by CSA Group under Part II of the *Canadian Electrical Code*. This edition supersedes the first edition published in 1992.

This Standard applies to stationary hot-water and steam boilers for residential, commercial, and industrial use that utilize metal-sheathed immersion-type heater elements and are intended for permanent connection to the source of supply. It does not apply to electrode-type boilers.

The changes to this edition are as follows:

- a) reference documents updated;
- b) requirements modified for plated and unplated parts;
- c) references to transformer standards updated;
- d) references to IEC-based standards added; and
- e) Table 8 updated and reformatted.

This Standard sets minimum requirements that are not intended to conflict with or supersede the requirements of CSA B51 or other applicable standards for boilers that fall under the provisions of the *Boilers and Pressure Vessels Act* of the provinces or territories of Canada.

For general information on the standards of the Committee on *Canadian Electrical Code, Part II*, see the Preface of CAN/CSA-C22.2, No. 0, *General Requirements — Canadian Electrical Code, Part II*.

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

This Standard was prepared by the Subcommittee on Electric Boilers, under the jurisdiction of the Technical Committee on Industrial Products and the Strategic Steering Committee on Requirements for Electrical Safety, and has been formally approved by the Technical Committee.

Interpretations: The Strategic Steering Committee on Requirements for Electrical Safety 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 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.

- 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 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.*

C22.2 No. 165-17

Electric boilers

1 Scope

1.1

This Standard applies to stationary, permanently connected, hot-water and steam boilers for use with nominal system voltages of 600 V and less, for residential, commercial, and industrial use in nonhazardous locations in accordance with the Rules of the *Canadian Electrical Code, Part I*.

1.2

This Standard applies to boilers utilizing metal-sheathed-type heater elements.

1.3

This Standard does not apply to

- a) storage-type water heaters as covered in CAN/CSA-C22.2 No. 110;
- b) swimming pool and spa hot-water heaters;
- c) electrode-type boilers;
- d) industrial heating equipment covered in CSA C22.2 No. 88; or
- e) electric heating equipment for medical and dental use.

1.4

This Standard sets minimum requirements. It is not intended that the requirements of this Standard conflict with or supersede the requirements of CSA B51 or any other applicable standard for boilers that fall under the provisions of the *Boilers and Pressure Vessels Act* of the provinces or territories of Canada.

1.5

In this Standard, “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 such reference is made, it shall be the edition below, including all amendments published thereto.

CSA Group

B51-14

Boiler, Pressure Vessel, and Pressure Piping Code

C22.1-15

Canadian Electrical Code, Part I

CAN/CSA-C22.2 No. 0-10 (R2015)

General requirements — Canadian Electrical Code, Part II

C22.2 No. 0.4-04 (R2013)

Bonding of electrical equipment

C22.2 No. 0.5-16

Threaded conduit entries

C22.2 No. 0.8-12 (R2016)

Safety functions incorporating electronic technology

C22.2 No. 0.12-M1985 (R2016)

Wiring space and wire bending space in enclosures for equipment rated 750 V or less

CAN/CSA-C22.2 No. 14-13

Industrial control equipment

C22.2 No. 24-15

Temperature-indicating and -regulating equipment

C22.2 No. 55-15

Special use switches

C22.2 No. 66.2-06 (R2015)

Low voltage transformers — Part 2: General purpose transformers

C22.2 No. 66.3-06 (R2015)

Low voltage transformers — Part 3: Class 2 and Class 3 transformers

C22.2 No. 72-10 (R2014)

Heater elements

C22.2 No. 77-14

Motors with inherent overheating protection

C22.2 No. 88-1958 (R2013)

Construction and test of industrial heating equipment

C22.2 No. 100-14

Motors and generators